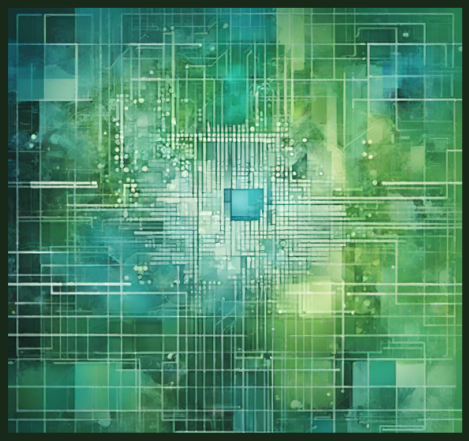
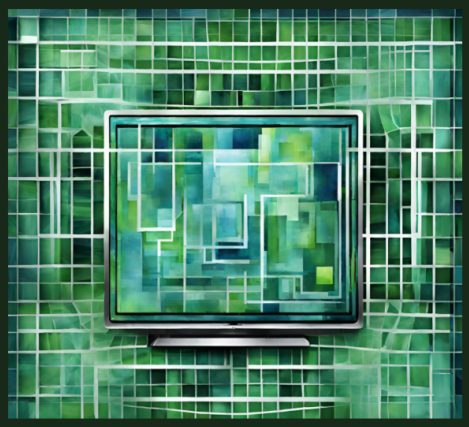
Computer Concepts

OER Textbook

Aggregated & Authored by Gabrielle Brixey MBA MC

West Hills College Coalinga | 1st Edition



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Aggregated and Authored by Gabrielle Brixey MBA MC,

Published by West Hills College Coalinga, January 2024. 1st Edition.

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Chapter Learning Outcomes:

1. Recognize information systems and their key components.
2. Outline the fundamental history of information systems.
3. Examine the primary components, including technology, people, and process.
4. Identify the evolution of technology integrations within an organization.
5. Identify communication and network concepts, systems, and applications.

Chapter 1: What Is an Information System?

1.1 Introduction

Welcome to the world of information systems, a world that seems to change almost daily. Over the past few decades information systems have progressed to being virtually everywhere, even to the point where you may not realize its existence in many of your daily activities. Stop and consider how you interface with various components in information systems every day through different

electronic devices. Smartphones, laptop, and personal computers connect us constantly to a variety of systems including messaging, banking, online retailing, and academic resources, just to name a few examples. Information systems are at the center of virtually every organization, providing users with almost unlimited resources. Have you ever considered why businesses invest in technology? Some purchase computer hardware and software because everyone else has computers. Some even invest in the same hardware and software as their business friends even though different technology might be more appropriate for them. Finally, some businesses do sufficient research before deciding what best fits their needs. As you read through this book be sure to evaluate the contents of each chapter based on how you might someday apply what you have learned to strengthen the position of the business you work for, or maybe even your own business. Wise decisions can result in stability and growth for your future enterprise. Information systems surround you almost every day. Wi-fi networks on your university campus, database search services in the learning resource center, and printers in computer labs are good examples. Every time you go shopping you are interacting with an information system that manages inventory and sales. Even driving to school or work results in an interaction with the transportation information system, impacting traffic lights, cameras, etc. Vending machines connect and communicate using the Internet of Things (IoT). Your car's computer system does more than just control the engine – acceleration, shifting, and braking data is always recorded. And, of course, everyone's smartphone is constantly connecting to available networks via Wi-fi, recording your location and other data. Can you think of some words to describe an information system?

Words such as “computers,” “networks,” or “databases” might pop into your mind. The study of information systems encompasses a broad array of devices, software, and data systems. Defining an information system provides you with a solid start to this course and the content you are about to encounter.

1.1.1 Defining Information Systems

Many programs in business require students to take a course in information systems. Various authors have attempted to define the term in different ways. Read the following definitions, then see if you can detect some variances.

- “An information system (IS) can be defined technically as a set of interrelated components that collect, process, store, and distribute information to support decision making and control in an organization.”
- “Information systems are combinations of hardware, software, and telecommunications networks that people build and use to collect, create, and distribute useful data, typically in organizational settings.”
- “Information systems are interrelated components working together to collect, process, store, and disseminate information to support decision making, coordination, control, analysis, and visualization in an organization.”

As you can see these definitions focus on two different ways of describing information systems: the components that make up an information system and the role those components play in an organization. Each of these need to be examined.

1.1.2 The Components of Information Systems

Information systems can be viewed as having five major components: hardware, software, data, people, and processes. The first three are technology. These are probably what you thought of when defining information systems. The last two components, people and processes, separate the idea of information systems from more technical fields, such as computer science. In order to fully understand information systems, you will need to understand how all of these components work together to bring value to an organization.

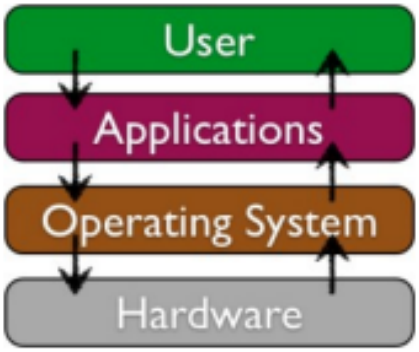
1.1.3 Technology

Technology can be thought of as the application of scientific knowledge for practical purposes. From the invention of the wheel to the harnessing of electricity for artificial lighting, technology has become ubiquitous in daily life, to the degree that it is assumed to always be available for use regardless of location. As discussed before, the first three components of information systems – hardware, software, and data – all fall under the category of technology. Each of these will be addressed in an individual chapter. At this point a simple introduction should help you in your understanding.

1.1.4 Hardware

Hardware is the tangible, physical portion of an information system – the part you can touch. Computers, keyboards, disk drives, and Flash drives are all examples of systems hardware. How these hardware components function and work together will be covered in future chapter.

1.1.5 Software



Software comprises the set of instructions that tell the hardware what to do. Software is not tangible – it cannot be touched. Programmers create software by typing a series of instructions telling the hardware what to do. Two main categories of software are: Operating Systems and Application software. Operating Systems software provides the interface between the hardware and the Application software. Examples of operating systems for a personal computer include Microsoft Windows and Ubuntu Linux. The mobile phone operating system market is dominated by Google Android and Apple iOS. Application software allows the user to perform tasks such as creating documents, recording data in a spreadsheet, or messaging a friend. Software will be explored more thoroughly later in the book.

1.2 Data

The third technology component is data. You can think of data as a collection of facts. For example, your address (street, city state, postal code), your phone number, and your social networking account are all pieces of data. Like software, data is also intangible, unable to be seen in its native state. Pieces of unrelated data are not very useful. But aggregated, indexed, and organized together into a database, data can become a powerful tool for businesses. Organizations collect all kinds of data and use it to make decisions which can then be analyzed as to

their effectiveness. The analysis of data is then used to improve the organization's performance. Future sections will focus on data and databases, and how it is used in organizations.

1.3 Networking Communication

Besides the technology components (hardware, software, and data) which have long been considered the core technology of information systems, it has been suggested that one other component should be added: communication. An information system can exist without the ability to communicate – the first personal computers were stand-alone machines that did not access the Internet. However, in today's hyper-connected world, it is an extremely rare computer that does not connect to another device or to an e-network. Technically, the networking communication component is made up of hardware and software, but it is such a core feature of today's information systems that it has become its own category. Networking will be covered in future sections.

1.3.1 People

Jeff Bezos, Amazon CEO

When thinking about information systems, it is easy to focus on the technology components and forget to look beyond these tools to fully understand their integration into an organization. A focus on the people involved in information systems is the next step. From the front-line user support staff, to systems analysts, to developers, all the way up to the chief information officer (CIO), the people involved with information systems

are an essential element. The people component will be covered as we progress through the book.

1.3.2 Process

The last component of information systems is process. A process is a series of steps undertaken to achieve a desired outcome or goal. Information systems are becoming more integrated with organizational processes, bringing greater productivity and better control to those processes. But simply automating activities using technology is not enough – businesses looking to utilize information systems must do more. The ultimate goal is to improve processes both internally and externally, enhancing interfaces with suppliers and customers. Technology buzzwords such as “business process re-engineering,” “business process management,” and “enterprise resource planning” all have to do with the continued improvement of these business procedures and the integration of technology with them. Businesses hoping to gain a competitive advantage over their competitors are highly focused on this component of information systems. The process element in information systems will be discussed as move though the chapters.

1.4 The Role of Information Systems

You should now understand that information systems have a number of vital components, some tangible, others intangible, and still others of a personnel nature. These components collect, store, organize, and distribute data throughout the organization. You may have even realized that one of the roles of

information systems is to take data and turn it into information, and then transform that information into organizational knowledge. As technology has developed, this role has evolved into the backbone of the organization, making information systems integral to virtually every business. The integration of information systems into organizations has progressed over the decades.

1.4.1 The Mainframe Era

IBM 704 Mainframe (Copyright: Lawrence Livermore National Laboratory)

From the late 1950s through the 1960s, computers were seen as a way to more efficiently do calculations. These first business computers were room sized monsters, with several machines linked together. The primary work was to organize and store large volumes of information that were tedious to manage by hand. Only large businesses, universities, and government agencies could afford them, and they took a crew of specialized personnel and dedicated facilities to provide information to organizations. Time-sharing allowed dozens or even hundreds of users to simultaneously access mainframe computers from locations in the same building or miles away. Typical functions included scientific calculations and accounting, all under the broader umbrella of "data processing."

Registered trademark of International Business Machines

1.4.2 The PC Revolution

In 1975, the first microcomputer was announced on the cover of Popular Mechanics: the Altair 8800. Its immediate popularity sparked the imagination of entrepreneurs everywhere, and

IBM PC

there were soon dozens of companies manufacturing these “personal computers.” Though at first just a niche product for computer hobbyists, improvements in usability and the availability of practical software led to growing sales. The most prominent of these early personal computer makers was a little company known as Apple Computer, headed by Steve Jobs and Steve Wozniak, with the hugely successful “Apple II.” Not wanting to be left out of the revolution, in 1981 IBM teamed with Microsoft, then just a startup company, for their operating system software and hurriedly released their own version of the personal computer simply called the “PC.” Small businesses finally had affordable computing that could provide them with needed information systems. Popularity of the IBM PC gave legitimacy to the microcomputer and it was named Time magazine’s “Man of the Year” for 1982.

Because of the IBM PC’s open architecture, it was easy for other companies to copy, or “clone” it. During the 1980s, many new computer companies sprang up, offering less expensive versions of the PC. This drove prices down and spurred innovation. Microsoft developed the Windows operating system, with version 3.1 in 1992 becoming the first commercially successful release. Typical uses for the PC during this period included word processing, spreadsheets, and databases. These early PCs were standalone machines, not connected to a network.

1.5 Client-Server

In the mid-1980s, businesses began to see the need to connect their computers as a way to collaborate and share resources. Known as “client-server,” this networking architecture allowed

users to log in to the Local Area Network (LAN) from their PC (the “client”) by connecting to a central computer called a “server.” The server would lookup permissions for each user to determine who had access to various resources such as printers and files. Software companies began developing applications that allowed multiple users to access the same data at the same time. This evolved into software applications for communicating, with the first popular use of electronic mail appearing at this time.

This networking and data sharing all stayed mainly within the confines of each business. Sharing of electronic data between companies was a very specialized function. Computers were now seen as tools to collaborate internally within an organization. These networks of computers were becoming so powerful that they were replacing many of the functions previously performed by the larger mainframe computers at a fraction of the cost. It was during this era that the first Enterprise Resource Planning (ERP) systems were developed and run on the client server architecture. An ERP system is an application with a centralized database that can be used to run a company’s entire business. With separate modules for accounting, finance, inventory, human resources, and many more, ERP systems, with Germany’s SAP leading the way, represented the state of the art in information systems integration. ERP systems will be discussed in later in the chapters.

1.6 The Internet, World Wide Web and E-Commerce

The first long distance transmission between two computers occurred on October 29, 1969 when developers under the direction of Dr. Leonard Kleinrock sent the

word “login” from the campus of UCLA to Stanford Research Institute in Menlo Park, California, a distance of over 350 miles. The United States Department of Defense created and funded ARPA Net (Advanced Research Projects Administration), an experimental network which eventually became known as the Internet. ARPA Net began with just four nodes or sites, a very humble start for today’s Internet.

ARPA Net, 1969

Initially, the Internet was confined to use by universities, government agencies, and researchers. Users were required to type commands (today we refer to this as “command line”) in order to communicate and transfer files. The first e-mail messages on the Internet were sent in the early 1970s as a few very large companies expanded from local networks to the Internet. The computer was now evolving from a purely computational device into the world of digital communications. In 1989, Tim Berners-Lee developed a simpler way for researchers to share information over the Internet, a concept he called the World Wide Web. 4 This invention became the catalyst for the growth of the Internet as a way for businesses to share information about themselves. As web browsers and Internet connections became the norm, companies rushed to grab domain names and create websites.

In 1991 the National Science Foundation, which governed how the Internet was used, lifted restrictions on its commercial use. Corporations soon realized the huge potential of a digital marketplace on the Internet and in 1994 both eBay and

amazon.com

Registered trademark of Amazon.com, Inc.

Amazon were founded. A mad rush of investment in Internet-based businesses led to the dot-com boom through the late 1990s, and then the dot-com bust in 2000. The bust occurred as investors, tired of seeing hundreds of companies reporting losses, abandoned their investments. An important outcome for businesses was that thousands of miles of Internet connections, in the form of fiber optic cable, were laid around the world during that time. The world became truly “wired” heading into the new millennium, ushering in the era of globalization, which will be discussed in later in the book. This TED Talk video focuses on connecting Africa to the Internet through undersea fiber optic cable. The digital world became a more dangerous place as virtually all companies connected to the Internet. Computer viruses and worms, once slowly propagated through the sharing of computer disks, could now grow with tremendous speed via the Internet. Software and operating systems written for a standalone world found it very difficult to defend against these sorts of threats. A whole new industry of computer and Internet security arose. Information security will be discussed as we move through the chapters.

1.6.1 Web 2.0

As the world recovered from the dot-com bust, the use of technology in business continued to evolve at a frantic pace. Websites became interactive. Instead of just visiting a site to find out about a business and then purchase its products, customers wanted to be able to customize their experience and interact online with the business. This new type of interactive website, where you did not have to know how to create a web page or do any programming in order to put

information online, became known as Web 2.0. This new stage of the Web was exemplified by blogging, social networking, and interactive comments being available on many websites. The new Web 2.0 world, in which online interaction became expected, had a major impact on many businesses and even whole industries. Many bookstores found themselves relegated to a niche status. Video rental chains and travel agencies simply began going out of business as they were replaced by online technologies. The newspaper industry saw a huge drop in circulation with some cities such as New Orleans no longer able to support a daily newspaper. Disintermediation is the process of technology replacing a middleman in a transaction. Web 2.0 allowed users to get information and news online, reducing dependence of physical books and newspapers. As the world became more connected, new questions arose. Should access to the Internet be considered a right? Is it legal to copy a song that had been downloaded from the Internet? Can information entered into a website be kept private? What information is acceptable to collect from children? Technology moved so fast that policymakers did not have enough time to enact appropriate laws. Ethical issues surrounding information systems will be covered in later chapters.

1.6.2 The Post-PC World, Sort of

Ray Ozzie, a technology visionary at Microsoft, stated in 2012 that computing was moving into a phase he called the post PC world. Now six years later that prediction has not stood up very well to reality. As you will read in future chapters, PC sales have dropped slightly in recent years while there has been a precipitous decline in tablet sales. Smartphone sales have accelerated, due

largely to their mobility and ease of operation. Just as the mainframe before it, the PC will continue to play a key role in business, but its role will be somewhat diminished as people emphasize mobility as a central feature of technology. Cloud computing provides users with mobile access to data and applications, making the PC more of a part of the communications channel rather than a repository of programs and information. Innovation in the development of technology and communications will continue to move businesses forward.

Era	Hardware	Operating System	Applications
Mainframe (1970s)	Terminals connected to mainframe computer	Time-sharing (TSO) on Multiple Virtual Storage (MVS)	Custom-written MRP software
PC (mid-1980s)	IBM PC or compatible. Sometimes connected to mainframe computer via network interface card.	MS-DOS	WordPerfect, Lotus 1-2-3
Client-Server (late 80s to early 90s)	IBM PC "clone" on a Novell Network.	Windows for Workgroups	Microsoft Word, Microsoft Excel
World Wide Web (mid-90s to early 2000s)	IBM PC "clone" connected to company intranet.	Windows XP	Microsoft Office, Internet Explorer
Web 2.0 (mid-2000s – present)	Laptop connected to company Wi-Fi.	Windows 10	Microsoft Office
Post-PC (today and beyond)	Smartphones	Android, iOS	Mobile-friendly websites, mobile apps

1.6.3 *Can Information Systems Bring Competitive Advantage?*

It has always been the assumption that the implementation of information systems will bring a business competitive advantage. If installing one computer to manage inventory can make a company more efficient, then it can be expected that installing several computers can improve business processes and efficiency. In 2003, Nicholas Carr wrote an article in the Harvard Business Review that questioned this assumption. Entitled "I.T. Doesn't Matter." Carr was concerned that information technology had become just a commodity. Instead of viewing

technology as an investment that will make a company stand out, Carr said technology would become as common as electricity – something to be managed to reduce costs, ensure that it is always running, and be as risk-free as possible. The article was both hailed and scorned. Can I.T. bring a competitive advantage to an organization? It sure did for Walmart (see sidebar). Technology and competitive advantage will be discussed later in the book.

1.6.4 Case Study: Walmart Uses Information Systems to Become the World's Leading Retailer

Walmart is the world's largest retailer, earning 8.1 billion for the fiscal year that ended on January 31, 2018. Walmart currently serves over 260 million customers every week worldwide through its 11,700 stores in 28 countries. In 2018 Fortune magazine for the sixth straight year ranked Walmart the number one company for annual revenue as they again exceeded $500 billion in annual sales. The next closest company, Exxon, had less than half of Walmart's total revenue. Walmart's rise to prominence is due in large part to making information systems a high priority, especially in their Supply Chain Management (SCM) system known as Retail Linking $14.3 billion on sales of $30.

This system, unique when initially implemented in the mid-1980s, allowed Walmart's suppliers to directly access the inventory levels and sales information of their products at any of Walmart's more than eleven thousand stores. Using Retail Link, suppliers can analyze how well their products are selling at one or more Walmart stores with a range of reporting options. Further, Walmart requires

the suppliers to use Retail Link to manage their own inventory levels. If a supplier feels that their products are selling out too quickly, they can use Retail Link to petition Walmart to raise the inventory levels for their products. This has essentially allowed Walmart to “hire” thousands of product managers, all of whom have a vested interest in the products they are managing. This revolutionary approach to managing inventory has allowed Walmart to continue to drive prices down and respond to market forces quickly.

Today Walmart continues to innovate with information technology. Using its tremendous market presence, any technology that Walmart requires its suppliers to implement immediately becomes a business standard. For example, in 1983 Walmart became the first large retailer to require suppliers to the use Uniform Product Code (UPC) labels on all products. Clearly, Walmart has learned how to use I.T. to gain a competitive advantage.

1.7 Summary

In this section you have been introduced to the concept of information systems. Several definitions focused on the main components: technology, people, and process. You how the business use of information systems has evolved over the years, from the use of large mainframe computers for number crunching, through the introduction of the PC and networks, all the way to the era of mobile computing. During each of these phases, new innovations in software and technology allowed businesses to integrate technology more deeply into their organizations. Virtually every company uses information systems which leads to the question: Does information systems bring a competitive advantage? In the

final analysis the goal of this book is to help you understand the importance of information systems in making an organization more competitive. Your challenge is to understand the key components of an information system and how it can be used to bring a competitive advantage to every organization you will serve in your career.

End of Chapter Summary

- Chapter 1 introduces the worldwide presence of information systems in daily life by emphasizing their impact on various activities and their strategic importance for businesses.
- It defines information systems as interrelated components facilitating data collection, processing, storage, and distribution in organizations.
- Components include technology (hardware, software, data), networking communication, people, an processes.
- The five major components—technology (hardware, software, data), networking communication, people, and process—are explored, with technology detailed in subsequent chapters.
- The evolution of information systems, from the mainframe era to the post-PC world, highlights key milestones such as the PC revolution, client-server architecture, and the rise of the internet, the World Wide Web, and e-commerce.
- The chapter addresses the question of whether information systems bring competitive advantage, referencing Nicholas Carr's argument in "Does IT Matter?" and illustrating success with Walmart's innovative use of information systems.
- The concluding emphasis is on understanding information system components for organizational competitiveness, setting the stage for further exploration in the book.

Key Terms

Advanced Research Projects Administration (ARPA): an experimental network that eventually became known as the Internet.

Application Software: allows the user to perform tasks such as creating documents, recording data in spreadsheets, or messaging a friend.

Cloud Computing: the practice of using a network of remote servers hosted on the internet to store, manage, and process data, rather than a local server or a personal computer.

Data (computers): data is any sequence of one or more symbols.

Enterprise Resource Planning (ERP): an application with a centralized database that can be used to run a company's entire business.

Hardware: includes the physical parts of the computer, such as the case, central processing unit, random access memory, monitor, mouse, keyboard, computer data storage, graphics card, sound card, speakers, and motherboard.

Information Security: the state of being protected against the unauthorized use of information, especially electronic data.

Information Systems (IS): is a formal, sociotechnical, organizational system designed to collect, process, store, and distribute information. *(Examples are laptops, databases, networks, and smartphones.)*

Information Technology (IT): Any computer-based tool that people use to work with information and support the information and support the information and information-processing needs of an organization.

Intangible: unable to touch or grasp; not having a physical presence.

Internet of Things (IoT): refers to a network of physical devices, vehicles, appliances, and other physical objects embedded with sensors, software, and network connectivity that allows them to collect and share data. *(Examples are connected appliances, smart home security systems, wearable health monitors, and autonomous farming equipment.)*

Local Area Network (LAN): a computer network that interconnects computers within a limited area such as a residence, school, laboratory, university campus or office building.

Manufacturing Resources Planning (MRP): refers to an information system that is used by businesses involved in manufacturing goods. MRP systems focus on materials management.

Network: A connecting system (wireline or wireless) that enables multiple computers to share resources.

Operating Systems: is software that provides the interface between the hardware and the application software. *(Examples are personal computer include Microsoft Windows and Ubuntu Linux.)*

People: refers to anything that has to do with the role of people in the development or use of computer software and hardware system. (Examples are individual people, teams of people, business innovators and end users.

Process: A series of steps undertaken to achieve a desired outcome or goal.

Software: is a collection of instructions, data, and programs that enable to user to interact with a computer, its hardware, pr perform tasks. Software can be classified into three main categories: system software, application software, and programming software. *(Examples are internet browser software, word processing software, spreadsheet software, and programming software.)*

Tangible: Physical objects

World Wide Web: a collection of webpages and other web resources that are linked by hyperlinks and can be accessed over the internet.

End of Chapter Discussions

1. Reflect on your daily life: Have you ever used your mobile device for work-related task? What about activities like listening to audiobooks or using music streaming services? Describe your typical technology usage in a day.
2. Envision starting a business: Discuss how information technology could (a) aid in finding and researching a business idea, (b) assist in formulating a business plan, and (c) contribute to enhancing the overall business.
3. Explore careers with computers: What are the five most common computing disciplines when we think about professions related to computers?
4. Differentiate between information technology and information systems.

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1.8 Section Attributions

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2: Hardware & Software

Chapter Learning Outcomes:

Hardware:

1. Define digital devices and articulate their significance in daily life.
2. Identify and comprehend the primary components of a computer system, elucidating the functions each component performs.
3. Explain the factors that differentiate the computing power of computers, fostering an understanding of their capabilities.
4. Describe various types of input, output, and memory devices, outlining their roles in information processing.
5. Discuss current hardware trends, including the proliferation of mobile computing and the integration of computing into diverse technologies.
6. Assess the impact of the commoditization of computers on the technology landscape and its implications for users and industries.
7. Summarize the environmental challenges associated with electronic waste (e-waste), recognizing the importance of responsible technology disposal and its broader implications for sustainability.

Software:

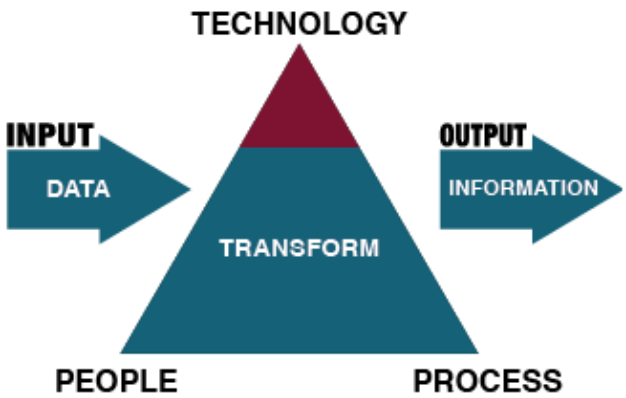
1. Define the term “software” and recognize its integral role in computer systems.
2. Describe the two primary categories of software, distinguishing between system software and application software.
3. Discuss cloud computing, elucidating its advantages and disadvantages for organizational use, and grasp its impact on modern computing.
4. List various methods through which software can be obtained, including purchase, licensing, and open-source alternatives.
5. Define the term “open-source” and identify its primary characteristics, fostering an understanding of collaborative and transparent software development practices.

Chapter 2.1: Hardware

2.1.1 Introduction

Photo via PxHere CCO

As you learned in the first chapter, an information system is made up of three components: technology, people, and processes. In this chapter we will focus on the first element of technology-hardware. Computer hardware encompasses devices that you can physically touch including desktop computers, laptop computers, mobile phones, tablets, e-readers, storage devices, and input and output devices. Besides these more traditional computer hardware devices, many items that were once not considered digital devices are now becoming computerized themselves. Digital technologies are being integrated into many everyday objects so the days of a device being labeled categorically as computer hardware may be ending. In this chapter, you will also explore digital devices, beginning with defining what is meant by the term itself.



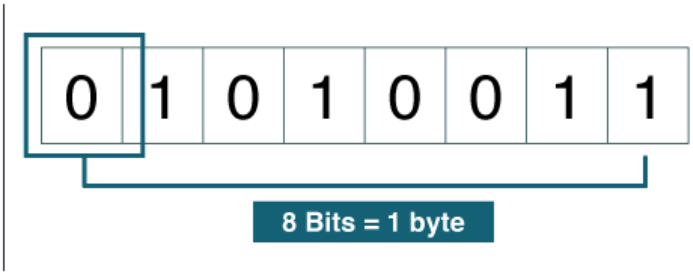
Information Systems Components: Technology

2.1.2 Digital Devices

A digital device processes electronic signals into discrete values, of which there can be two or more. In comparison analog signals are continuous and can be represented by a smooth wave pattern. You might think of digital (discrete) as being the opposite of analog.

Many electronic devices process signals into two discrete values, typically known as binary. These values are represented as either a one (“on”) or a zero (“off”). It is commonly accepted to refer to the on state as representing the presence of an electronic signal. It then follows that the off state is represented by the absence of an electronic signal. Technically, the voltages in a system are evaluated with high voltages converted into a one or on state and low voltages converted into a zero or off state.

Each one or zero is referred to as a bit (a blending of the two words “binary” and “digit”). A group of eight bits is known as a byte (think of a byte as being a single character you can type from a keyboard). The first personal computers could process 8 bits of data at once. The number of bits that can be processed by a computer’s processor at one time is known as word size. Today’s personal computers can process 64 bits of data at a time which is where the term 64-bit processor comes from. You are most likely using a computer with a 64-bit processor.

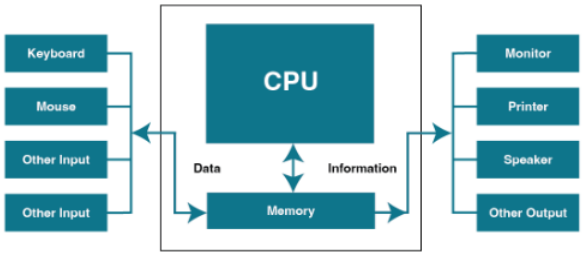


Bits & Bytes

As the capacities of digital devices grew, new terms were developed to identify the capacities of processors, memory, and disk storage space. Prefixes were applied to the word byte to represent different orders of magnitude. Since these are digital specifications, the prefixes were originally meant to represent multiples of 1024 (2^{10}), this usage is referred to as a binary measurement, but have more recently been rounded for the sake of simplicity to mean multiples of 1000, as shown in the table below.

Prefix	Represents	Approximate Examples
kilo	one thousand bytes	1 typewritten page
mega	one million bytes	1 digital photo
giga	one billion bytes	1 Blu-ray movie 25GB
tera	one trillion bytes	Printed Collection of the library of congress 20TB
peta	one quadrillion bytes	Data generated on Facebook everyday 4PB
exa	one quintillion bytes	
zetta	one sextillion bytes	
yotta	one septillion bytes	

2.1.3 Personal Computer Tour



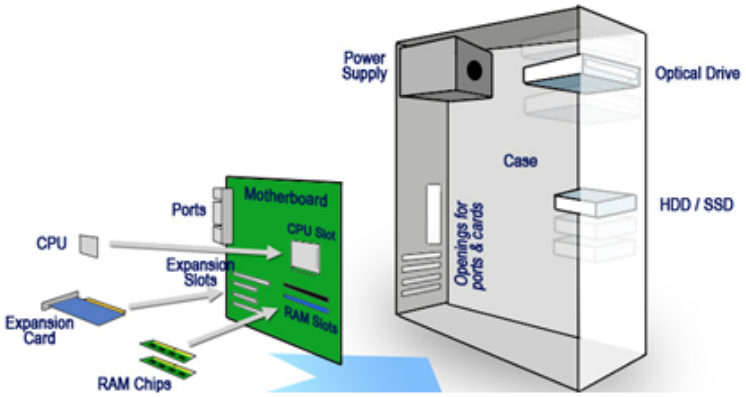
Computer Components

Computers are machines that accept data as input, processes that data using stored instructions, and outputs the information.

All personal computers consist of the same basic components:

- network connection
- motherboard
- central processing unit (CPU)
- storage/memory
- input/output devices

Almost every digital device uses the same set of components, so examining the personal computer will give you insight into the structure of a variety of digital devices. The components will be explored in more detail in the following sections.



Anatomy of a Computer

Network Connection

Personal computers were first developed as stand alone units, which meant that data was brought into the computer or removed from the computer via removable media (i.e. hard drives, USB devices, CD's). However, beginning in the mid-1980s, organizations began to see the value in connecting computers together via a digital network. Because of this, personal computers needed the ability to connect to these networks. Initially, this was done by adding an expansion card to the computer that enabled the network connection. These cards were known as Network Interface Cards (NIC). By the mid-1990s, an Ethernet network port was built into the motherboard on most personal computers. As wireless technologies began to dominate in the early 2000s, many personal computers also began including wireless networking capabilities. Digital communication technologies will be discussed further in a later chapter.

Motherboard

The motherboard is the main circuit board on the computer. The CPU, memory, and storage components, among other things, all connect into the motherboard. Motherboards come in different shapes and sizes, depending upon how compact or expandable the computer is designed to be. Most modern motherboards have many integrated components, such as network interface card, video, and sound processing, which previously required separate components.

The motherboard provides much of the bus of the computer (the term bus refers to the electrical connections between different computer components). The bus is an important factor in determining the computer's speed (the combination of how

fast the bus can transfer data and the number of data bits that can be moved at one time). The traces shown in the image are on the underside of the motherboard and provide connections between motherboard components.

Motherboard by Darklanlan CC-BY

2.1.4 Processing Data

The CPU

CPU Chip by Bru-No Pixabay License

The core of a computer is the Central Processing Unit, or CPU. It can be thought of as the “brains” of the device. The CPU carries out the commands sent to it by the software and returns results to be acted upon. The earliest CPUs were large circuit boards with limited functionality. Today, a CPU can perform a large variety of functions. There are two primary manufacturers of CPUs for personal computers: Intel and Advanced Micro Devices (AMD).

The speed (clock time) of a CPU is measured in hertz. A hertz is defined as one cycle per second. A kilohertz (kHz) is one thousand cycles per second, a megahertz (mHz) is one million cycles per second, and a gigahertz (gHz) is one billion cycles per second. The CPU's processing power is increasing at an amazing rate.

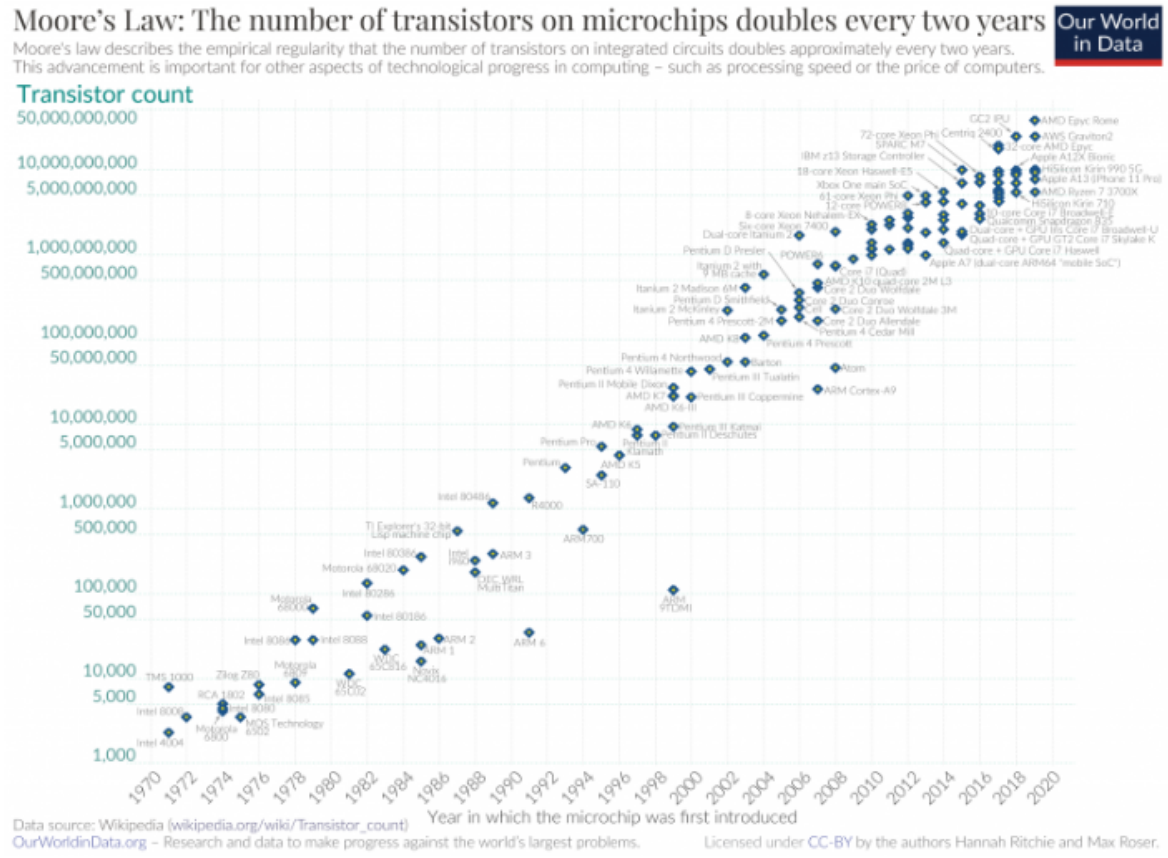
Besides a faster clock time, today's CPU chips contain multiple processors. These chips, known as dual-core (two processors) or quad-core (four processors), increase the processing power of a computer by providing the capability of multiple CPUs all sharing the processing load. Intel's Core i7 processors contain 6 cores and their Core i9 processors contain 16 cores.

Faster & Cheaper

Faster and cheaper are two words that have driven the computer industry for decades. This phenomenon of "faster, cheaper" computing is often referred to as 'Moore's Law', after Intel co-founder, Gordon Moore. Moore recognized that microprocessor transistor counts had been doubling every year, enabling the development of more powerful chips to be manufactured at cheaper prices.[1] Moore's Law has been generalized into the concept that computing power will double every two years for the same price point. Another way of looking at this is to think that the price for the same computing power will be cut in half every two years. Moore's Law has held true for over fifty years. (See image below).

The limits of Moore's Law are now being reached and circuits cannot be reduced further, but a new law, Huang's Law has arrived. This law, named for Nvidia's CEO Jensen Huang, says that Graphics Processing Units (GPUs) which power

artificial intelligence, are increasing faster than Moore's Law. In fact the performance has more than doubled every year. [2]



Moore's Law by Max Roser & Hannah Ritchie CC-BY (click to enlarge)

Section Footnote Links

1. Moore, G. E. (1965). Cramming more components onto integrated circuits. Electronics Magazine, 4 ↵

2. Mims, C. (2020, Sept 19). Huang's Law Is the New Moore's Law, and Explains Why Nvidia Wants Arm. The Wall Street Journal. https://www.wsj.com/articles/huangs-law-is-the-new-moores-law-and-explains-why-nvidia-wants-arm-11600488001 ↵

2.1.5 Storing Data

Random-Access Memory

When a computer boots up (starts), it begins to load information from storage into its working memory. This working memory, called Random-Access Memory (RAM), can transfer data much faster than the hard disk. Any program that you are running on the computer is loaded into RAM for processing. In order for a computer to work effectively, some minimal amount of RAM must be installed. In most cases, adding more RAM will allow the computer to run faster. Another characteristic of RAM is that it is "volatile." This means that it can store data as long as it is receiving power. When the computer is turned off, any data stored in RAM is lost.

Hard Disk

While the RAM is used as working memory, the computer also needs a place to store data for the longer term. Most of today's personal computers use a hard disk for long-term data storage. A hard disk is considered non-volatile storage because when the computer is turned off the data remains in storage on the disk, ready for when the computer is turned on. Drives with a capacity less than 1 Terabyte usually have just one platter. Notice the single platter in the image. The read/write arm must be positioned over the appropriate track before accessing or writing data.

Hard Disk by Evan-Amos CC-BY-SA

Solid State Drives

Solid State Drives (SSD) are becoming more popular in personal computers. The SSD performs the same function as a hard disk, namely long-term storage. Instead of spinning disks, the SSD uses flash memory that incorporates EEPROM (Electrically Erasable Programmable Read Only Memory) chips, which is much faster.

Solid State Drive by Hans Haase CC-BY-SA

Solid-state drives are currently a bit more expensive than hard disks. However, the use of flash memory instead of disks makes them much lighter and faster than hard disks. SSDs are primarily utilized in portable computers, making them lighter, more durable, and more efficient. Some computers combine the two storage technologies, using the SSD for the most accessed data (such as the operating system) while using the hard disk for data that is accessed less frequently. SSDs are considered more reliable since there are no moving parts.

Removable Media: USB Drive

Removable storage has changed greatly over the four decades of PCs. Floppy disks have been replaced by CD-ROM drives, then they were replaced by USB (Universal Serial Bus) drives. USB drives are now standard on all PCs, and USB-C is the latest version. USB-C's

USB-C by Ajay-suresh CC-BY 2.0

shape is oblong instead of rectangular and it is symmetrical, meaning it can be inserted either way which differs from the previous version. New specifications allow for greater data transfer speeds.[1]

Cloud Computing

In addition to the physical devices mentioned above, cloud computing offers another option for data storage. Cloud computing provides access to software applications, services and data storage through the internet. Online data storage provides many benefits including: accessibility, recovery and updates. Data is accessible from anywhere there is an internet connection and has a back-up function to mitigate the risk of data loss. As well, many service providers ensure automatic updating or syncing of data. Personal cloud storage providers include: Microsoft OneDrive, Google Drive, Dropbox. Cloud computing is explored more in a later chapter.

1. Brant, T. (2021, April 28). What is USB-C? An explainer. PC Magazine. https://www.pcmag.com/how-to/what-is-usb-c-an-explainer ↵

2.1.6 Computer Speed Factors

The speed of a computer is determined by many elements, some related to hardware and some related to software. In hardware, speed is improved by giving the electrons shorter distances to travel in completing a circuit. Since the first CPU was created in the early 1970s, engineers have constantly worked to figure out how to shrink these circuits and put more and more circuits onto the

same chip – these are known as integrated circuits. And this work has paid off as the speed of computing devices has been continuously improving.

Multi-core processors, or CPUs, have contributed to faster speeds. Intel engineers have also improved CPU speeds by using QuickPath Interconnect, a technique which minimizes the processor's need to communicate directly with RAM or the hard drive. Instead, the CPU contains a cache of frequently used data for a particular program. An algorithm evaluates a program's data usage and determines which data should be temporarily stored in the cache.

The hardware components that contribute to the speed of a personal computer are the CPU, the Motherboard, RAM, and the Hard Disk. In most cases, these items can be replaced with newer, faster components. The table below shows how each of these contributes to the speed of a computer. Besides upgrading hardware, there are many changes that can be made to the software of a computer to make it faster.

Component	Speed measured by	Units	Description
CPU	Clock speed	GHz (billions of cycles)	Hertz indicates the time it takes to complete a cycle.
Motherboard	Bus speed	MHz	The speed at which data can move across the bus.
RAM	Data transfer rate	Mb/s (millions of bytes per second)	The time it takes for data to be transferred from memory to system measured in Megabytes.
Hard Disk	Access time	ms (millisecond)	The time it takes for the drive to locate the data to be accessed.
	Data transfer rate	MBit/s	The time it takes for data to be transferred from disk to system.

2.1.7 Input and Output Devices

In order for a personal computer to be useful, it must have channels for receiving input from the user and channels for delivering output to the user. Input and output devices connect to the computer through connection ports, which are generally part of the motherboard and are accessible outside the computer case. In early personal computers, specific ports were designed for each type of output device. The configuration of these ports has evolved over the years, becoming more and more standardized over time. Today, almost all devices plug into a computer through the use of a USB port. This has increased in its capabilities, both in its data transfer rate and power supplied.

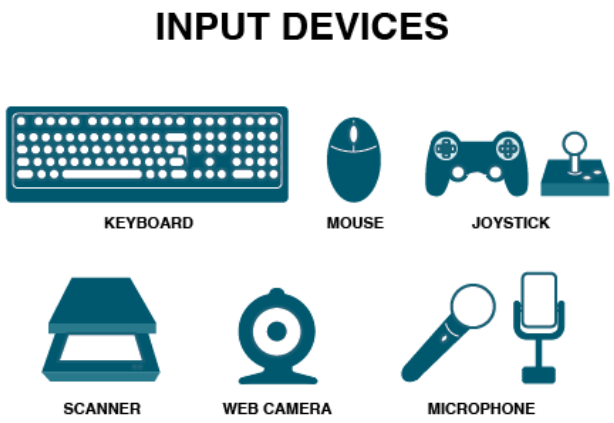
USB Cable Connection Max Pixel CCO

Bluetooth

Besides USB, some input and output devices connect to the computer via a wireless-technology standard called Bluetooth, which was invented in 1994. Bluetooth exchanges data over short distances of 10 meters up to 100 meters using radio waves. Two devices communicating with Bluetooth must both have a Bluetooth communication chip installed. Bluetooth devices include pairing your

phone to your car, computer keyboards, speakers, headsets, and home security, just to name a few.

Input Devices



Input Devices

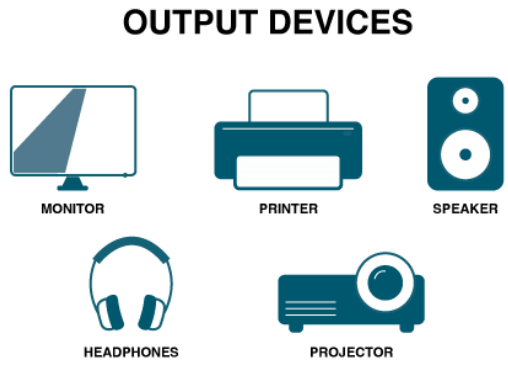
All personal computers need components that allow the user to input data. Early computers simply used a keyboard for entering data or selecting an item from a menu to run a program. With the advent of operating systems offering the graphical user interface, the mouse became a standard component of a computer. These two components are still the primary input devices to a personal computer, though variations of each have been introduced with varying levels of success over the years. For example, many new devices now use a touch screen as the primary way of data entry.

Other input devices include scanners which allow users to input documents into a computer either as images or as text. Microphones can be used to record audio or give voice commands. Webcams and other types of video cameras can be used to record video or participate in a video chat session.

Output Devices

Output devices are essential as well. The most obvious output device is a display or monitor, visually representing the state of the computer. In some cases, a

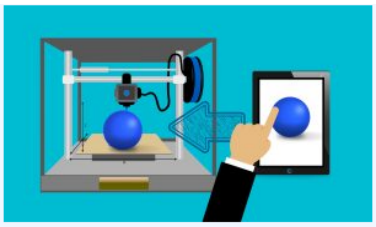
personal computer can support multiple displays or be connected to larger-format displays such as a projector or large-screen television. Other output devices include speakers for audio output and printers for hardcopy output.



Output-Devices

3D Printing

A 3-D printer allows you to print virtually any 3-D object based on a model of that object designed on a computer. 3-D printers work by creating layer upon layer of the model using malleable materials, such as different types of glass, metals, or even wax. 3-D printing is quite useful for prototyping the designs of products to determine their feasibility and marketability. 3-D printing has also been used to create working prosthetic legs and an ear that can hear beyond the range of normal hearing. The US military now uses 3-D printed parts on aircraft such as the F-18. [1]



3D Printer by Mohamed Hassan CCO 1.0

Section Footnote Links

1. The Economist. (2013, September 13). 3-D Printing Scales Up. ↵

2.1.8 Trends in Personal Computing

A personal computer is designed to be a general-purpose device, able to solve many different types of problems. As the technologies of the personal computer have become more commonplace, many of the components have been integrated into other devices that previously were purely mechanical. The definition or description of what defines a computer has changed. Portability has been an important feature for most users. Here is an overview of some trends in personal computing.

Portable Computers

Portable computing today includes laptops, notebooks and netbooks, many weighing less than 4 pounds and providing longer battery life. The MacBook Air is a good example of this: it weighs less than three pounds and is only 0.68 inches thick!

Netbooks (short for Network Books) are extremely light because they do not have a hard drive, depending instead on the Internet “cloud” for data and application storage. Netbooks depend on a Wi-Fi connection and can run Web browsers as well as a word processor.

Smartphones

While cell phones were introduced in the 1970s, smartphones have only been around for the past 20 years. As cell phones evolved they gained a broader array of features and programs. Today’s smartphones provide the user with telephone, email, location, and calendar services, just to name a few. They function as a

highly mobile computer, able to connect to the Internet through either cell technology or Wi-Fi. Smartphones have revolutionized computing, bringing the one feature PCs and laptops could not deliver, namely mobility. The Apple iPhone was introduced in January 2007 and went on the market in June of that same year. Its ease of use and intuitive interface made it an immediate success and solidified the future of smartphones. The first Android phone was released in 2008 with functionality similar to the iPhone.

Tablet Computers

A tablet computer uses a touch screen as its primary input and is small enough and light enough to be easily transported. They generally have no keyboard and are self-contained inside a rectangular case. Apple set the standard for tablet computing with the introduction of the iPad in 2010 using iOS, the operating system of the iPhone. After the success of the iPad, computer manufacturers began to develop new tablets that utilized operating systems that were designed for mobile devices, such as Android. The Samsung Galaxy and Amazon Fire are both popular competitors to the iPad.

Integrated Computing and Internet of Things (IoT)

Along with advances in computers themselves, computing technology is being integrated into many everyday products. From automobiles to refrigerators to airplanes, computing technology is enhancing what these devices can do and is adding capabilities into our everyday lives thanks in part to IoT.

IoT is a network of billions of devices, each with their own unique network address, around the world with embedded electronics allowing them to connect to the Internet for the purpose of collecting and sharing data, all without the involvement of human beings.[1]Objects ranging from a simple light bulb to a fitness band such as FitBit to a driverless truck are all part of IoT thanks to the processors inside them. A smartphone app can control and/or communicate with each of these devices as well as others such as: electric garage door openers, kitchen appliances, thermostats (like Nest), home security systems, and audio speakers.

Internet of Things (IoT) by Tumisu Pixabay License

Section Footnote Links

1. Ranger, S. (2018, January 19). What is the IoT? ZDNet. http://www.zdnet.com/article/what-is-the-internet-of-things-everything-you-need-to-know-about-the-iot-right-now/. ↵

2.1.9 PC Commoditization and E-Waste

The Commoditization of the Personal Computer

Over the past forty years, as the personal computer has gone from technical marvel to part of everyday life, it has also become a commodity. There is very little differentiation between computer models and manufacturers, and the primary factor that controls their sale is their price. Hundreds of manufacturers all over the world now create parts for personal computers which are purchased and assembled. As commodities, there are essentially little or no differences between computers made by these different companies. Profit margins for personal computers are minimal, leading hardware developers to find the lowest-cost manufacturing methods.

There is one brand of computer for which this is not the case – Apple. Because Apple does not make computers that run on the same open standards as other manufacturers, they can design and manufacture a unique product that no one can easily copy. By creating what many consider to be a superior product, Apple can charge more for their computers than other manufacturers. Just as with the iPad and iPhone, Apple has chosen a strategy of differentiation, an attempt to avoid commoditization.

E-Waste

Advances in computing technology reduce costs, increase productivity and allow innovation to flourish. But there is a dark side to advancement. A PC has an expected lifetime of three to five years, and a cell phone is expected to last less

than two years. Rapid obsolescence means the creation of ever-growing mountains of discarded tech junk, known as electronic waste or e-waste. In 2016 alone approximately 44.7 million metric tonnes of e-waste were created. By 2020, it is predicted that amount will increase by 17% and we will create approximately 52.2 million metric tonnes of e-waste annually throughout the world.[1] Canada is a large contributor to this e-waste problem. A report released by Statistics Canada stated that, in 2012 we contributed 14.3 million tonnes of waste to the global e-waste problem. [2] Consumer electronics and computing equipment can be a toxic cocktail that includes cadmium, mercury, lead, and other hazardous materials. Once called the “effluent of the affluent,” e-waste will only increase with the rise of living standards worldwide.

Ghanaians working in Agbogbloshie by *Marlene Napoli* *CC0 1.0 Universal Public Domain Dedication*

The quick answer would be to recycle, as e-waste contains materials like plastics and aluminum, as well as small bits of increasingly valuable metals such as silver, platinum, and copper. However, there’s often a disconnect between consumers and managers who want to do good and those efforts that are actually doing good. The complexities of the modern value chain, the vagaries of international law, and the nefarious actions of those willing to put profits above principle show how difficult addressing this problem will be.

The process of separating out the densely packed materials inside tech products so that the value in e-waste can be effectively harvested is extremely labor intensive, more akin to reverse manufacturing than any sort of curbside recycling efforts. Therefore a lot of e-waste is sent abroad which can be much cheaper than processing at home. Much of this waste ends up in China, South Asia, or sub-Saharan Africa.

Thinking deeply about the ethical consequences of a firm's business is an imperative for the modern manager. A slip up (intentional or not) can, in seconds, be captured by someone with a cell phone, uploaded to YouTube, or offered in a blog posting for the world to see. The worst cases expose firms to legal action and can tarnish a brand for years. Big firms are big targets, and environmentalists have been quick to push the best-known tech firms and retailers to take back their products for responsible recycling and to eliminate the worst toxins from their offerings.

Section Footnote Links

1. Leary, K. (n.d.). The World's E-Waste Is Piling Up at an Alarming Rate, Says New Report. https://www.sciencealert.com/global-electronic-waste-growth-report-2017-significant-increase ↵
2. Statistics Canada. (2016, May 24). EnviroStats. Trash Talking : Dealing with Canadian household e-waste. http://www.statcan.gc.ca/pub/16-002-x/2016001/article/14570-eng.htm ↵

Chapter 2.2: Software

2.2.1 Chapter Introduction

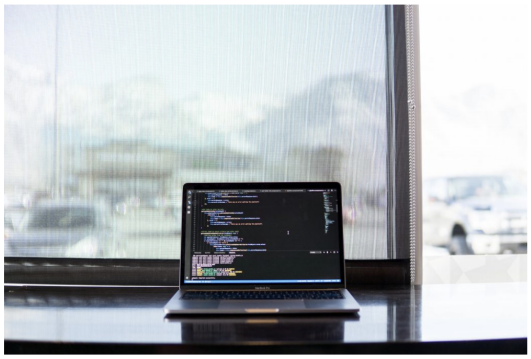


Photo by Maxwell Nelson Unsplash License

You will remember from the last chapter that computer hardware is the components of information technology that you can physically touch. Computing hardware is getting faster and cheaper, creating all sorts of exciting and disruptive opportunities for organizations. However, it is the software that makes the magic of computing happen. Software refers to a computer program or collection of programs—sets of instructions that tell the hardware what to do, and without software, the hardware would not be functional. Software gets your computer to behave like a Web browser or word processor, makes your phone play music and video, and enables your bank's ATM to spit out cash. In this chapter we will explore the different types of software, how to obtain it, and understand the importance of software from a managerial context.

Managers who understand software can better understand the possibilities and impact of technology. They can make better decisions regarding the strategic value of IT and the potential for technology-driven savings. They can appreciate the challenges, costs, security vulnerabilities, legal and compliance issues, and limitations involved in developing and deploying technology solutions.

2.2.2 Operating Systems

Software can be broadly divided into two categories: Operating Systems and Application Software.

Operating System Placement (Software)

Operating systems manage the hardware and create the interface between the hardware and the user. Operating systems are designed to create a platform so that programmers can write additional applications, allowing the computer to do even more useful things. Application software (sometimes referred to as software applications, applications or even just apps) performs specific tasks for the user.

Operating Systems

An operating system is first loaded into the computer by the boot program, then it manages all of the programs in the computer, including both programs native to the operating system such as file and memory management and application software. Operating systems provide you with these key functions:

1. Managing the hardware resources of the computer;
2. Providing the user-interface components;
3. Providing a platform for software developers to write applications.

All computing devices require an operating system. The most popular operating systems for personal computers are: Microsoft Windows, Apple's Mac OS, and various versions of Linux. Smartphones and tablets run operating systems as well, such as iOS (Apple), and Android (Google).

Microsoft provided the first operating system for the IBM-PC, released in 1981. Their initial venture into a Graphical User Interface (GUI) operating system, known as Windows, occurred in 1985. A GUI provides the way a user interacts with a program on a computer. It is what gives a program its look and feel. Today's Windows 10 supports the 64-bit Intel CPU. Recall that "64-bit" indicates the size of data that can be moved within the computer.

Apple introduced the Macintosh computer 1984 with the first commercially successful GUI. Apple's operating system for the Macintosh is known as "Mac OS " and also uses an Intel CPU supporting 64-bit processing. Mac OS versions used to be named after mountains (such as El Capitan) and are now named after locations in California. The most recent version is called Monterey. Multitasking, virtual memory, and voice input have become standard features of both operating systems.

The Linux operating system is open source, meaning individual developers are allowed to make modifications to the programming code. Linux is a version of the Unix operating system. Unix runs on large and expensive minicomputers (computers that are smaller and less powerful than a mainframe or supercomputer but more expensive and more powerful than a personal computer). Linux developer Linus Torvalds, a professor in Finland and the creator of Linux, wanted to find a way to make Unix run on less expensive personal computers. Linux has many variations and now powers a large percentage of web servers in the world.

Why Is Microsoft Software So Dominant in the Business World?

If you've worked in business, you may have noticed that almost all computers in business run a version of Microsoft Windows. Many businesses used IBM mainframe computers back in the 1960s and 1970s. When businesses migrated to the microcomputer (personal computer) market, they elected to stay with IBM and chose the PC. Companies took the safe route, invested in the Microsoft operating system and in Microsoft software/applications.

Microsoft soon found itself with the dominant personal computer operating system for businesses. As the networked PC began to replace the mainframe computer, Microsoft developed a network operating system along with a complete suite of programs focused on business users. Today Microsoft's desktop operating system Windows controls 71% of the market, and their productivity software Office 365 has 48% of the market share. [1]

1. Liu, S. (2021, August 31). Topic: Microsoft. Statista. https://www.statista.com/topics/823/microsoft/#dossierKeyfigures. / ↵

2.2.3 Application Software

The second major category of software is Application Software. Application Software is used to accomplish a specific goal such as word processing, calculations on a spreadsheet, or surfing the internet using a web browser. There are many different types of application software, and they can work on mobile devices or desktop and laptop computers. Typically, software falls into the categories of productivity, multimedia, home, and communication and collaboration. This section will focus on a few of these categories below.

Productivity Software

Productivity Software includes word processors, email clients, presentation and spreadsheet editors.

Productivity software is a type of application software that has become a standard tool for the workplace. These programs allow office employees to complete their daily work efficiently. Many times these applications come packaged together as integrated software suites, such as in Microsoft's Office suite. Here is a list of some of these applications and their basic functions:

Word processing

- Users can create and edit documents using this class of software. Functions include the ability to type and edit text, format fonts and paragraphs, as well as add, move, and delete text throughout the document. Tables and images can be inserted. Documents can be saved in a variety of electronic file formats with Microsoft Word's DOCX being the most popular. Documents can also be converted to other formats such as Adobe's PDF (Portable Document Format) or to a TXT file.

Spreadsheet

- This class of software provides a way to do numeric calculations and analysis, displaying the result in charts and graphs. The working area is divided into rows and columns, where users can enter numbers, text, or formulas. It is the formulas that make a spreadsheet powerful, allowing the

user to develop complex calculations that can change based on the numbers entered. The most popular spreadsheet package is Microsoft Excel, which saves its files in the XLSX format.

Presentation

- Users can create slideshow presentations using this class of software. The slides can be projected, printed, or distributed to interested parties. Text, images, audio, and visual can all be added to the slides. Microsoft's PowerPoint is the most popular software right now, saving its files in PPTX format.

Database management system

- This software serves as an electronic filing cabinet for records such as customer lists, employee data, and inventory information. Data can be sorted, manipulated and queried to create reports. (Databases are covered more in a later chapter)

Desktop publishing

- This software combines word processing, graphics, and page layout software to create documents. Allows companies to design and produce sales brochures, catalogs, advertisements, and newsletters in-house.

Financial software

- This software is used to compile accounting and financial data and create financial statements and reports.

Some office suites include other types of software. For example, Microsoft Office includes Outlook, its e-mail package, and OneNote, an information-gathering collaboration tool. The professional version of Office also includes Microsoft Access, a database package. Microsoft popularized the idea of the office-software productivity bundle with their release of the Microsoft Office Suite. This package continues to dominate the market and most businesses expect employees to know how to use this software. However, many competitors to Microsoft Office do exist and are compatible with the file formats used by Microsoft. Microsoft also offers a cloud-based version of their office suite named Microsoft Office 365. Similar to Google Drive, this suite allows users to edit and share documents online utilizing cloud-computing technology.

The "Killer" App: Spreadsheets

When a new type of digital device is invented, there are generally a small group of technology enthusiasts who will purchase it just for the joy of figuring out how it works. A "killer" application is one that becomes so essential that large numbers of people will buy a device just to run that application. For the personal computer, the killer application was the spreadsheet.

The first spreadsheet was created by an MBA student at Harvard University who tired of making repeated calculations to determine the optimal result on a problem and decided to create a tool that allowed the user to easily change values and recalculate formulas. The result was the spreadsheet. Today's dominant spreadsheet is Microsoft Excel which still retains the basic functionality of the first spreadsheet.

Collaborative Systems

As organizations began to implement networking technologies, information systems emerged that allowed employees to begin collaborating in different ways. These systems allowed users to brainstorm ideas together without the necessity of physical, face-to-face meetings. Tools such as video conferencing with Zoom or WebEx, collaboration and document sharing with Microsoft SharePoint or Teams, and project management with SAP's Project System make collaboration possible in a variety of endeavors.

Broadly speaking, any software that allows multiple users to interact on a document or topic could be considered collaborative. Electronic mail, a shared Word document, and social networks fall into this broad definition. However, many software tools have been created that are designed specifically for collaborative purposes. These tools offer a broad spectrum of collaborative functions. Here is just a short list of some collaborative tools available for businesses today:

- **Google Drive**. Google Drive offers a suite of office applications (such as a word processor, spreadsheet, drawing, presentation) that can be shared between individuals. Multiple users can edit the documents at the same time and the threaded comments option is available.
- **Microsoft SharePoint.** SharePoint integrates with Microsoft Office and allows for collaboration using tools most office workers are familiar with. SharePoint will be covered in greater detail in chapter 5.

- **Cisco WebEx**. WebEx combines video and audio communications and allows participants to interact with each other's computer desktops. WebEx also provides a shared whiteboard and the capability for text-based chat to be going on during the sessions, along with many other features. Mobile editions of WebEx allow for full participation using smartphones and tablets.
- **GitHub**. Programmers/developers use GitHub for web-based team development of computer software.

Utility Software and Programming Software

Utility software includes programs that allow you to fix or modify your computer in some way. Examples include anti-malware software and programs that totally remove software you no longer want installed. These types of software packages were created to fill shortcomings in operating systems. Many times a subsequent release of an operating system will include these utility functions as part of the operating system itself.

Programming software's purpose is to produce software. Most of these programs provide developers with an environment in which they can write the code, test it, and convert/compile it into the format that can then be run on a computer. This software is typically identified as the Integrated Development Environment (IDE) and is provided free from the corporation that developed the programming language that will be used to write the code.

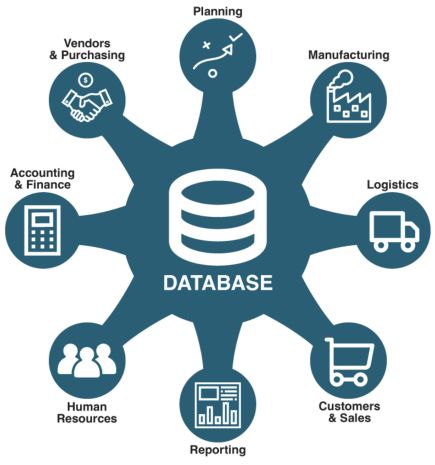
Software Providers

There are hundreds of types of businesses that require systems to facilitate operations. A look at the software providers by category as compiled by Capterra (https://www.capterra.com/categories) gives you some insight into how expansive the information systems industry actually is.

2.2.4 Desktop and Enterprise Software

Desktop software refers to applications installed on a personal computer—your browser, your Office suite, photo editors, and computer games are all desktop software. Enterprise software refers to applications that address the needs of multiple, simultaneous users in an organization or work group. Most companies run various forms of enterprise software programs to keep track of their inventory, record sales, manage payments to suppliers, cut employee paychecks, and handle other functions.

Some firms write their own enterprise software from scratch, but this can be time consuming and costly. Since many firms have similar procedures for accounting, finance, inventory management, and human resource functions, it often makes sense to buy a software package (a software product offered commercially by a third party) to



Enterprise Resource Planning System

support some of these functions. Enterprise resource planning (ERP) software packages serve precisely this purpose. In the way that Microsoft can sell you a suite of desktop software programs that work together, many companies sell ERP software that coordinates and integrates many of the functions of a business.

The leading ERP vendors include the firm's SAP and Oracle, although there are many firms that sell ERP software. A company does not have to install all of the modules of an ERP suite, but it might add functions over time—for example, to plug in an accounting program that is able to read data from the firm's previously installed inventory management system. And although a bit more of a challenge to integrate, a firm can also mix and match components, linking software the firm has written with modules purchased from different enterprise software vendors. We will discuss enterprise software and decision support software in later chapters.

Most enterprise software works in conjunction with a database management system (DBMS). The database management system stores and retrieves the data that an application creates and uses. Although the DBMS is itself considered an application, it's often useful to think of a firm's database systems as sitting above the operating system, but under the enterprise applications. Many ERP systems and enterprise software programs are configured to share the same database system so that an organization's different programs can use a common, shared set of data. This system can be hugely valuable for a company's efficiency. We will discuss databases and DBMS's in a later chapter.

2.2.5 Mobile Software

Just as with the personal computer, mobile devices such as smartphones and tablets also have operating systems and application software. These mobile devices are in many ways just smaller versions of personal computers. A mobile app is a software application designed to run specifically on a mobile device.

As discussed in a previous chapter smartphones are becoming the dominant form of computing, with more smartphones being sold than personal computers. Businesses have adjusted to this trend by increasing their investment in the development of apps for mobile devices. The number of mobile apps in the Apple App Store has increased from zero in 2008 to over 2 million in 2017.[1]

Cloud Computing

Historically, an individual copy of the software had to be installed on the computer to use it. The concept of cloud computing changed this, as applications, services, and data storage are made accessible through the internet. Cloud service providers rely on giant server farms and massive storage devices that are connected via a network.

You probably already use cloud computing in some form. For example, if you access your email on your web browser, or use Google Drive's applications you are using a form of cloud computing. While these are free versions of cloud computing, there is big business in providing applications and data storage over the web. Software as a service (SaaS) is software that is rented rather than purchased. It is subscription-based. Software as a service gives companies

access to a large assortment of software packages without having to invest in hardware or install and maintain software on their own computers. The available software, which includes e-mail and collaboration systems and customer relationship management programs, can be customized and used by an individual client or shared among several clients.

Advantages of Cloud Computing

- No software to install or upgrades to maintain.
- Available from any computer that has access to the Internet.
- Can scale to a large number of users easily.
- New applications can be up and running very quickly.
- Services can be leased for a limited time on an as-needed basis.
- Your information is not lost if your hard disk crashes or your laptop is lost or stolen.
- You are not limited by the available memory or disk space on your computer.

Disadvantages of Cloud Computing

- Your information is stored on someone else's computer.
- You must have Internet access to use it.
- You are relying on a third-party to provide these services.
- Cloud computing has the ability to really impact how organizations manage technology. For example, why is an IT department needed to purchase, configure, and manage personal computers and software when all that is really needed is an Internet connection?
- Automatic upgrades can be done without notice causing confusion for the user.

The benefit is that all of the software requirements are outsourced to a company with expertise. However, the concern is that this can leave a company vulnerable. If a traditional software company goes out of business, in most cases its customers can still go on using its products. But if your SaaS vendor goes under, they have all the data, and even if firms could get their data out, most organizations don't have the hardware, software, staff, or expertise to quickly absorb an abandoned function. Firms that buy and install packaged software usually have the option of sticking with the old stuff as long as it works, but organizations adopting SaaS may find they are forced into adopting new versions. Keep in mind that SaaS systems are also reliant on a network connection. If a firm's link to the Internet goes down, the link to its SaaS vendor is also severed. Relying on an Internet connection also means that data is transferred to and from a SaaS firm at Internet speeds, rather the potentially higher speeds of a firm's internal network.

Amazon Web Services (AWS)

Cloud computing is not limited to web applications. It can also be used for services such as audio or video streaming. Amazon Web Services (AWS) is the largest on-demand cloud computing platform. AWS offers more than 90 services ranging from computing, storage, networking, database, analytics application services, deployment, mobile, developer tools, and the Internet of Things.[2]

Using a Private Cloud

Many organizations are understandably nervous about giving up control of their data and some of their applications by using cloud computing. But they also see the value in reducing the need for installing software and adding disk storage to local computers. A solution to this problem lies in the concept of a private cloud. While there are various models of a private cloud, the basic idea is for the cloud service provider to section off web server space for a specific organization. The organization has full control over that server space while still gaining some of the benefits of cloud computing.

Virtualization

Virtualization is the process of using software to simulate a computer or some other device. For example, using virtualization a single physical computer can perform the functions of several virtual computers, usually referred to as Virtual Machines (VMs). Organizations implement virtual machines in an effort to reduce the number of physical servers needed to provide the necessary services to users. This reduction in the number of physical servers also reduces the demand for electricity to run and cool the physical servers. For more detail on how virtualization works, see this informational page from VMWare.

Section Footnote Links

1. Statista. (2018). Number of apps in Apple App Store July 2008 to January 2017. https://www.statista.com/statistics/263795/number-of-available-apps-in-the-apple-app-store/. ↵
2. Wikiversity. (n.d.). Amazon Web Services. https://en.wikiversity.org/wiki/Amazon_Web_Services ↵

2.2.6 Obtaining Software

Software can be obtained in a number of different ways. It can be developed internally which is referred to as proprietary software, or it can be purchased off-the-shelf, also referred to as packaged software. Proprietary software is developed for a specific problem and is owned by the company. If the company does not have the resources within, they may contract another company to build the software for them. Off-the-shelf software is software that is readily available and already developed, such as Microsoft Windows or the Office Suite.

Proprietary Software		**Off-the-shelf Software**	
Advantages	**Disadvantages**	**Advantages**	**Disadvantages**
Get exactly what you need and want. Control over the process.	Significant investment (time and money) Need to provide ongoing support and maintenance.	Initial cost is lower. Usually will meet the basic needs of the organization, and may have the ability to customize. Support and training available.	Might pay for features that are not needed or wanted. Software may lack required features and customization can be costly.

Software Creation

Software is created via programming, which is the process of creating a set of logical instructions for a digital device to follow. The process of programming is sometimes called “coding” because the developer takes the design and encodes it into a programming language which then runs on the computer. Modern software applications are written using a programming language such as Java, Visual C, C++, Python, etc. A programming language consists of a set of commands and syntax that can be organized logically to execute specific functions. Using this language a programmer writes a program (known as source code) that can then be compiled into machine-readable form, the ones and zeroes necessary to be executed by the CPU. Languages such as HTML and Javascript are used to develop web pages.

Software programming was originally an individual process, with each programmer working on an entire program, or several programmers each working on a portion of a larger program. However, newer methods of software development include a more collaborative approach, with teams of programmers working on code together. When the personal computer was first released, it did not serve any practical need. Early computers were difficult to program and required great attention to detail. However, many personal-computer enthusiasts immediately banded together to build applications and solve problems. These computer enthusiasts were happy to share any programs they built and solutions to problems they found; this collaboration enabled them to innovate and fix problems quickly.

As software began to become a business, however, this idea of sharing everything fell out of favor, at least with some. When a software program takes hundreds of man-hours to develop, it is understandable that the programmers do not want to just give it away. This led to a new business model of restrictive software licensing, which required payment for software, a model that is still dominant today. This model is sometimes referred to as closed source, as the source code is not made available to others.

Software Ownership

When you purchase software and install it on your computer, are you the owner of that software? Technically, you are not. When you install software, you are actually just being given a license to use it. When you first install a package, you are asked to agree to the terms of service or the license agreement. In that agreement, you will find that your rights to use the software are limited. For example, in the terms of the Microsoft Office software license, you will find the following statement: “This software is licensed, not sold. This agreement only gives you some rights to use the features included in the software edition you licensed.” [1]

For the most part, these restrictions are what you would expect. You cannot make illegal copies of the software and you may not use it to do anything illegal. However, there are other, more unexpected terms in these software agreements. For example, many software agreements ask you to agree to a limit on liability. This means if a problem with the software causes harm to your business, you cannot hold Microsoft or the supplier responsible for damages.

Section Footnote Links

1. Microsoft. (n.d.) Microsoft software license terms.https://support.microsoft.com/en-us/windows/microsoft-software-license-terms-e26eedad-97a2-5250-2670-aad156b654bd ↵

2.2.7 Open Source Software

The last section discussed closed source software where the source code is not available to others to use or copy. However, there are many who feel that software should not be restricted in this way. Just as with those early hobbyists in the 1970s, they feel that innovation and progress can be made much more rapidly if they share what has been learned. In the 1990s, with Internet access connecting more people together, the open-source movement gained steam.

Open-source software makes the source code available for anyone to copy and use. For most people having access to the source code of a program does little good since it is challenging to modify existing programming code. However, open-source software is also available in a compiled format that can be downloaded and installed. The open-source movement has led to the development of some of the most used software in the world such as the Firefox browser, the Linux operating system, and the Apache web server.

Many businesses are wary of open-source software precisely because the code is available for anyone to see. They feel that this increases the risk of an attack. Others counter that this openness actually decreases the risk because the code is exposed to thousands of programmers who can incorporate code changes to

quickly patch vulnerabilities. There are many arguments on both sides of the open-source model debate and can be found below.

Advantages of Open Source

- The software is available for free
- The software source-code is available; it can be examined and reviewed before it is installed.
- The large community of programmers who work on open-source projects leads to quick bug-fixing and feature additions.

Disadvantages of Open Source

- Technical support is not available like with traditional software products.
- Software companies provide updates and features as required by the users.
- The user interface may be more challenging to use.

Open Source Applications

There are thousands of open-source applications available for download. For example, you can get the productivity suite from Open Office. One good place to search for open-source software is sourceforge.net, where thousands of programs are available for free download.

End of Chapter Summary

- Defines digital devices and explores primary components (desktops, laptops, mobile phones, tablets, storage devices) in the context of information systems.
- Dives into electronic signal processing, explaining the binary systems, bits, and bytes.
- Introduces Moore's Law, emphasizing the continuous increase in computer power.
- Explores various storage options, including RAM, hard disks, and solid-state drives.
- Emphasizes the significance of input and output devices, detailing their evolution and integration with personal computers.
- Explores emerging trends such as portable computing, smartphones, tablet computers, and the Internet of Things (IoT).
- Addresses the commoditization of personal computers and critical issues of electronic waste (e-waste).
- Focuses on the second major category of software, exploring its diverse applications across desktops, laptops, and mobile devices.
- Highlights that application software serves specific purposes like word processing, spreadsheet calculations, and internet browsing.
- Illustrates how productivity software, exemplified by suites like Microsoft Office, streamlines workplace tasks with integrated functionalities such as word processing, spreadsheets, presentations, database management, desktop publishing, and financial tools.
- Explores collaborative systems enabled by networking technologies, facilitating remote collaboration through tools like Zoom, Webex, and Microsoft SharePoint.
- Details the roles of utility and programming software in fixing computer issues and developing applications.

- Explores enterprise software, including ERP, that aids organizational functions and integrates with database management systems.
- Discusses the rise of mobile software in parallel with the dominance of smartphones.
- Examines cloud computing, exemplified by services like AWS, and its transformative impact on software accessibility.
- Discuss SaaS advantages and disadvantages, private clouds, and the benefits of virtualization.
- Concludes with insights into software acquisition methods, programming languages, software ownership, and the contrasting perspectives an open-source software.

Key Terms

"Killer" App: An application viewed as so desirable by consumers that it can influence them to purchase devices or applications that include it.

Analog signals: are continuous and can be represented by smooth wave patterns.

Android: A mobile operating system (OS) based on the Linux kernel and currently developed by Google.

Binary: A number expressed in the binary numeral system, or base-2 numeral system, which represents numeric values using two different symbols: typically 0 (zero) and 1 (one).

Bit: The smallest unit of data in a computer represented by one or zero.

Bluetooth: A wireless technology standard for exchanging data over short distances (using short-wavelength UHF radio waves in the ISM band from 2.4 to 2.485 GHz[4]) from fixed and mobile devices, and building personal area networks.

Bus: The electrical connection between different computer components that is an important determiner of the computer's speed.

Byte: A unit of data that computers use to represent a character such as a letter, number, or typographic symbol with a group of eight bits.

Central Processing Unit (CPU): The "brains" of the device, carries out the commands sent to it by the software and returns results to be acted upon. (3.4)

Collaborative Systems: These systems allow users to brainstorm ideas together without the necessity of physical, face-to-face meetings. (*Example: zoom, teams)*

Customer Relationship Management (CRM): An approach to managing a company's interactions with current and future customers. It often involves using technology to organize, automate, and synchronize sales, marketing, customer service, and technical support.

Database Management System (DBMS): Stores and retrieves the data that an application creates and uses. Although the DBMS is itself considered an application,

it's often useful to think of a firm's database systems as sitting above the operating system, but under the enterprise applications.

Desktop Software: Refers to applications installed on a personal computer—your browser, your Office suite, photo editors, and computer games are all desktop software.

Digital Devices: Is an electronic device that uses discrete, numerable data and processes for all its operations.

Electronic Waste: Used electronics that are destined for reuse, resale, salvage, recycling, or disposal.

Enterprise Software: Refers to applications that address the needs of multiple, simultaneous users in an organization or work group. Most companies run various forms of enterprise software programs to keep track of their inventory, record sales, manage payments to suppliers, cut employee paychecks, and handle other functions.

Hard Disk: Where data is stored when the computer is turned off and where it is retrieved from when the computer is turned on.

Hertz: A measure of computer processing speed.

Input Devices: Peripheral hardware used to provide data and control signals to a computer. Examples of input devices include keyboards, mice, scanners, digital cameras, and joysticks.

Integrated Computing: Integration of computing technology into everyday products to enhance its capabilities.

iOS(iPhone OS): An operating system used for mobile devices manufactured by Apple Inc.

LINUX/UNIX: Linux is a version of the Unix operating system that runs on the personal computer. Unix is an operating system used primarily by scientists and engineers on larger minicomputers.

Memory: *Specifically, Computer Memory.* Any physical device capable of storing information temporarily or permanently.

Mobile Applications: Programs that run on tablet computers and smartphones.

Moore's Law: The observation that over the history of computing hardware, the number of transistors in a dense integrated circuit has doubled approximately every two years.

Motherboard: The main circuit board on the computer that connects to the CPU, memory, and storage components, among other things.

Network Connection: Provides connectivity between your computer and the Internet, a network, or another computer.

Open Source: Software that can be freely used, changed, and shared (in modified or unmodified form) by anyone.

Output Devices: An output device sends data from a computer to another device or user. This includes audio and video output. Other examples are monitors, projectors, speakers, headphones, and printers.

Private Cloud: A particular model of cloud computing that involves a distinct and secure cloud-based environment in which only the specified client can operate.

Productivity Software: Software applications have become standard tools for the workplace. (*Example: Excel or spreadsheet software)*

Read Access Memory (RAM): The working memory that begins to load information from the hard disk as the computer starts up.

Removable Media: Fixed storage components. Removable storage media that is portable.

Software as a service (SaaS): Is software that is rented rather than purchased. It is subscription-based. Software as a service gives companies access to a large assortment of software packages without having to invest in hardware or install and maintain software on their own computers.

Solid State Drive (SSD): Performs the same function as a hard disk: long-term storage that uses spinning disks, and flash memory, which is much faster.

Storage Devices: any device used to store digital data or information through input or output operations.

Storage: The retention of retrievable data on a computer or other electronic system.

Systems, Application & Products in Data Processing (SAP): A German multinational software corporation that makes enterprise software to manage business operations and customer relations.

Virtualization: Refers to the act of creating a virtual (rather than actual) version of something, including (but not limited to) a virtual computer hardware platform, operating system (OS), storage device, or computer network resources.

Windows: Microsoft's operating system.

Chapter Discussions

1. Identify the main hardware components of a personal computer.
2. Differentiate between RAM and a hard drive.
3. Elaborate on why the personal computer is now considered a commodity.
4. If you were the CIO of a firm, what factor would you prioritize when selecting secondary storage media for the company's records (files)?
5. Provide examples of desktop operating systems and application software.
6. List some of the top application programs for mobile devices or smartphones.
7. Decode the meaning of the statement, "Hardware is useless without software."

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3: Data & Databases

Chapter Learning Outcomes:

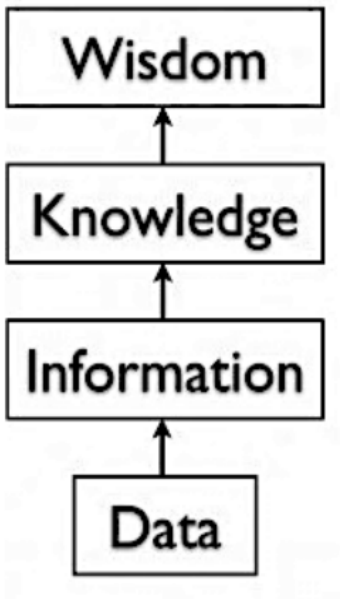
1. Clearly articulate the distinctions between data, information, and knowledge, showcasing a comprehensive understanding of their roles in information systems.
2. Explain the necessity of employing database technology for effective data resource management, demonstrating an awareness of the advantages it offers in organizing and accessing data.
3. Provide a precise definition of a database and outline the sequential steps involved in its creation, displaying competence in the fundamental processes.
4. Articulate the significance of a Database Management System (DBMS) and elucidate its role in maintaining and manipulating databases efficiently.
5. Outline the key characteristics of a data warehouse, highlighting its unique features and purposes in managing large volumes of structured and unstructured data.
6. Offer a concise definition of data mining and elaborate on its organizational role, showcasing an understanding of how it contributes to deriving valuable insights from complex datasets.

Chapter 3: Data and Databases

3.1 Introduction

You have already been introduced to the first two components of information systems: hardware and software. However, those two components by themselves do not make a computer useful. Imagine if you turned on a computer, started the word processor, but could not save a document. Imagine if you opened a music player but there was no music to play. Imagine opening a web browser but there were no web pages. Without data, hardware and software are not very useful! Data is the third component of an information system.

3.2 Data, Information, and Knowledge



There have been many definitions and theories about data, information, and knowledge. The three terms are often used interchangeably, although they are distinct in nature. We define and illustrate the three terms from the perspective of information systems.

Data are the raw facts, and may be devoid of context or intent. For example, a sales order of computers is a piece

of data. Data can be quantitative or qualitative. Quantitative data is numeric, the result of a measurement, count, or some other mathematical calculation. Qualitative data is descriptive. “Ruby Red,” the color of a 2013 Ford Focus, is an example of qualitative data. A number can be qualitative too: if I tell you my favorite number is 5, that is qualitative data because it is descriptive, not the result of a measurement or mathematical calculation.

Information is processed data that possess context, relevance, and purpose. For example, monthly sales calculated from the collected daily sales data for the past year are information. Information typically involves the manipulation of raw data to obtain an indication of magnitude, trends, in patterns in the data for a purpose. Knowledge in a certain area is human beliefs or perceptions about relationships among facts or concepts relevant to that area. For example, the conceived relationship between the quality of goods and the sales is knowledge. Knowledge can be viewed as information that facilitates action. Once we have put our data into context, aggregated and analyzed it, we can use it to make decisions for our organization. We can say that this consumption of information produces knowledge. This knowledge can be used to make decisions, set policies, and even spark innovation. Explicit knowledge typically refers to knowledge that can be expressed into words or numbers. In contrast, tacit knowledge includes insights and intuitions, and is difficult to transfer to another person by means of simple communications. Evidently, when information or explicit knowledge is captured and stored in computer, it would become data if the context or intent is devoid. The final step up the information ladder is the step from knowledge (knowing a lot about a topic) to wisdom. We can say that someone has wisdom

when they can combine their knowledge and experience to produce a deeper understanding of a topic. It often takes many years to develop wisdom on a particular topic, and requires patience.

3.3 Big Data

Almost all software programs require data to do anything useful. For example, if you are editing a document in a word processor such as Microsoft Word, the document you are working on is the data. The word-processing software can manipulate the data: create a new document, duplicate a document, or modify a document. Some other examples of data are: an MP3 music file, a video file, a spreadsheet, a web page, a social media post, and an e-book. Recently, big data has been capturing the attention of all types of organizations. The term refers to such massively large data sets that conventional data processing technologies do not have sufficient power to analyze them. For example, Walmart must process millions customer transactions every hour across the world. Storing and analyzing that much data is beyond the power of traditional data management tools. Understanding and developing the best tools and techniques to manage and analyze these large data sets are a problem that governments and businesses alike are trying to solve.

3.4 Databases

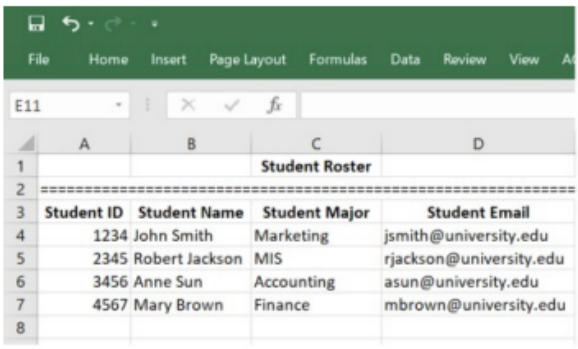
The goal of many information systems is to transform data into information in order to generate knowledge that can be used for decision making. In order to do this, the system must be able to take data, allow the user to put the data into

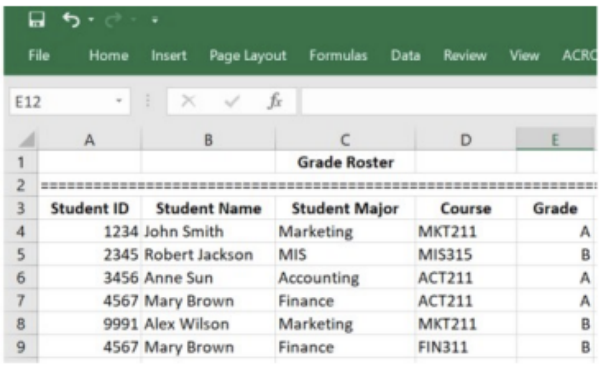
context, and provide tools for aggregation and analysis. A database is designed for just such a purpose.

3.5 Why Databases?

Data is a valuable resource in the organization. However, many people do not know much about database technology, but use non- database tools, such as Excel spreadsheet or Word document, to store and manipulate business data, or use poorly designed databases for business processes. As a result, the data are redundant, inconsistent, inaccurate, and corrupted. For a small data set, the use of non-database tools such as spreadsheet may not cause serious problem. However, for a large organization, corrupted data could lead to serious errors and destructive consequences. The common defects in data resources management are explained as follows.

(1) No control of redundant data People often keep redundant data for convenience. Redundant data could make the data set inconsistent. We use an illustrative example to explain why redundant data are harmful. Suppose the registrar's office has two separate files that store student data: one is the registered student roster which records all students who have registered and





paid the tuition, and the other is student grade roster which records all students who have received grades.

As you can see from the two spreadsheets, this data management system has problems. The fact that “Student 4567 is Mary Brown, and her major is Finance” is stored more than once. Such occurrences are called data redundancy. Redundant data often make data access convenient, but can be harmful. For example, if Mary Brown changes her name or her major, then all her names and major stored in the system must be changed altogether. For small data systems, such a problem looks trivial. However, when the data system is huge, making changes to all redundant data is difficult if not impossible. As a result of data redundancy, the entire data set can be corrupted.

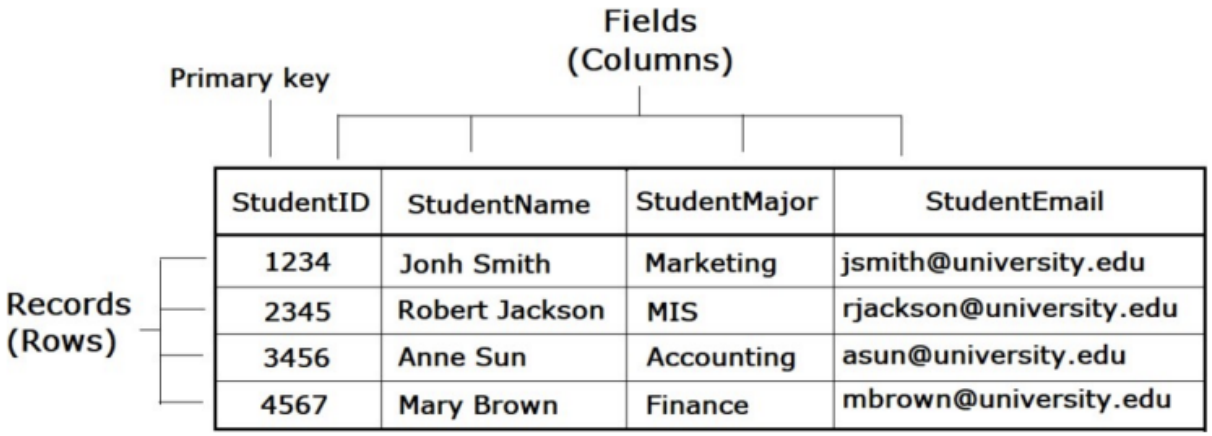
(2) Violation of data integrity Data integrity means consistency among the stored data. We use the above illustrative example to explain the concept of data integrity and how data integrity can be violated if the data system is flawed. You can find that Alex Wilson received a grade in MKT211; however, you can’t find Alex Wilson in the student roster. That is, the two rosters are not consistent. Suppose we have a data integrity control to enforce the rules, say, “no student can receive a grade unless she/he has registered and paid tuition”, then such a violation of data integrity can never happen. (3) Relying on human memory to store and to search needed data. The third common mistake in data resource management is the over use of human memory for data search. A human can remember what data are stored and where the data are stored, but can also make mistakes. If a piece of data is stored in an un-remembered place, it has

actually been lost. As a result of relying on human memory to store and to search needed data, the entire data set eventually becomes disorganized. To avoid the above common flaws in data resource management, database technology must be applied. A database is an organized collection of related data. It is an organized collection, because in a database, all data is described and associated with other data. For the purposes of this text, we will only consider computerized databases. Though not good for replacing databases, spreadsheets can be ideal tools for analyzing the data stored in a database. A spreadsheet package can be connected to a specific table or query in a database and used to create charts or perform analysis on that data.

3.6 Data Models and Relational Databases

Databases can be organized in many different ways by using different models. The data model of a database is the logical structure of data items and their relationships. There have been several data models. Since the 1980s, the relational data model has been popularized. Currently, relational database systems are commonly used in business organizations with few exceptions. A relational data model is easy to understand and use. In a relational database, data is organized into tables (or relations). Each table has a set of fields which define the structure of the data stored in the table. A record is one instance of a set of fields in a table. To visualize this, think of the records as the rows (or tuple) of the table and the fields as the columns of the table. In the example below, we have a table of student data, with each row representing a student record, and each column representing one filed of the student record. A special filed or a

combination of fields that determines the unique record is called primary key (or key). A key is usually the unique identification number of the records.



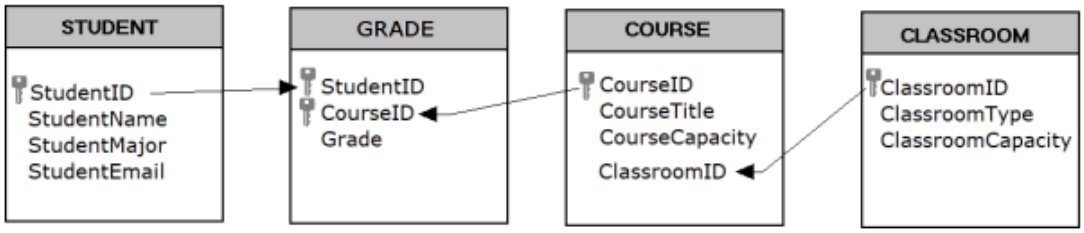
Rows and columns in a table

3.7 Designing a Database

Suppose a university wants to create a School Database to track data. After interviewing several people, the design team learns that the goal of implementing the system is to give better insight into students' performance and academic resources. From this, the team decides that the system must keep track of the students, their grades, courses, and classrooms. Using this information, the design team determines that the following tables need to be created: • STUDENT: student name, major, and e-mail. • COURSE: course title, enrollment capacity. • GRADE: this table will correlate STUDENT with COURSE, allowing us to have any given student to enroll multiple courses and to receive a grade for each course. • CLASSROOM: classroom location, classroom type, and classroom capacity Now that the design team has determined which tables to create, they need to define the specific data items that each table will hold. This requires identifying the fields that will be in each table. For example, course title

would be one of the fields in the COURSE table. Finally, since this will be a relational database, every table should have a field in common with at least one other table (in other words, they should have relationships with each other). A primary key must be selected for each table in a relational database. This key is a unique identifier for each record in the table. For example, in the STUDENT table, it might be possible to use the student name as a way to identify a student. However, it is more than likely that some students share the same name. A student's email address might be a good choice for a primary key, since e- mail addresses are unique. However, a primary key cannot change, so this would mean that if students changed their e-mail address, we would have to remove them from the database and then re-insert them – not an attractive proposition. Our solution is to use student ID as the primary key of the STUDENT table. We will also do this for the COURSE table and the CLASSROOM table. This solution is quite common and is the reason you have so many IDs! The primary key of table can be just one field, but can also be a combination of two or more fields. For example, the combination of StudentID and CourseID the GRADE table can be the primary key of the GRADE table, which means that a grade is received by a particular student for a specific course. The next step of design of database is to identify and make the relationships between the tables so that you can pull the data together in meaningful ways. A relationship between two tables is implemented by using a foreign key. A foreign key is a field in one table that connects to the primary key data in the original table. For example, ClassroomID in the COURSE table is the foreign key that connects to the primary key ClassroomID in the CLASSROOM table. With this design, not only do we have a

way to organize all of the data we need and have successfully related all the table together to meet the requirements, but have also prevented invalid data from being entered into the database. You can see the final database design in the figure below:



Tables of the student database

3.8 Normalization

When designing a database, one important concept to understand is normalization. In simple terms, to normalize a database means to design it in a way that: 1) reduces data redundancy; and 2) ensure data integrity. In the School Database design, the design team worked to achieve these objectives. For example, to track grades, a simple (and wrong) solution might have been to create a Student field in the COURSE table and then just list the names of all of the students there. However, this design would mean that if a student takes two or more courses, then his or her data would have to be entered twice or more times. This means the data are redundant. Instead, the designers solved this problem by introducing the GRADE table. In this design, when a student registers into the school system before taking a course, we first must add the student to the STUDENT table, where their ID, name, major, and e-mail address are entered. Now we will add a new entry to denote that the student takes a specific

course. This is accomplished by adding a record with the StudentID and the CourseID in the GRADE table. If this student takes a second course, we do not have to duplicate the entry of the student's name, major, and e-mail; instead, we only need to make another entry in the GRADE table of the second course's ID and the student's ID. The design of the School database also makes it simple to change the design without major modifications to the existing structure. For example, if the design team were asked to add functionality to the system to track instructors who teach the courses, we could easily accomplish this by adding a PROFESSOR table (similar to the STUDENT table) and then adding a new field to the COURSE table to hold the professors' ID.

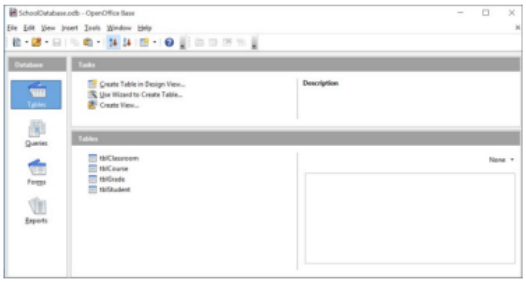
3.9 Data Types

When defining the fields in a database table, we must give each field a data type. For example, the field StudentName is text string, while Enrollment Capacity is number. Most modern databases allow for several different data types to be stored. Some of the more common data types are listed here: • Text: for storing non-numeric data that is brief, generally under 256 characters. The database designer can identify the maximum length of the text. • Number: for storing numbers. There are usually a few different number types that can be selected, depending on how large the largest number will be. • Boolean: a data type with only two possible values, such as 0 or 1, "true" or "false", "yes" or "no". • Date/Time: a special form of the number data type that can be interpreted as a number or a time. • Currency: a special form of the number data type that formats all values with a currency indicator and two decimal places. • Paragraph Text: this

data type allows for text longer than 256 characters. • Object: this data type allows for the storage of data that cannot be entered via keyboard, such as an image or a music file.

There are two important reasons that we must properly define the data type of a field. First, a data type tells the database what functions can be performed with the data. For example, if we wish to perform mathematical functions with one of the fields, we must be sure to tell the database that the field is a number data type. For example, we can subtract the course capacity from the classroom capacity to find out the number of extra seats available. The second important reason to define data type is so that the proper amount of storage space is allocated for our data. For example, if the StudentName field is defined as a Text (50) data type, this means 50 characters are allocated for each name we want to store. If a student's name is longer than 50 characters, the database will truncate it.

3.10 Database Management Systems



Open Office Database Management System

To the computer, a database looks like one or more files. In order for the data in the database to be stored, read, changed, added, or removed, a software program must access it. Many software applications have this ability: iTunes can read its database to give you a listing of its songs (and play the songs); your mobile-phone software can interact with your list of contacts. But

what about applications to create or manage a database? What software can you use to create a database, change a database's structure, or simply do analysis? That is the purpose of a category of software applications called database management systems (DBMS). DBMS packages generally provide an interface to view and change the design of the database, create queries, and develop reports. Most of these packages are designed to work with a specific type of database, but generally are compatible with a wide range of databases. A database that can only be used by a single user at a time is not going to meet the needs of most organizations. As computers have become networked and are now joined worldwide via the Internet, a class of database has emerged that can be accessed by two, ten, or even a million people. These databases are sometimes installed on a single computer to be accessed by a group of people at a single location. Other times, they are installed over several servers worldwide, meant to be accessed by millions. In enterprises the relational DBMS are built and supported by companies such as Oracle, Microsoft SQL Server, and IBM Db2. The open-source MySQL is also an enterprise database. Microsoft Access and Open Office Base are examples of personal database-management systems. These systems are primarily used to develop and analyze single-user databases. These databases are not meant to be shared across a network or the Internet, but are instead installed on a particular device and work with a single user at a time. Apache OpenOffice.org Base (see screen shot) can be used to create, modify, and analyze databases in open-database (ODB) format. Microsoft's Access DBMS is used to work with databases in its own Microsoft

Access Database format. Both Access and Base have the ability to read and write to other database formats as well.

3.11 Structured Query Language

Once you have a database designed and loaded with data, how will you do something useful with it? The primary way to work with a relational database is to use Structured Query Language, SQL (pronounced “sequel,” or simply stated as S-Q-L). Almost all applications that work with databases (such as database management systems, discussed below) make use of SQL as a way to analyze and manipulate relational data. As its name implies, SQL is a language that can be used to work with a relational database. From a simple request for data to a complex update operation, SQL is a mainstay of programmers and database administrators. To give you a taste of what SQL might look like, here are a couple of examples using our School database: The following query will retrieve the major of student John Smith from the STUDENT table:

```
SELECT StudentMajor
FROM STUDENT
WHERE StudentName = ‘John Smith’;
```

The following query will list the total number of students in the STUDENT table:

```
SELECT COUNT (*)
FROM STUDENT;
```

SQL can be embedded in many computer languages that are used to develop platform-independent web-based applications. An indepth description of how SQL works is beyond the scope of this introductory text, but these examples

should give you an idea of the power of using SQL to manipulate relational databases. Many DBMS, such as Microsoft Access, allow you to use QBE (Query-by- Example), a graphical query tool, to retrieve data though visualized commands. QBE generates SQL for you, and is easy to use. In comparison with SQL, QBE has limited functionalities and is unable to work without the DBMS environment.

3.12 Other Types of Databases

The relational database model is the most used database model today. However, many other database models exist that provide different strengths than the relational model. The hierarchical database model, popular in the 1960s and 1970s, connected data together in a hierarchy, allowing for a parent/child relationship between data. The document-centric model allowed for a more unstructured data storage by placing data into “documents” that could then be manipulated. Perhaps the most interesting new development is the concept of NoSQL (from the phrase “not only SQL”). NoSQL arose from the need to solve the problem of large-scale databases spread over several servers or even across the world. For a relational database to work properly, it is important that only one person be able to manipulate a piece of data at a time, a concept known as record- locking. But with today’s large-scale databases (think Google and Amazon), this is just not possible. A NoSQL database can work with data in a looser way, allowing for a more unstructured environment, communicating changes to the data over time to all the servers that are part of the database. As stated earlier, the relational database model does not scale well. The term scale

here refers to a database getting larger and larger, being distributed on a larger number of computers connected via a network. Some companies are looking to provide large-scale database solutions by moving away from the relational model to other, more flexible models. For example, Google now offers the App Engine Datastore, which is based on NoSQL. Developers can use the App Engine Datastore to develop applications that access data from anywhere in the world. Amazon.com offers several database services for enterprise use, including Amazon RDS, which is a relational database service, and Amazon DynamoDB, a NoSQL enterprise solution.

3.13 Sidebar: What Is Metadata?

The term metadata can be understood as “data about data.” Examples of metadata of database are:

- number of records
- data type of field
- size of field
- description of field
- default value of field
- rules of use.

When a database is being designed, a “data dictionary” is created to hold the metadata, defining the fields and structure of the database.

3.14 Finding Value in Data: Business Intelligence

With the rise of Big Data and a myriad of new tools and techniques at their disposal, businesses are learning how to use information to their advantage. The term business intelligence is used to describe the process that organizations use to take data they are collecting and analyze it in the hopes of obtaining a competitive advantage. Besides using their own data, stored in data warehouses (see below), firms often purchase information from data brokers to get a big-picture understanding of their industries and the economy. The results of these analyses can drive organizational strategies and provide competitive advantage.

3.14.1 Data Visualization

Data visualization is the graphical representation of information and data. These graphical representations (such as charts, graphs, and maps) can quickly summarize data in a way that is more intuitive and can lead to new insights and understandings. Just as a picture of a landscape can convey much more than a paragraph of text attempting to describe it, graphical representation of data can quickly make meaning of large amounts of data. Many times, visualizing data is the first step towards a deeper analysis and understanding of the data collected by an organization. Examples of data visualization software include Tableau and Google Data Studio.

3.14.2 Data Warehouses

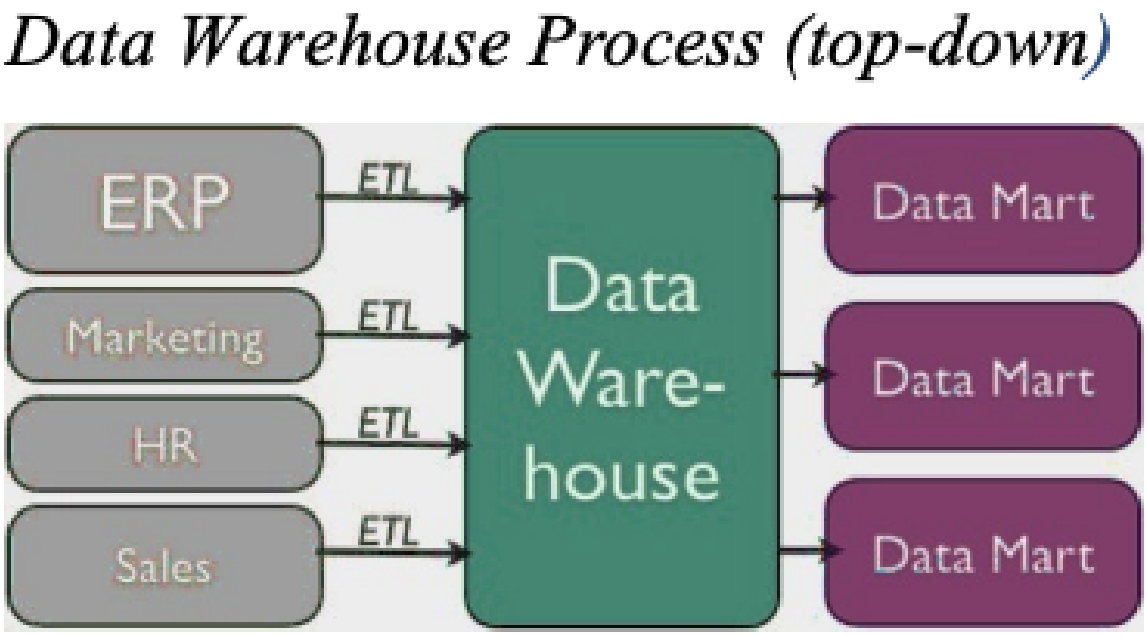
As organizations have begun to utilize databases as the centerpiece of their operations, the need to fully understand and leverage the data they are collecting

has become more and more apparent. However, directly analyzing the data that is needed for day-to-day operations is not a good idea; we do not want to tax the operations of the company more than we need to. Further, organizations also want to analyze data in a historical sense: How does the data we have today compare with the same set of data this time last month, or last year? From these needs arose the concept of the data warehouse. The concept of the data warehouse is simple: extract data from one or more of the organization's databases and load it into the data warehouse (which is itself another database) for storage and analysis. However, the execution of this concept is not that simple. A data warehouse should be designed so that it meets the following criteria:

- It uses non-operational data. This means that the data warehouse is using a copy of data from the active databases that the company uses in its day-to-day operations, so the data warehouse must pull data from the existing databases on a regular, scheduled basis.
- The data is time-variant. This means that whenever data is loaded into the data warehouse, it receives a time stamp, which allows for comparisons between different time periods.
- The data is standardized. Because the data in a data warehouse usually comes from several different sources, it is possible that the data does not use the same definitions or units. For example, each database uses its own format for dates (e.g., mm/dd/yy, or dd/mm/yy, or yy/mm/dd, etc.). In order for the data warehouse to match up dates, a standard date format would have to be agreed upon and all data loaded into the data warehouse

would have to be converted to use this standard format. This process is called extraction-transformation-load (ETL).

There are two primary schools of thought when designing a data warehouse: bottom-up and top-down. The bottom-up approach starts by creating small data warehouses, called data marts, to solve specific business problems. As these data marts are created, they can be combined into a larger data warehouse. The topdown approach suggests that we should start by creating an enterprise- wide data warehouse and then, as specific business needs are identified, create smaller data marts from the data warehouse.



3.14.3 Benefits of Data Warehouses

Organizations find data warehouses quite beneficial for a number of reasons:

- The process of developing a data warehouse forces an organization to better understand the data that it is currently collecting and, equally important, what data is not being collected.

- A data warehouse provides a centralized view of all data being collected across the enterprise and provides a means for determining data that is inconsistent.
- Once all data is identified as consistent, an organization can generate “one version of the truth”. This is important when the company wants to report consistent statistics about itself, such as revenue or number of employees.
- By having a data warehouse, snapshots of data can be taken over time. This creates a historical record of data, which allows for an analysis of trends.
- A data warehouse provides tools to combine data, which can provide new information and analysis.

3.14.4 Data Mining and Machine Learning

Data mining is the process of analyzing data to find previously unknown and interesting trends, patterns, and associations in order to make decisions. Generally, data mining is accomplished through automated means against extremely large data sets, such as a data warehouse. Some examples of data mining include:

- An analysis of sales from a large grocery chain might determine that milk is purchased more frequently the day after it rains in cities with a population of less than 50,000.
- A bank may find that loan applicants whose bank accounts show particular deposit and withdrawal patterns are not good credit risks.

- A baseball team may find that collegiate baseball players with specific statistics in hitting, pitching, and fielding make for more successful major league players.

One data mining method that an organization can use to do these analyses is called machine learning. Machine learning is used to analyze data and build models without being explicitly programmed to do so. Two primary branches of machine learning exist: supervised learning and unsupervised learning. Supervised learning occurs when an organization has data about past activity that has occurred and wants to replicate it. For example, if they want to create a new marketing campaign for a particular product line, they may look at data from past marketing campaigns to see which of their consumers responded most favorably. Once the analysis is done, a machine learning model is created that can be used to identify these new customers. It is called “supervised” learning because we are directing (supervising) the analysis towards a result (in our example: consumers who respond favorably). Supervised learning techniques include analyses such as decision trees, neural networks, classifiers, and logistic regression. Unsupervised learning occurs when an organization has data and wants to understand the relationship(s) between different data points. For example, if a retailer wants to understand purchasing patterns of its customers, an unsupervised learning model can be developed to find out which products are most often purchased together or how to group their customers by purchase history. Is it called “unsupervised” learning because no specific outcome is expected? Unsupervised learning techniques include clustering and association rules.

3.14.5 Privacy Concerns

The increasing power of data mining has caused concerns for many, especially in the area of privacy. In today's digital world, it is becoming easier than ever to take data from disparate sources and combine them to do new forms of analysis. In fact, a whole industry has sprung up around this technology: data brokers. These firms combine publicly accessible data with information obtained from the government and other sources to create vast warehouses of data about people and companies that they can then sell. This subject will be covered in much more detail in a later chapter – the chapter on the ethical concerns of information systems.

3.15 Sidebar: What is data science? What is data analytics?

The term "data science" is a popular term meant to describe the analysis of large data sets to find new knowledge. For the past several years, it has been considered one of the best career fields to get into due to its explosive growth and high salaries. While a data scientist does many different things, their focus is generally on analyzing large data sets using various programming methods and software tools to create new knowledge for their organization. Data scientists are skilled in machine learning and data visualization techniques. The field of data science is constantly changing, and data scientists are on the cutting edge of work in areas such as artificial intelligence and neural networks.

3.16 Knowledge Management

We end the chapter with a discussion on the concept of knowledge management (KM). All companies accumulate knowledge over the course of their existence. Some of this knowledge is written down or saved, but not in an organized fashion. Much of this knowledge is not written down; instead, it is stored inside the heads of its employees. Knowledge management is the process of creating, formalizing the capture, indexing, storing, and sharing of the company's knowledge in order to benefit from the experiences and insights that the company has captured during its existence.

End of Chapter Summary

- Distinguishing data, information, and knowledge within computer information systems.
- Highlights the significance of database technology in efficient data resource management.
- Discusses the process of creating databases and the role of Database Management Systems (DBMS).
- Addresses challenges such as redundancy and integrity violations, emphasizing the role of database technology in resolving these issues.
- Explores complexities associated with big data and ongoing efforts to manage and analyze massive datasets.
- Covers topics such as data types, DBMS, and Structured Query Language (SQL) in the context of database management.
- Examines various database models and addresses challenges in large-scale distributed systems.
- Explores applications in business intelligence, data visualization, and data warehouses.
- Equipes readers with a holistic understanding of fundamental concepts, practical applications, and emerging trends in data and database management within information systems.

Key Terms

Big data: extremely large data sets that may be analyzed computationally to reveal patterns, trends, and associations, especially relating to human behavior and interactions.

Competitive advantage: a condition or circumstance that puts a company in a favorable or superior business position.

Data integrity: the accuracy, completeness, and quality of data as it's maintained over time and across formats.

Data mining: the practice of analyzing large databases to generate new information.

Data redundancy: when multiple copies of the same information are stored in more than one place at a time.

Data resource management: known as data administration, deals with computer science and information systems.

Data visualization: is the graphical representation of information and data.

Data warehouses: a large store of data accumulated from a wide range of sources within a company and used to guide in management decisions.

Data: the raw facts and devoid of context or intent data can be quantitative or qualitative.

Database Management System (DBMS): Stores and retrieves the data that an application creates and uses. Although the DBMS is itself considered an application, it's often useful to think of a firm's database systems as sitting above the operating system, but under the enterprise applications.

Database technology: takes information and store, organize, and process it in a way that enables users to go back easily and intuitively and find details they are searching for.

Database: a structured set of data held in a computer, especially one that is accessible in various ways.

Enterprise database: must be able to keep track of all operations on the database that are applied by a certain user during each log-in session.

Information: is processed data that possess context, relevance, and purpose.

Knowledge management: efficient handling of information and resources within a commercial organization.

Knowledge: is human beliefs or perceptions about relationships among facts or concepts relevant to that area.

Meta base: an open-source tool that allows for powerful data instrumentation, visualization, and querying.

Normalization: is the process of organizing data in a database.

Open Source: Software that can be freely used, changed, and shared (in modified or unmodified form) by anyone.

Qualitative data: is descriptive.

Quantitative data: is a numeric, the result of a measurement, count, or other mathematical calculation.

Query-by-example (QBE): a database query language for relationship databases.

Relational data model: the logical data structures – the data tables, views, and indexes – are separate from the physical storage structures.

Structured query language: a programming language for storing and processing information in a relational database.

End of Chapter Discussions

1. Distinguish between data, information, and knowledge.
2. Clarify how the data component is interconnected with the hardware and software components in information systems.
3. Differentiate between a spreadsheet and a database by identifying three key distinctions.
4. Enumerate three advantages of utilizing a data warehouse.

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2. Chapter summaries, key terms, chapter learning outcomes, 7.2, and introduction authored by Gabrielle Brixey MBA at West Hills College Coalinga.

4: Networking E- business/ E- commerce / mobile commerce

Chapter Learning Outcomes:

Networks:

1. Articulate the major components of a data communication system, providing a comprehensive understanding of the infrastructure that enables effective information exchange.
2. Differentiate between various types of networks, showcasing proficiency in recognizing and categorizing networks architectures based on their structures and functionalities.
3. Define key concepts related to networking technologies, demonstrating a clear grasp of the terminology and principles that underpin modern networking.
4. Explain the structure of the Internet and World Wide Web, illustrating and in-depth understanding of the interconnected web of information and services that define the digital landscape.
5. Describe organizational networking detailing how networks are implemented within organizational settings to facilitate communication and data sharing.
6. Summarize widely used web applications for business activities, showcasing awareness of diverse web-based tools and platforms essential for conducting business operations effectively.

E-Business:

1. Clearly articulate the definitions of e-business and e-commerce, highlighting the distinctions between these two terms.
2. Analyze and communicate the pros and cons associated with engaging in electronic commerce.
3. Illustrate the stages and processes involved in the business-to-consumer e-commerce cycle.
4. Ability to list major categories of E-business: Categorize and detail the primary classifications of e-business activities.

5. Provide concise summaries of the major models employed in the field of electronic commerce.
6. Explore and discuss various technologies integral to the functioning of e-commerce platforms.
7. Clearly articulate the concept of blockchain technology, emphasizing its relevance and application in the context of e-commerce.
8. Provide comprehensive explanations of social commerce and New Retail, elucidating the factors contributing to their growing popularity in the business landscape.

Chapter 4.1: Networks

4.1.1 Introduction

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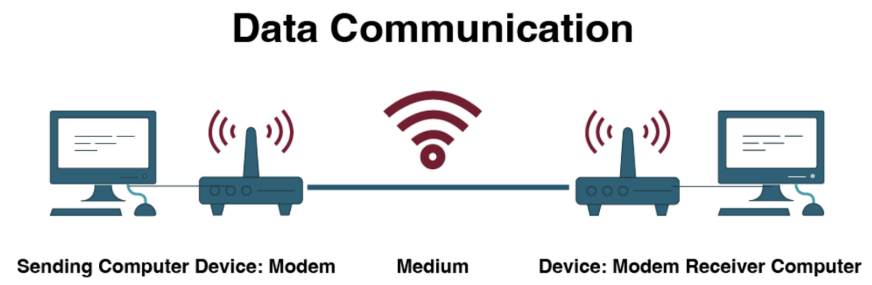
In the early days of computing, computers were seen as devices for making calculations, storing data, and automating business processes. However, as the devices evolved, it became apparent that many of the functions of telecommunications could be integrated into the computer. During the 1980s, many organizations began combining their once-separate telecommunications and information systems departments into an Information Technology (IT) department. This ability for

computers to communicate with one another and to facilitate communication between individuals and groups has had a major impact on the growth of computing over the past several decades.

Computer networking began in the 1960s with the birth of the Internet. However, while the Internet and web were evolving, corporate networking was also taking shape in the form of local area networks and client-server computing. The Internet went commercial in 1994 as technologies began to pervade all areas of the organization. Today it would be unthinkable to have a computer that did not include communications capabilities. This chapter reviews the different technologies that have been put in place to enable this communications revolution.

4.1.2 Communications Process

Before delving into the details of networking, it is important to understand how data is communicated between computers. Data communication is the electronic transmission of encoded information to, from and between computers. Data communication requires a number of devices in order for information to be transferred. The process begins when a computer sends an instruction to transmit information.



Data Communication Process

- A modem converts the format of the data so it may be transmitted between computers.
- A medium provides a path for signals to be transmitted. This can be in a physical format like copper cable, coaxial cable or fiber optics. It can also be radiated or wireless.
- The receiving computer accepts the transmission.

In communicating data, speed is important. The amount of data that can be transferred from one point to another in a certain period of time is referred to as bandwidth. Bandwidth can be narrow or broad, and it depends on the access technology. Broadband is when a high amount of data is transmitted simultaneously by digital subscriber line, cable and fiber optic technologies. Narrowband is when a limited amount of data is transferred over a specified time period.

> *Communication Through the Ages*
>
> Communication modes and technologies have changed dramatically over time from cave paintings to social media platforms. To check out the history of communication review this communication timeline from BizTech Magazine.

4.1.3 Networks

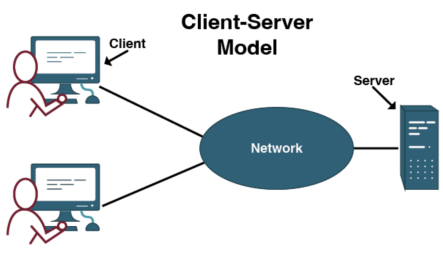
Today most businesses use networks to deliver information to employees, suppliers, and customers. A computer network is a group of two or more

computer systems linked together by communications channels to share data and information. Networks often link thousands of users and can transmit audio and video as well as data.

Networks include clients and servers. The client is the application that runs on a personal computer or workstation. It relies on a server that manages network resources or performs special tasks such as storing files, managing one or more printers, or processing database queries. Any user on the network can access the server's capabilities.

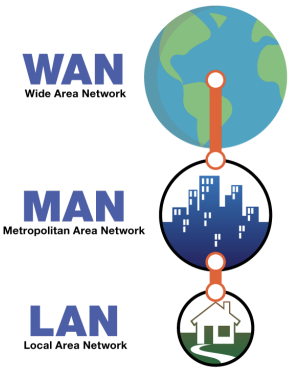
By making it easy and fast to share information, networks have created new ways to work and increase productivity. They provide more efficient use of resources, permitting communication and collaboration across distance and time. With file-sharing, all employees, regardless of location, have access to the same information. Shared databases also eliminate duplication of effort. Employees at different sites can "screen-share" computer files, working on data as if they were in the same room. Their computers are connected by phone or cable lines, they all see the same thing on their display, and anyone can make changes that are seen by the other participants. The employees can also use the networks for videoconferencing.

Networks also make it possible for companies to run enterprise software, large programs with integrated modules that manage all of the corporation's internal operations. We will discuss enterprise systems more in a later chapter.



Client-Server Modell

Connecting Near and Far



WAN, MAN, LAN Networks (click to enlarge)

There are three types of networks distinguished by the area they cover: local area networks, wide area networks and metropolitan area networks. A local area network (LAN) lets people at one site exchange data and share the use of hardware and software. LANs offer companies a more cost-effective way to link computers than linking terminals to a mainframe computer. The most common uses of LANs at small businesses, for example, are office automation, accounting, and information management. LANs can be set up with wired or wireless connections.

A Metropolitan area network (MAN) spans a larger area like a city or region whereas a wide area network (WAN) connects computers at different sites via telecommunications media such as phone lines, satellites, and microwaves. A modem connects the computer or a terminal to the telephone line and transmits data almost instantly, in less than a second. Telecommunications companies, such as Rogers Communications, Bell Canada, or Telus Inc., operate very large WANs. The internet is essentially a worldwide WAN.

4.1.4 The Internet

The internet is a network of networks—millions of them, actually. If the network at your university, your employer, or your home has internet access, it connects to an internet service provider (ISP). Many, but not all, ISPs are big telecommunications companies like Rogers Communications, Bell Canada, or

Telus Inc. These providers connect to one another, exchanging traffic, and ensure your messages get to other computers that are online and willing to communicate with you.

The internet has no center and no one owns it. That's a good thing. The internet was designed to be redundant and fault-tolerant—meaning that if one network, connecting wire, or server stops working, everything else should keep on running. Rising from military research and work at educational institutions dating as far back as the 1960s, the internet really took off in the 1990s, when graphical web browsing was invented. Much of the internet's operating infrastructure was transitioned to be supported by private firms rather than government grants. We will now explore this history in more detail.

4.1.5 History of the Internet

In the Beginning: ARPANET

The story of the internet, and networking in general, can be traced back to the late 1950s. The United States was in the depths of the Cold War with the USSR as each nation closely watched the other to determine which would gain a military or intelligence advantage. In 1957, the Soviets surprised the U.S. with the launch of Sputnik, propelling us into the space age. In response to Sputnik, the U.S. Government created the Advanced Research Projects Agency (ARPA), whose initial role was to ensure that the U.S. was not surprised again. It was from ARPA, now called DARPA ((Defense Advanced Research Projects Agency), that the internet first sprang.

ARPA was the center of computing research in the 1960s, but there was just one problem. Many of the computers could not communicate with each other. In 1968 ARPA sent out a request for proposals for a communication technology that would allow different computers located around the country to be integrated together into one network. Twelve companies responded to the request, and a company named Bolt, Beranek, and Newman (BBN) won the contract. They immediately began work and were able to complete the job just one year later.

ARPA Net 1969

Professor Len Kleinrock of UCLA along with a group of graduate students were the first to successfully send a transmission over the ARPANET. The event occurred on October 29, 1969 when they attempted to send the word “login” from their computer at UCLA to the Stanford Research Institute. The first four nodes were at UCLA, University of California, Stanford, and the University of Utah.

Adapted from ARPA Net Nodes 1969 by D.Bourgeois CC-BY-NC

The Internet

Over the next decade, the ARPANET grew and gained popularity. During this time, other networks also came into existence. Different organizations were connected to different networks. This led to a problem. The networks could not communicate with each other. Each network used its own proprietary language, or protocol to send information back and forth. A protocol is the set of rules that govern how communications take place on a network. This problem was solved by the invention of the Transmission Control Protocol/Internet Protocol (TCP/IP).

TCP/IP was designed to allow networks running on different protocols to have an intermediary protocol that would allow them to communicate. So as long as your network supported TCP/IP, you could communicate with all of the other networks running TCP/IP. TCP/IP quickly became the standard protocol and allowed networks to communicate with each other.

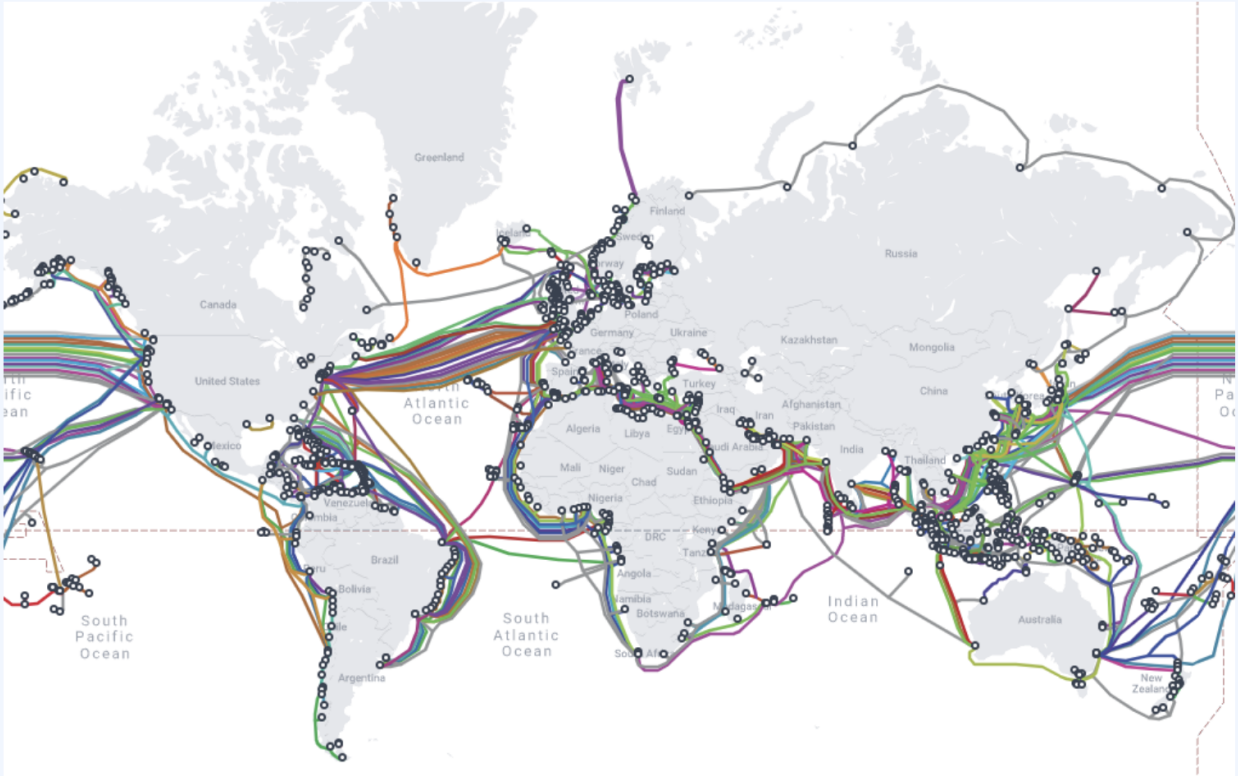
The 1980s witnessed a significant growth in internet usage. Internet access came primarily from government, academic, and research organizations. Much to the surprise of the engineers and developers, the early popularity of the internet was driven by the use of electronic mail. People connecting with people was the killer app (see a later chapter) for the internet.

The World Wide Web

Initially, internet use meant having to type commands, even including IP addresses, in order to access a web server. That all changed in 1990 when Tim Berners-Lee introduced his World Wide Web project which provided an easy way to navigate the internet through the use of hypertext. The World Wide Web gained even more steam in 1993 with the release of the Mosaic browser which allowed graphics and text to be combined as a way to present information and navigate the internet. Many times the terms “Internet” and “World Wide Web,” or even just “the web,” are used interchangeably. But really, they are not the same thing.

The Internet and the Web – What's the Difference?

The internet is an interconnected network of networks. Services such as email, voice and video, file transfer, and the World Wide Web (the web for short) all run across the internet. The web is simply one part of the internet. It is made up of web servers that have HTML pages that are being viewed on devices with web browsers. To see an interactive map of the world's major submarine cable systems go to TeleGeography's Submarine Cable Map. A snapshot of the interactive map can be seen below.



Submarine Cable Map by *TeleGeography* *CC-BY-NC-SA*

The Dot-Com Bubble

In the 1980s and early 1990s, the internet was being managed by the National Science Foundation (NSF). The NSF had restricted commercial ventures on the

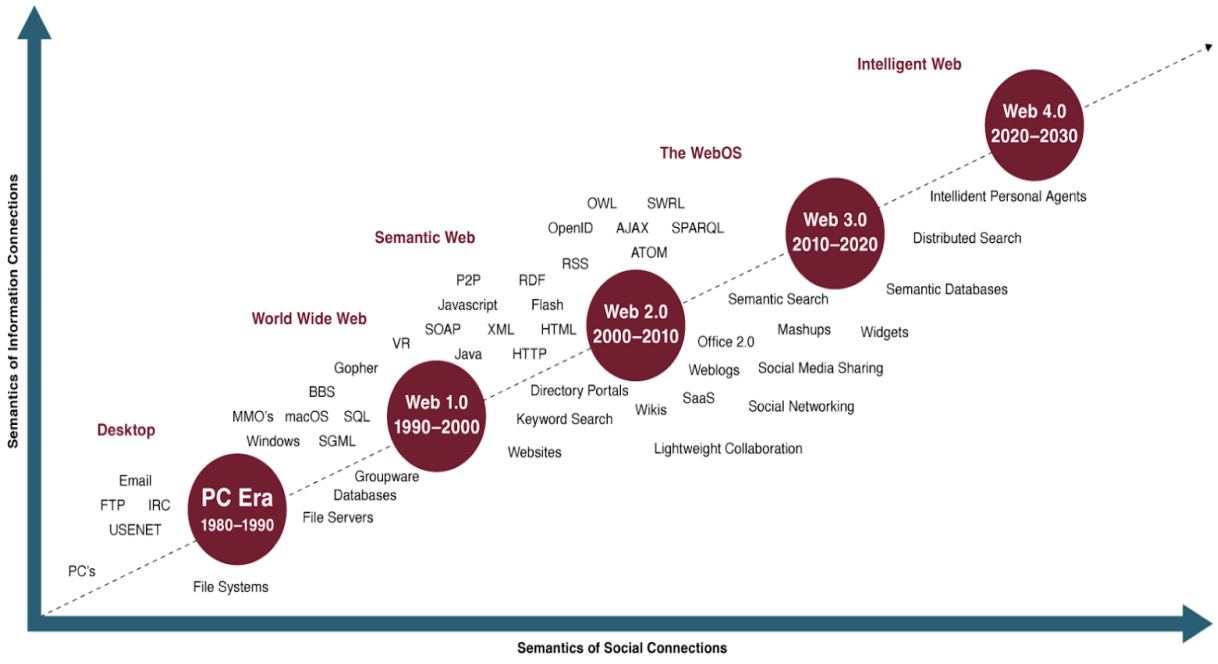
internet, which meant that no one could buy or sell anything online. In 1991, the NSF transferred its role to three other organizations, thus getting the US government out of direct control over the internet and essentially opening up commerce online.

This new commercialization of the internet led to what is now known as the dot-com bubble. A frenzy of investment in new dot-com companies took place in the late 1990s with new tech companies issuing Initial Public Offerings (IPO) and heating up the stock market. This investment bubble was driven by the fact that investors knew that online commerce would change everything. Unfortunately, many of these new companies had poor business models and anemic financial statements showing little or no profit. In 2000 and 2001, the bubble burst and many of these new companies went out of business. Some companies survived, including Amazon (started in 1994) and eBay (1995). After the dot-com bubble burst, a new reality became clear. In order to succeed online, e-business companies would need to develop business models appropriate for the online environment. E-business is explored in later chapters.

The Generations of the Web

In the first few years of the web, creating and hosting a website required a specific set of knowledge. A person had to know how to set up a web server, get a domain name, create web pages in HTML, and troubleshoot various technical issues. Since then the web has evolved. This evolution has been referred to as different phases.

- Web 2.0 is also referred to as the social web and occurred between 2000-2010. During this time there was a shift from read only to read and write, which allowed individuals to be content creators. Social networking with apps such as Facebook, Twitter, Youtube, and personal blogs have allowed people to express their own view points and share content.
- Web 3.0 is also referred to as the semantic web and is the time after 2010 when the web evolved again to allow individuals to read, write and execute. This means that the web is more intelligent and is able to interact with users. For example, algorithms that can personalize search results.
- Web 4.0 is the future of the web, which is referred to as the intelligent web and will involve the Internet of Things and connected devices.



Phases of the Web (Click to enlarge)

There's Another Internet?

Internet2 is a research network created by a consortium of research, academic, industry, and government firms. These organizations have collectively set up a high-performance network running at speeds of up to one hundred gigabits per second to support and experiment with demanding applications. Examples include high-quality video conferencing; high-reliability, high-bandwidth imaging for the medical field; and applications that share huge data sets among researchers.

Chapter 4.2: E-Business

4.2.1 Introduction

Photo by Igor Miske Unsplash License

As we learned in a previous chapter, the internet has had a massive impact on the way we communicate and how businesses operate. Businesses have found new ways to reach customers, expand markets, and transact more efficiently in digital formats. Changes in technology have allowed new business models to flourish while also making it difficult for some industries to keep pace. In general, electronic business has created a revolution in business practices. However, if organizations are going to take advantage of electronic technologies, they must take a strategic perspective. Corporate strategy must align with the company's e-commerce strategy. In this chapter, we will discuss definitions of electronic business and categories of e-commerce, as well as discussing the trends in e-commerce.

4.2.2 Definitions

E-Business & E-Commerce

Electronic business or e-business, in a broad sense, is the use of computer networks to improve organizational performance. Increasing profitability, gaining

market share, improving customer service, and delivering products faster are some of the organizational performance gains possible by doing business electronically. E-business is more than ordering goods online, it involves all aspects of an organization's electronic interactions with its stakeholders.

E-business includes activities such as establishing a webpage to support investor relations or communicating electronically with employees. It involves the use of information technology to enhance communications and transactions with all of an organization's stakeholders. Such stakeholders include: customers, suppliers, government regulators, financial institutions, managers, employees, and the public at large. E-business involves several major components: business intelligence (BI), customer relationship management (CRM), supply chain management (SCM), enterprise resource planning (ERP), e-commerce, conducting electronic transactions within the firm, collaboration, and online activities among businesses.

E-business involves several major components: business intelligence (BI), customer relationship management (CRM), supply chain management (SCM), enterprise resource planning (ERP), e-commerce, conducting electronic transactions within the firm, collaboration, and online activities among businesses. Adapted from Components of E-Business by Matthew Pauley CC-BY-NC-SA

E-business and e-commerce are often used interchangeably, but they are not the same thing. E-commerce is the marketing, selling, and buying of goods and services online. It generates revenue, while e-business does not. The facilitation of commerce on a website, such as the ability for customers to order products online, to get questions answered about products, and for the company to introduce new products and ideas is considered e-commerce. E-business refers to all aspects of operating an online business while e-commerce refers specifically to the transaction of goods and services.

The history of e-commerce begins with the first ever online sale on August 11, 1994. A man sold a CD by Sting to his friend through his website NetMarket, an American retail platform. This is the first example of a consumer purchasing a product from a business through the internet. Since then, e-commerce has evolved to make products easier to discover and purchase through online retailers and marketplaces. Independent freelancers, small businesses, and large corporations have all benefited from e-commerce, which enables them to sell their goods and services at a scale that was not possible with traditional offline retail.

E-Commerce in Canada

E-commerce activity in Canada proliferated during the COVID-19 pandemic as restrictions for in-person shopping were put in place. Overall retail sales declined by about 18%, but e-commerce sales nearly doubled at 99.3%. As can be seen in the graph below, sales dramatically increased in April of 2020 at the peak of the pandemic. E-commerce grew in all retail sub-sectors, but the greatest gains

were experienced in non-essential items. Many businesses had to shift their models and increase their web presence in order to support online selling.[1] To see more on Canadian's online shopping habits, see this infographic from Statistics Canada.

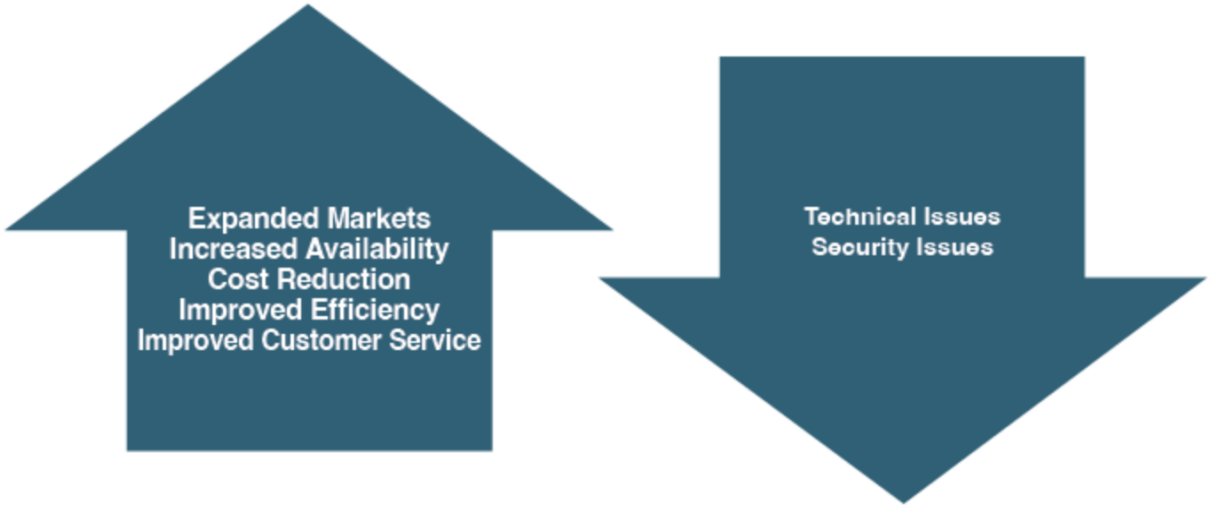
Adapted from Statistics Canada, Indexed monthly retail e-commerce sales vs. in-store sales, Canada- July 24, 2020. This does not constitute an endorsement by Statistics Canada of this product. (click to enlarge)

Section Footnote Links

1. Aston, J., Vipond, O., Virgin, K., & Youssouf, O. (2020, July 24). Retail e-commerce and COVID-19: How online shopping opened doors while many were closing. Statistics Canada. https://www150.statcan.gc.ca/n1/pub/45-28-0001/2020001/article/00064-eng.htm ↵

4.2.3 E-Commerce Advantages & Disadvantages

It is important to understand the advantages and disadvantages of this model compared to traditional brick-and-mortar businesses. Businesses need to understand their customers and their needs as well as the value of this model.



E-Commerce Advantages & Disadvantages (click to enlarge).

Advantages

Expanded Markets

Businesses with an online presence are not limited to servicing customers in their immediate geographic area only, and can broaden their market to serve customers at greater distances, even globally. The business would be limited only by shipping methods and costs and would need to consider this in their setup.

Increased Availability

Online operations allow businesses to interact and transact with customers all day every day, and are no longer limited to traditional bricks and mortar operating hours. This makes it easy for customers to make their purchases at a time that is convenient for them. As well, the automation of the online site means that a business can expand operating hours without necessarily increasing labour costs. As well, there are no limitations on shelf space making it possible to expand product offerings.

Reduce Costs

There are many ways that online technology can be utilized by businesses to reduce costs. For a traditional brick and mortar business, by moving online they can save on all of the infrastructure costs of having a physical presence, such as rent, utilities, and maintenance. As well, since online businesses are not limited to shelf space, they can provide expanded product offerings to their customers without the added costs of stocking in store. For businesses that manufacture goods they can use an online site to transact directly with their customers and remove any need for a retailer (intermediary). The elimination of an intermediary is referred to as disintermediation. An example of this is Dell Direct. As well, instead of drawing employees from their local area, organizations can now hire people from the global labor pool. This allows organizations to pay a lower labor cost for the same work based on the prevailing wage in different countries.

Improved Efficiency

When processes are done online or digitally as opposed to more traditional approaches like paper based, the business benefits through efficiency. For example, online ordering allows customers to create accounts and enter in their own information which can reduce errors and speed processes like ordering and payment. This allows the business to track their customers and their shopping habits which can benefit them in the future.

Improved Customer Service

Customers are able to connect with businesses online in different ways which can improve customer satisfaction. Some businesses even have chatbots that allow customers to ask questions and receive immediate answers based on similar questions asked before. As well, customers can leave reviews and have the opportunity to provide feedback to businesses online about their satisfaction with their products and services. Some businesses have made the online return process fairly simple by automating the process and allowing customers to print return labels and drop in the mail.

The amount of data collected digitally on customers as they are interacting with the website is extremely valuable as well. This information can be used to help encourage further purchases or to help target new customers. Many sites use algorithms to suggest similar products when purchasing online to upsell the customer.

While e-commerce provides a number of advantages there are also some disadvantages with this method of doing business.

Disadvantages

Technical & Accessibility issues

Around the world customers may still experience bandwidth issues that prevent them from being able to efficiently interact with businesses online. Bandwidth and access issues will not be a problem in the future as more infrastructure is built.

Security & Privacy Issues

Customers may still be wary about shopping online especially when large privacy breaches have been well publicized. According to the Canadian Internet Use Survey looking at the online shopping habits of Canadians in 2020, for those Canadians who don't shop online, close to a quarter stated that it is due to security and privacy reasons. [1]

Establishing Customer Trust & Satisfaction

Trust is about believing that someone will do what they say and that they will not intentionally do something to hurt you. Trust in business is essential and it is easier to establish in the physical world as customers receive cues from the environment as well as body language from the sales staff. In the online environment, businesses can help build trust by ensuring customers have a good experience by making their online platform easy to navigate and use. Their website presentation should also be high quality and free from errors. They can also provide reviews on other customers experiences.

Fake Reviews

Since online reviews of a company's products and services have been found to generate online sales, the prevalence of fake reviews has proliferated. According to estimates, 4% of all online reviews are fake which equates to an impact on global online spending of $152 billion. Fake reviews are often created by bots which allows companies to leverage security systems to filter and remove this type of activity. Removing fake reviews is important for a company's authenticity and helps to build and maintain customer trust.

To build trust, businesses should also make sure the product or service meets the customers expectations. Customers may be dissatisfied especially when ordering products online if the product is not reliable, or different than expected. Meaning that the display and description of the product on the website is not what they received. Online retailers should provide a complete and realistic description of the product and its benefits—with high-quality pictures and perhaps even demonstration videos if possible, appropriate, and affordable—along with product availability and likely ship dates. Customers should be notified by e-mail of order acceptance, and the anticipated delivery date with phone and e-mail contacts for any needed assistance.

Section Footnote Links

1. Statistics Canada. (2021, June 22). Online shopping by Canadians in 2020: Results from the Canadian Internet Use Survey. https://www150.statcan.gc.ca/n1/pub/11-627-m/11-627-m2021048-eng.htm ↵
2. Marciano Jonathan Marciano, J. (2021, August 10). Fake online reviews cost $152 billion a year. Here's how e-commerce sites can stop them. World Economic Forum. https://www.weforum.org/agenda/2021/08/fake-online-reviews-are-a-152-billion-problem-heres-how-to-silence-them/. ↵

4.2.4 Online Strategy

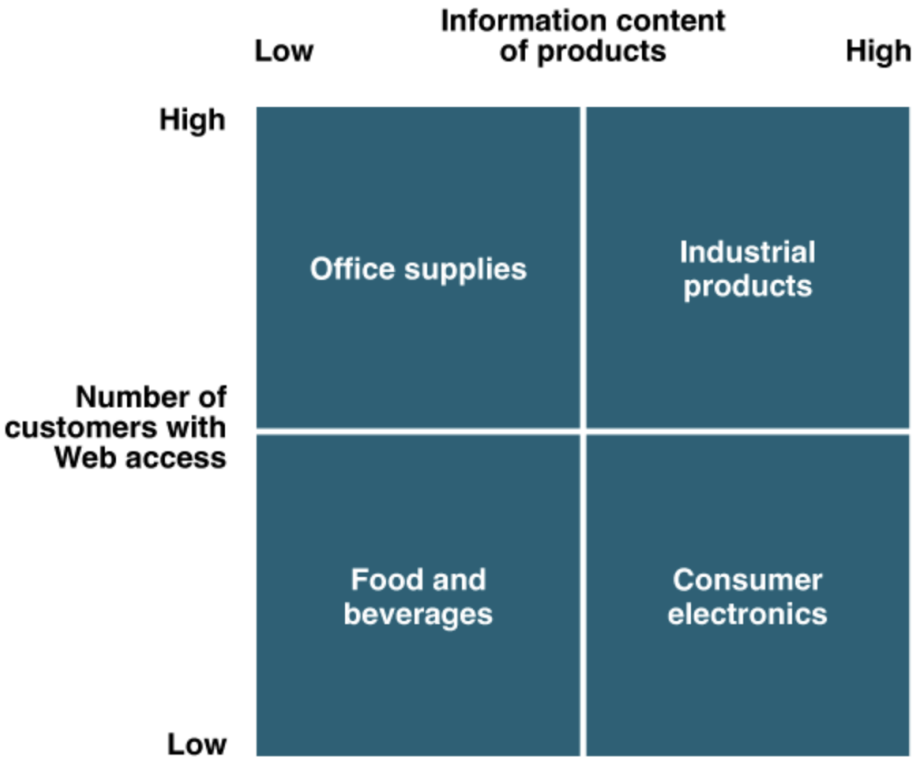
Every business needs to consider the extent of their online presence. There are two key factors to be considered when considering an online strategy:

1. **How many existing or potential customers are likely to do business online?**

   If a significant portion of a company's customers are internet users, and the search cost for the product or service are reasonably, even moderately high, then an organization should have a considerable online presence; otherwise, it is missing an opportunity to inform and interact with its customers. If a company does not have a website, then there is the risk that potential customers will flow to competitors who have a web presence.

2. **What is the information intensity of the product?**

   An information-intense product is one that requires considerable information to describe it completely. The two parameters, number of customers on the web and product information intensity, can be combined to provide a straightforward model (see Exhibit 1) for determining which companies should be using the internet. Organizations falling in the top right quadrant are prime candidates because many of their customers have internet access and their products have a high information content. Firms in the other quadrants, particularly the low-low quadrant, have less need to invest in a website.



Internet Presence Grid (click to enlarge) adapted from Richard T. Watson CC-BY

Strategic Challenges

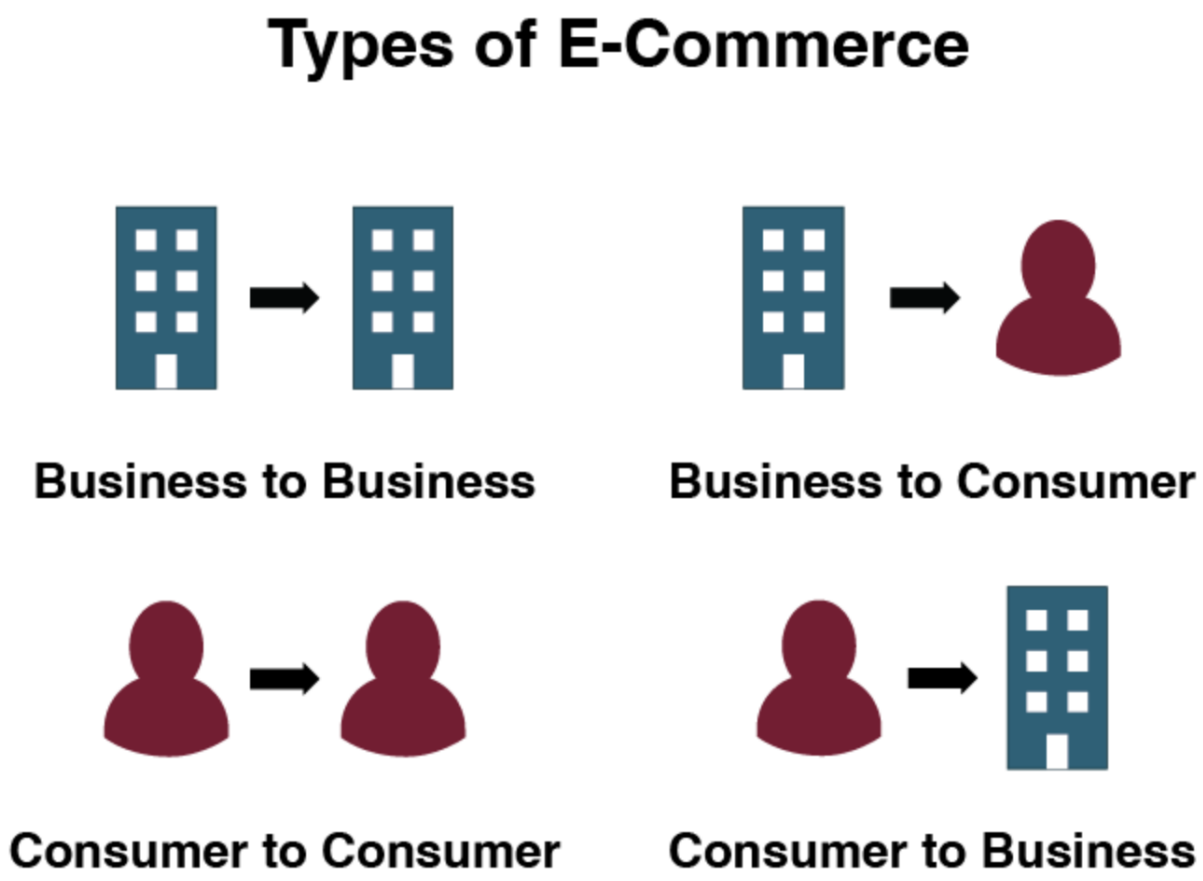
Now that we have explored how businesses are leveraging the internet to sell their products and services and the benefits and concerns, it is important to understand the strategic challenges of doing so. Companies often face three critical strategic challenges:

Demand Risk	Sharply changing demand or the collapse of markets poses a significant risk for many firms. The web can be used to diversify a business by taking new products to new markets.
Innovation Risk	Not being adaptable, which can lead to stagnation, and ultimately failure to remain competitive. Businesses need to be open to new ideas, and these ideas can come from customers. The internet allows communication with customers for this purpose.
Inefficiency risk	Failure to match competitors' unit costs–inefficiency risk. The internet can help reduce operating costs, such as information distribution.

4.2.5 Types of E-Commerce

Every internet business is either pure-play, or brick-and-click. A pure-play business, such as Amazon and Well.ca, has an online presence only and uses the capabilities of the internet to create a new business. Brick-and-click businesses, such as Indigo and Canadian Tire, combine a physical presence with an online presence. These businesses use the Internet to supplement their existing businesses. [1]

There are several different types of e-commerce that can describe almost every transaction that takes place between consumers and businesses.



Types of e-Commerce

Business to Business (B2B)	When a business sells a good or service to another business. For example, a business that sells software-as-a-service for other businesses to use, or Staples selling office supplies. This is the largest form of e-commerce
Business to Consumer (B2C)	When a business sells a good or service to an individual consumer. For example, when you buy a pair of shoes from an online retailer like Nike.
Consumer to Consumer (C2C)	When a consumer sells a good or service to another consumer. The most well known C2C is eBay, but there are many other online market providers as well, like Kijijii or Craigslist. Peer-to-peer (P2P) are also a form of consumer to consumer. See more about P2P below.
Consumer to Business (C2B)	When a consumer sells their own products or services to a business or organization. For example, an influencer offers exposure to their online audience in exchange for a fee, or a photographer licenses their photo for a business to use.

e-Commerce can also involve the government.

Business to Government (B2G)	Defined as e-commerce transactions with the government. The internet is used for procurement, filing taxes, licensing procedures, business registrations, and other government-related operations. This is an insignificant segment of e-commerce in terms of volume, but it is growing.
Consumer to Government (C2G)	Defined as e-commerce transactions between the government and individuals. This would involve licenses and registrations, and paying taxes.

M-Commerce

Mobile e-commerce (m-commerce) refers to the purchase of goods and services through wireless technology, such as cell phones and handheld devices. M-commerce is growing fast with an estimated 73% of all e-commerce sales being done via a mobile device. [2] This can be attributed to the fact that many people now own smartphones, and they are using them all the time. This has made it convenient to be able to leverage this technology to shop online.

Growth in M-Commerce

M-commerce transactions continue to grow as a result of the following:

- The **number of global mobile users is steadily increasing** every year, resulting in an increased demand for mobile websites and applications.

- The **rapid adoption of e-commerce** means that evolving customers are looking for more options across more devices.
- **Improved technology** has given mobile devices advanced capabilities and faster internet access enabling m-commerce to be available on even the most affordable devices.
- **Broadband technology** and **lowering data costs** mean more consumers have access to m-commerce even on affordable devices and data plans.

Mobile users are looking for **instant gratification** online; this includes their online shopping needs. Increase in m-commerce for fast food, fresh produce and basic household items have been driven by this need for customers to get what they need when and where they want it.

Benefits of M-Commerce

Access	Gaining access to the internet through mobile is easier and more affordable than desktop options. The falling costs of data and improved internet access on mobile mean more and more users have access to the internet via mobile than any other device.
Convenience	Mobile phones are always with us and being constantly connected enhances the benefits of anytime, anywhere use with no need to plug in to or log in to computers wherever they are situated.
Costs	Mobile devices are more affordable than computers and offer multiple uses reducing the need for an additional computer. Calls, messaging services, social media and news content are just a few of the reasons consumers would prefer to use a single device making mobile phones the obvious choice
Ease of use	Mobile phones are relatively easy and simple to use, and there is no need for a particularly digitally skilled consumer. They allow consumers to make instant purchases with little technical skill.
Mobile Payment	Security around online payments remains the biggest barrier to e-commerce. Mobile payments allow alternative options for transactions via mobile currencies, mobile wallets and alternative mobile only payment methods. Such easy and secure payment options make mobile the preferred choice for many users.
Rich Content	Advances in mobile processing power means content can be easily accessed on mobile web browsers and mobile applications. Rich media allows brands to better demonstrate a product's key features, share testimonials, and showcase the use/look of the product or service.

Peer to Peer (P2P)

Peer-to-peer is a form of e-commerce comprised of an online platform that connects individuals looking to transact with one another. Some examples of P2P are Etsy, Uber, Airbnb and TaskRabbit.

Section Footnote Links

1. Krishnamurthy, S. (2003). E-Commerce Management: Text and Cases. p.73. ↵

2. Loesche, D., & Richter, F. (2018, March 6). Infographic: Mobile e-commerce is up and poised for further growth. Statista. https://www.statista.com/chart/13139/estimated-worldwide-mobile-e-commerce-sales/. ↵

4.2.6 E-Commerce Models

An e-commerce business model is the method that a business uses to generate revenue online. E-commerce can take on a variety of forms involving different transactional relationships between businesses and consumers.

Retail	The sale of a product by a business directly to a customer without any intermediary.
Wholesale	The sale of products in bulk, often to a retailer that then sells them directly to consumers.
Dropshipping	The sale of a product, which is manufactured and shipped to the consumer by a third party.
Crowdfunding	The collection of money from consumers in advance of a product being available in order to raise the startup capital necessary to bring it to market. Example: Kickstarter
Subscription	The automatic recurring purchase of a product or service on a regular basis until the subscriber chooses to cancel. Examples: newspaper subscriptions, music streaming sites (Spotify)
Transaction Brokers	Companies who facilitate a transaction and take a portion of the revenue. Example AirBnb, EventBrite

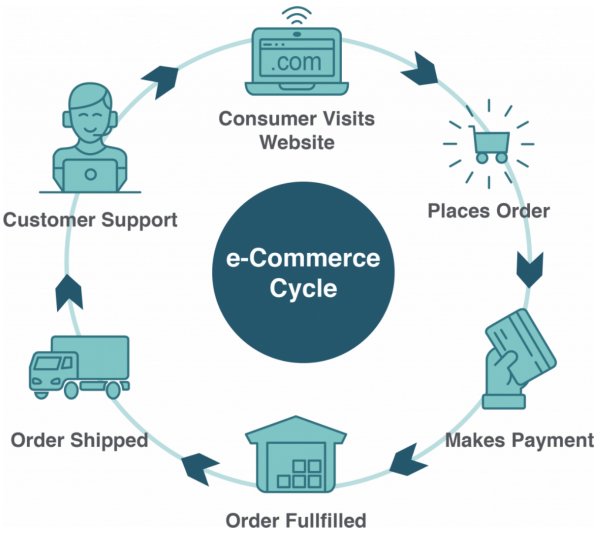
As well e-commerce can involve different objects being exchanged as part of these transactions.

Physical products	Any tangible good that requires inventory to be replenished and orders to be physically shipped to customers as sales are made.
Digital products	Downloadable digital goods, templates, and courses, or media that must be purchased for consumption or licensed for use. For example, maybe you take a digital course online through LinkedIn Learning.
Services	A skill or set of skills provided in exchange for compensation. The service provider's time can be purchased for a fee.

The Business to Consumer Cycle

In the B2C e-commerce cycle a customer visits a website and peruses the products offered. They choose a product and place an order which then gets added to their online shopping cart. Once they have completed their selection, they navigate to their shopping cart and choose a shipping address and make a payment. Payment options are explored in detail later in the chapter.

On the other end, the business fulfills the order and prepares it for shipping. The order is then shipped, and the customer is notified of this step. The customer can follow up with customer service if there are any issues with the order or shipment. The customer is also sometimes asked to provide a review of the product so that future potential customers can benefit from this experience. If a customer is unhappy with their product, they can reach out to customer service and explore their options. Some companies, like Amazon, allow customers to return their orders online, and a return label is automatically created for printing. The customer simply has to package the item and return it via Canada Post or another shipping company.



B2C e-Commerce Cycle (click to enlarge)

4.2.7 E-Commerce Technology


Adapted from image by 200degrees Pixabay License (re-coloured)

An e-commerce platform is a way to build and create an online experience that allows a company to make sales and fulfill orders. While most people think an e-commerce platform is just a tool that provides a list of products and accepts payments online, a true e-commerce platform is much more than that. It

is a complete business command center that controls everything from inventory to marketing. It should support basic requirements such as custom styling, search engine optimization, credit card processing, promotions, catalog management, analytics, product browsing, checkout, and order management. Some examples of e-commerce platforms are Shopify, Wix and BigCommerce.

To make an online store accessible to the public it requires a hosting solution. Hosting stores information on a server, which allows internet users to visit a company's site and view all of the content. Every website is hosted somewhere, meaning it has dedicated server space from a provider. Some e-commerce platforms have hosting built in, while others require self-hosting or open-source hosting.

Hosted	Some ecommerce website builders offer a hosted platform. Building on a hosted ecommerce platform provides freedom to focus on the business, and not the technology management of the site.
Self-hosted	Self-hosted platforms require companies to use their own server space or pay to rent space from a hosting provider. This makes ongoing website management complex, as you're responsible for updates, maintenance, and bug fixes. This requires a lot of internal resources that you could otherwise allocate elsewhere. Self-hosted platforms are typically open source, and you use a third party to host your website data. Third-party sourcing options charge fees for their services, and these costs quickly add up. Many times, these hosting services use tiered pricing structures, so those on the lowest plans don't get much in the way of customer support. This can leave you hanging at really important times, like traffic boosts after unexpected press coverage.

Instead of going with an e-commerce platform, businesses can also hire a full-service web developer to provide design, programming, support, hosting, search engine optimization, and more. Any combination of the services can be selected. Having the developer perform all the services would be the most expensive alternative. The ultimate cost for a website will be a function of its size, complexity, and the level of design. No two projects will cost the same. Part of the process of building a website, however, should be conducting some research and

talking with website designers. The Internet offers a variety of sources on how to determine how much a website should cost. WebFX.com offers a historical perspective on website costs, a cost calculator to find out how much a web project would cost, and examples of specific web design and website development projects with cost figures.[1]

Search Engine Optimization

It is important when creating a website to consider search engine optimization (SEO). Search Engine Optimization (SEO) refers to the techniques that help a website rank high in organic search results (such as on Google and other search engines). There are the two types of listings that appear when using a search engine: organic search and paid search. SEO aims to make a website more visible to people looking for specific information or a particular product or service via search engine. SEO falls under the umbrella of Search Engine Marketing(SEM). SEM is a form of internet marketing that involves the promotion of websites by increasing their visibility in search engine result pages primarily through paid advertising.

Payment Methods

Security, privacy, and trust are most important when considering the payment function. Without this transaction, there is no e-commerce, so it is imperative that businesses take the necessary steps to reduce customer concerns about shopping online. It is also important for merchants to offer multiple payment methods to provide flexibility and ensure customers complete their purchase.

See the following types of payment methods. Credit cards are by far the most popular payment method for online transactions.

Electronic Payment

E-payment is any payment done electronically. This form of payment includes debit cards, credit cards, gift cards, e-transfers, email payments, mobile wallets, and cryptocurrency.

e-Transfers

Electronic transfer or e-transfer is the ability to send money from your bank account held at a Canadian financial institution through the Interac Corporation. With e-transfers the sender logs-on to their bank account and chooses a recipient to send money to. The recipient's email or phone number is provided for notification of the transfer. A security question can be added so that only the recipient with the correct password can process the transaction. The popularity of e-transfers is growing with 57 percent of the country's population registering for the service by the end of 2018. Most e-transfers happen on mobile phones.[2]

E-Mail based methods (PayPal)

PayPal is a form of an email based payment method where members are able to send money to any registered person. Registration requires the user to set up an account with their e-mail address. A notification is sent to those individuals who are to receive funds but are not registered. PayPal accounts are tied to the registrants credit card or bank account. Paypal also has a mobile application that can be used for contactless payment through the use of QR codes.

Mobile Wallets

A mobile wallet is an application on your mobile device that stores your payment information to allow for contactless payments. It is like a regular wallet where you keep your credit, debit or prepaid cards. You can use your mobile wallet when shopping in-person or online. Your financial institution or the merchant may set limits on how much money you can spend using a mobile wallet. There are concerns about how financial information is stored on mobile wallets, and what happens if you were to lose your phone. To learn more about Mobile Wallets and the safety of them, go to the information page by the Financial Consumer Agency of Canada. Some examples of mobile wallets in Canada are: Apple Pay, Google Pay, Samsung Pay.

Section Footnote Links

1. WebFx. (2022). How Much Should a Web Site Cost? www.webpagefx.com/How-much-should-web-site-cost.html ↵ ↵
2. Interact Corporation. (2021, May 15). Why 2018 was another banner year for Interac e-Transfer. Interac In The Know. https://www.interac.ca/en/content/business/why-2018-was-another-banner-year-for-interac-e-transfer/. ↵

End of Chapter Summary

- Provides examination of computer networks within computer information systems.
- The chapter covers essential components like data communication, modems, mediums, and bandwidth, progressing to exploring computer networks, including LANs, MANs, and WANs.
- The Internet's structure, history, and the World Wide Web's development are discussed, emphasizing networks' significance in business and web applications.
- Focusing on pivotal milestones like the Dot-Com Bubble and the Generations of the Web, this chapter explores the transformative phases of the Internet.
- The chapter concludes with a glimpse into Internet2, a research network supporting high-performance applications through collaboration.
- It explores definitions, distinctions, and advantages/disadvantages of e-business and e-commerce.
- The advantages of e-commerce, strategic challenges, types of e-commerce, and the transformative impact of the Internet on communication and business operations are thoroughly examined.
- Equips readers with a comprehensive understanding of e-business and e-commerce, their strategic implications, and the evolving landscape of online commerce models.
- This section delves into the Business-to-Consumer (B2C) e-commerce cycle, outlining the steps from customer website visits to order fulfillment, emphasizing customer reviews and return flexibility.
- The chapter also covers the significance of Search Engine Optimization (SEO) and the critical aspects of Payment Methods, categorizing them and addressing security, privacy, and trust considerations.
- Overall, it provides a comprehensive overview of the B2C e-commerce cycle, e-commerce technology, and payment methods.

Key Terms

Brick-and-click business: selling products to consumers via several channels, one which is usually a tangible shop and the other one an e-business. The tangible location is the brick while the e-business is the click.

Business intelligence (BI): combines business analytics, data mining, data visualization, data tools and infrastructure, and best practices to help organizations make more data-driven decisions.

Business to Business (B2B): when a business sells a good or service to another business. For example, a business that sells software-as-a-service for other businesses to use, or Staples selling office supplies. This is the largest form of e-commerce.

Business to Consumer (B2C): When a business sells a good or service to an individual consumer. For example, when you buy a pair of shoes from an online retailer like Nike.

Business to Government (B2G): Defined as e-commerce transactions with the government. The internet is used for procurement, filing taxes, licensing procedures, business registrations, and other government-related operations. This is an insignificant segment of e-commerce in terms of volume, but it is growing.

Client: the application that runs on a personal computer or workstation.

Computer Network: a group of two or more computer systems linked together by communications channels to share data and information.

Consumer to Business (C2B): When a consumer sells their own products or services to a business or organization. For example, an influencer offers exposure to their online audience in exchange for a fee, or a photographer licenses their photo for a business to use.

Consumer to Consumer (C2C): When a consumer sells a good or service to another consumer. The most well-known C2C is eBay, but there are many other online market providers as well, like Kijijii or Craigslist. Peer-to-peer (P2P) are also a form of consumer-to-consumer.

Consumer to Government (C2G): Defined as e-commerce transactions between the government and individuals. This would involve licenses and registrations, and paying taxes.

Customer relationship management (CRM): An approach to managing a company's interactions with current and future customers. It often involves using technology to organize, automate, and synchronize sales, marketing, customer service, and technical support.

Data Communication: the exchange of data between two or more networked or connected devices.

E-commerce business model: this is the method that a business uses to generate revenue online.

E-commerce platform: a way to build and create an online experience that allows a company to make sales and fulfill orders.

E-Commerce: commercial transactions conducted electronically on the internet.

Electronic business (E-business): is the use of computer networks to improve organizational performance.

Electronic transfer: ability to send money from your bank account.

Enterprise resource planning (ERP): an application with a centralized database that can be used to run a company's entire business.

E-Payment: any payment done electronically. (*Example: debit cards, credit cards, gift cards, e-transfers, email payments, mobile wallets, and cryptocurrency.)*

Hosting: a computer or other device that communicates with other hosts on a network.

Internet service provider (ISP): a company that provides subscribers with access to the internet.

Internet: a network of networks.

Local area network (LAN): lets people at one site exchange data and share the use of hardware and software.

M-commerce: electronic commerce conducted on mobile phones.

Medium: provides a path for the signals to be transmitted. (*Examples: Physical form-copper cable, coaxial cable, or fiber optics; OR, wireless)*

Metropolitan area network (MAN): spans a larger area like a city or region.

Mobile wallet: an application on your mobile device that stores your payment information to allow contactless payments.

Modem: converts the format of the data so it may be transmitted between computers.

Peer-to-peer (P2P): denoting or relating to computer networks in which each computer can act as a server for the others, allowing shared access to files and peripherals without the need for a central server.

Protocol: is a set of rules that govern how communications take place on a network.

Pure-play business: a company that focuses on only one industry

Search Engine Marketing (SEM): a method of promotion and advertising to help companies content rank higher among search engine traffic.

Search engine optimization (SEO): the process of maximizing the number of visitors to a particular website by ensuring that the site appears high on the list of results returned by a search engine.

Server: manages network resources or performs special tasks. (*Example: storing files, managing one or more printers, or processing database queries)*

Supply chain management (SCM): the optimization of a product's creation and flow from raw material sourcing to production, logistics and delivery to the final customer.

Transmission Control Protocol/Internet Protocol (TCP/IP): a communications standard that enables application programs and computing devices to exchange messages over a network.

Web 2.0: is referred to as the social web and occurred between 2000-2010.

Web 3.0: referred to as the semantic web and is the time after 2010 when the web evolved again to allow individuals to read, write and execute.

Web 4.0: is the future of the web, which is referred to as the intelligent web and will involve the Internet of things and connected devices.

Wide area network (WAN): connects computers at different sites via telecommunications media. (*Example: phone lines, satellites, and microwaves.)*

World Wide Web: an information system on the internet that allows documents to be connected to other documents by hypertext links, enabling the user to search for information by moving from one document to another.

End of Chapter Discussions

1. Reflect on the computer networks you engage with daily and explain.
2. Identify and explain the three types of networks.
3. Describe the various generations of the web.
4. Break down the data communication process.
5. Enumerate the components associated with E-business.
6. Outline both the disadvantages and advantages of E-Commerce.
7. Reflect on your current online business activities, specifying the areas where you conduct business entirely online (e.g., shopping, ordering, or using services like Uber).
8. Categorize the types of E-Commerce that exist.

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5: Information Security, Ethics & Privacy

Chapter Learning Outcomes:

1. Describe what the term information systems ethics means.
2. Explain what a code of ethics is and describe the advantages and disadvantages.
3. Define the term intellectual property and explain the protections provided by copyright, patent, and trademark.
4. Describe the challenges that information technology brings to individual privacy.
5. Define and explain the fundamental goals of computer security: confidentiality, integrity, and availability.
6. Dive into various security measures, including access restrictions, peripheral security, firewalls, and antivirus software.
7. Introduce firewalls and emphasize their functions in network security.

5.1 The Ethical and Legal Implications of Information Systems

5.1.1 Introduction

Introduction Information systems have had an impact far beyond the world of business. New technologies create new situations that have never had to be confronted before. One issue is how to handle the new capabilities that these devices provide to users. What new laws are going to be needed for protection from misuse of new technologies. This chapter begins with a discussion of the impact of information systems has on user behavior or ethics. This will be followed with the new legal structures being put in place with a focus on intellectual property and privacy.

5.1.2 Information Systems Ethics

The term ethics means “a set of moral principles” or “the principles of conduct governing an individual or a group.”1 Since the dawn of civilization, the study of ethics and their impact has fascinated mankind. But what do ethics have to do

with information systems? The introduction of new technology can have a profound effect on human behavior. New technologies give us capabilities that we did not have before, which in turn create environments and situations that have not been specifically addressed in an ethical context. Those who master new technologies gain new power while those who cannot or do not master them may lose power. In 1913 Henry Ford implemented the first moving assembly line to create his Model T cars. While this was a great step forward technologically and economically, the assembly line reduced the value of human beings in the production process. The development of the atomic bomb concentrated unimaginable power in the hands of one government, who then had to wrestle with the decision to use it. Today's digital technologies have created new categories of ethical dilemmas.

For example, the ability to anonymously make perfect copies of digital music has tempted many music fans to download copyrighted music for their own use without making payment to the music's owner. Many of those who would never have walked into a music store and stolen a CD find themselves with dozens of illegally downloaded albums. Digital technologies have given us the ability to aggregate information from multiple sources to create profiles of people. What would have taken weeks of work in the past can now be done in seconds, allowing private organizations and governments to know more about individuals than at any time in history. This information has value, but also chips away at the privacy of consumers and citizens.

5.1.3 Sidebar: Data Privacy, Facebook, and Cambridge Analytica

Facebook logo

In early 2018 Facebook acknowledged a data breach affecting 87 million users. The app “thisisyourdigitallife”, created by Global Science Research, informed users that they could participate in a psychological research study. About 270,000 people decided to participate in the research, but the app failed to tell users that the data of all of their friends on Facebook would be automatically captured as well. All of this data theft took place prior to 2014, but it did not become public until four years later. In 2015 Facebook learned about Global Science Research’s collection of data on millions of friends of the users in the research. Global Science Research agreed to delete the data, but it had already been sold to Cambridge Analytica who used it in the 2016 presidential primary campaign. The ensuing firestorm resulted in Mark Zuckerberg, CEO of Facebook, testifying before the U.S. Congress in 2018 on what happened and what Facebook would do in the future to protect users’ data. Congress is working on legislation to protect user data in the future, a prime example of technology advancing faster than the laws needed to protect users. More information about this case of data privacy can be 2 found at Facebook and Cambridge Analytica.

5.1.4 Code of Ethics

A code of ethics is one method for navigating new ethical waters. A code of ethics outlines a set of acceptable behaviors for a professional or social group.

Generally, it is agreed to by all members of the group. The document details different actions that are considered appropriate and inappropriate. A good example of a code of ethics is the Code of Ethics and Professional Conduct of the Association for Computing Machinery,3 an organization of computing professionals that includes academics, researchers, and practitioners. Here is a quote from the preamble: Commitment to ethical professional conduct is expected of every member (voting members, associate members, and student members) of the Association for Computing Machinery (ACM). This Code, consisting of 24 imperatives formulated as statements of personal responsibility, identifies the elements of such a commitment. It contains many, but not all, issues professionals are likely to face. Section 1 outlines fundamental ethical considerations, while Section 2 addresses additional, more specific considerations of professional conduct. Statements in Section 3 pertain more specifically to individuals who have a leadership role, whether in the workplace or in a volunteer capacity such as with organizations like ACM. Principles involving compliance with this Code are given in Section 4.

In the ACM's code you will find many straightforward ethical instructions such as the admonition to be honest and trustworthy. But because this is also an organization of professionals that focuses on computing, there are more specific admonitions that relate directly to information technology:

- No one should enter or use another's computer system, software, or data files without permission. One must always have appropriate approval

before using system resources, including communication ports, file space, other system peripherals, and computer time.

- Designing or implementing systems that deliberately or inadvertently demean individuals or groups is ethically unacceptable.
- Organizational leaders are responsible for ensuring that computer systems enhance, not degrade, the quality of working life. When implementing a computer system, organizations must consider the personal and professional development, physical safety, and human dignity of all workers. Appropriate human-computer ergonomic standards should be considered in system design and in the workplace.

One of the major advantages of creating a code of ethics is that it clarifies the acceptable standards of behavior for a professional group. The varied backgrounds and experiences of the members of a group lead to a variety of ideas regarding what is acceptable behavior. While the guidelines may seem obvious, having these items detailed provides clarity and consistency. Explicitly stating standards communicates the common guidelines to everyone in a clear manner.

A code of ethics can also have some drawbacks. First, a code of ethics does not have legal authority. Breaking a code of ethics is not a crime in itself. What happens if someone violates one of the guidelines? Many codes of ethics include a section that describes how such situations will be handled. In many cases repeated violations of the code result in expulsion from the group.

In the case of ACM: “Adherence of professionals to a code of ethics is largely a voluntary matter. However, if a member does not follow this code by engaging in gross misconduct, membership in ACM may be terminated.” Expulsion from ACM may not have much of an impact on many individuals since membership in ACM is usually not a requirement for employment. However, expulsion from other organizations, such as a state bar organization or medical board, could carry a huge impact.

Another possible disadvantage of a code of ethics is that there is always a chance that important issues will arise that are not specifically addressed in the code. Technology is quickly changing and a code of ethics might not be updated often enough to keep up with all of the changes. A good code of ethics, however, is written in a broad enough fashion that it can address the ethical issues of potential changes to technology while the organization behind the code makes revisions.

Finally, a code of ethics could also be a disadvantage in that it may not entirely reflect the ethics or morals of every member of the group. Organizations with a diverse membership may have internal conflicts as to what is acceptable behavior. For example, there may be a difference of opinion on the consumption of alcoholic beverages at company events. In such cases the organization must make a choice about the importance of addressing a specific behavior in the code.

5.1.5 Sidebar: Acceptable Use Policies

Many organizations that provide technology services to a group of constituents or the public require agreement to an Acceptable User Policy (AUP) before those services can be accessed. Similar to a code of ethics, this policy outlines what is allowed and what is not allowed while someone is using the organization's services. An everyday example of this is the terms of service that must be agreed to before using the public Wi-Fi at Starbucks, McDonald's, or even a university. Here is an example of an acceptable use policy from Virginia Tech.

Just as with a code of ethics, these acceptable use policies specify what is allowed and what is not allowed. Again, while some of the items listed are obvious to most, others are not so obvious:

- "Borrowing" someone else's login ID and password is prohibited.
- Using the provided access for commercial purposes, such as hosting your own business website, is not allowed.
- Sending out unsolicited email to a large group of people is prohibited.

As with codes of ethics, violations of these policies have various consequences. In most cases, such as with Wi-Fi, violating the acceptable use policy will mean that you will lose your access to the resource. While losing access to Wi-Fi at Starbucks may not have a lasting impact, a university student getting banned from the university's Wi-Fi (or possibly all network resources) could have a large impact.

5.1.6 Intellectual Property

One of the domains that has been deeply impacted by digital technologies is intellectual property. Digital technologies have driven a rise in new intellectual property claims and made it much more difficult to defend intellectual property. Intellectual property is defined as “property (as an idea, invention, or process) that derives from the work of the mind or intellect.”4 This could include creations such as song lyrics, a computer program, a new type of toaster, or even a sculpture.

Practically speaking, it is very difficult to protect an idea. Instead, intellectual property laws are written to protect the tangible results of an idea. In other words, just coming up with a song in your head is not protected, but if you write it down it can be protected.

Protection of intellectual property is important because it gives people an incentive to be creative. Innovators with great ideas will be more likely to pursue those ideas if they have a clear understanding of how they will benefit. In the US Constitution, Article 8, Section 8, the authors saw fit to recognize the importance of protecting creative works: Congress shall have the power . . . To promote the Progress of Science and useful Arts, by securing for limited Times to Authors and Inventors the exclusive Right to their respective Writings and Discoveries.

An important point to note here is the “limited time” qualification. While protecting intellectual property is important because of the incentives it provides, it is also necessary to limit the amount of benefit that can be received and allow the

results of ideas to become part of the public domain. Outside of the US, intellectual property protections vary. You can find out more about a specific country's intellectual property laws by visiting the World Intellectual Property Organization. The following sections address three of the best-known intellectual property protections: copyright, patent, and trademark.

5.1.7 Copyright

Copyright is the protection given to songs, computer programs, books, and other creative works. Any work that has an "author" can be copyrighted. Under the terms of copyright, the author of a work controls what can be done with the work, including:

- Who can make copies of the work.
- Who can make derivative works from the original work.
- Who can perform the work publicly.
- Who can display the work publicly.
- Who can distribute the work.

Many times, a work is not owned by an individual but is instead owned by a publisher with whom the original author has an agreement. In return for the rights to the work, the publisher will market and distribute the work and then pay the original author a portion of the proceeds. Copyright protection lasts for the life of the original author plus seventy years. In the case of a copyrighted work owned by a publisher or another third party, the protection lasts for ninetyfive years from the original creation date. For works created before 1978, the protections vary

slightly. You can see the full details on copyright protections by reviewing the Copyright Basics document available at the US Copyright Office's website.

5.1.8 Obtaining Copyright Protection

In the United States a copyright is obtained by the simple act of creating the original work. In other words, when an author writes down a song, makes a film, or develops a computer program, the author has the copyright. However, for a work that will be used commercially, it is advisable to register for a copyright with the US Copyright Office. A registered copyright is needed in order to bring legal action against someone who has used a work without permission.

5.1.9 First Sale Doctrine

If an artist creates a painting and sells it to a collector who then, for whatever reason, proceeds to destroy it, does the original artist have any recourse? What if the collector, instead of destroying it, begins making copies of it and sells them? Is this allowed? The first sale doctrine is a part of copyright law that addresses this, as shown below5 :

The first sale doctrine, codified at 17 U.S.C. § 109, provides that an individual who knowingly purchases a copy of a copyrighted work from the copyright holder receives the right to sell, display or otherwise dispose of that particular copy, notwithstanding the interests of the copyright owner.

Therefore, in our examples the copyright owner has no recourse if the collector destroys the artwork. But the collector does not have the right to make copies of the artwork.

5.1.10 Fair Use

Another important provision within copyright law is that of fair use. Fair use is a limitation on copyright law that allows for the use of protected works without prior authorization in specific cases. For example, if a teacher wanted to discuss a current event in class, copies of the copyrighted new story could be handed out in class without first getting permission. Fair use is also what allows a student to quote a small portion of a copyrighted work in a research paper.

Unfortunately, the specific guidelines for what is considered fair use and what constitutes copyright violation are not well defined. Fair use is a well-known and respected concept and will only be challenged when copyright holders feel that the integrity or market value of their work is being threatened. The following four factors are considered when determining if something constitutes fair use:

1. The purpose and character of the use, including whether such use is of commercial nature or is for nonprofit educational purposes;
2. The nature of the copyrighted work;
3. The amount and substantiality of the portion used in relation to the copyrighted work as a whole;
4. The effect of the use upon the potential market for, or value of, the copyrighted work.

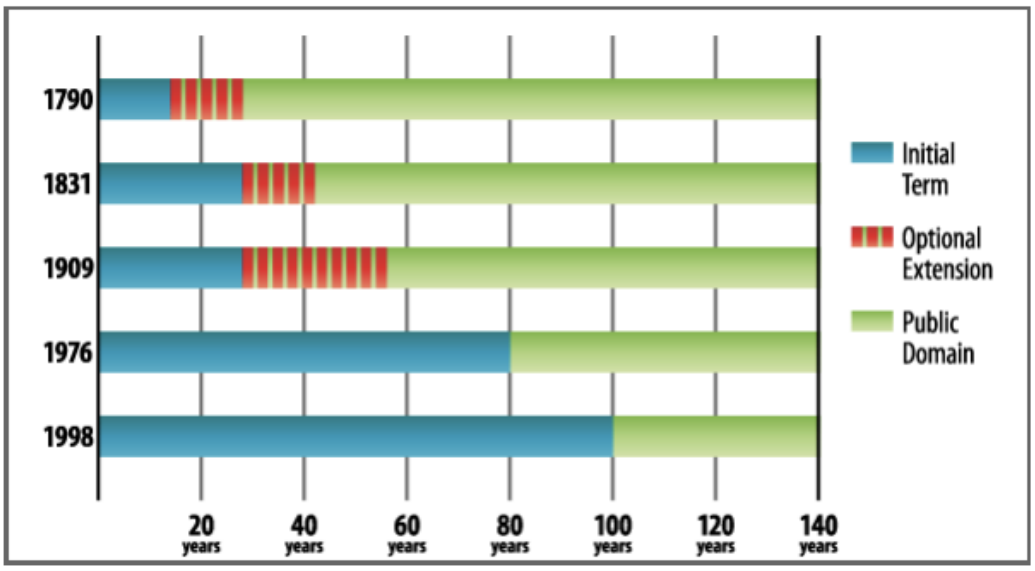
If you are ever considering using a copyrighted work as part of something you are creating, you may be able to do so under fair use. However, it is always best to check with the copyright owner to be sure you are staying within your rights and not infringing upon theirs.

5.1.11 Sidebar: The History of Copyright Law

As noted above, current copyright law grants copyright protection for seventy years after the author's death, or ninety-five years from the date of creation for a work created for hire. But it was not always this way.

The first US copyright law, which only protected books, maps, and charts, provided protection for only 14 years with a renewable term of 14 years. Over time copyright law was revised to grant protections to other forms of creative expression, such as photography and motion pictures. Congress also saw fit to extend the length of the protections, as shown in the following chart. Today, copyright has become big business with many businesses relying on the income from copyright protected works for their income.

Many now think that the protections last too long. The Sonny Bono Copyright Term Extension Act has been nicknamed the "Mickey Mouse Protection Act," as it was enacted just in time to protect the copyright on the Walt Disney Company's Mickey Mouse character. Because of this term extension, many works from the 1920s and 1930s that would have been available now in the public domain are still restricted.



Evolution of Copyright

5.1.12 The Digital Millennium Copyright Act

As digital technologies have changed what it means to create, copy, and distribute media, a policy vacuum has been created. In 1998, the US Congress passed the Digital Millennium Copyright Act (DMCA), which extended copyright law to take into consideration digital technologies. Two of the best-known provisions from the DMCA are the anti-circumvention provision and the "safe harbor" provision.

- The anti-circumvention provision makes it illegal to create technology to circumvent technology that has been put in place to protect a copyrighted work. This provision includes not just the creation of the technology but also the publishing of information that describes how to do it. While this provision does allow for some exceptions, it has become quite controversial and has led to a movement to have it modified.

- The “safe harbor” provision limits the liability of online service providers when someone using their services commits copyright infringement. This is the provision that allows YouTube, for example, not to be held liable when someone posts a clip from a copyrighted movie. The provision does require the online service provider to take action when they are notified of the violation (a “takedown” notice). For an example of how takedown works, here’s how YouTube handles these requests: YouTube Copyright Infringement Notification.

Many think that the DMCA goes too far and ends up limiting our freedom of speech. The Electronic Frontier Foundation (EFF) is at the forefront of this battle. In discussing the anti-circumvention provision, the EFF states: Yet the DMCA has become a serious threat that jeopardizes fair use, impedes competition and innovation, chills free expression and scientific research, and interferes with computer intrusion laws. If you circumvent DRM [digital rights management] locks for noninfringing fair uses or create the tools to do so you might be on the receiving end of a lawsuit.

5.1.13 Sidebar: Creative Commons

A previous chapter introduced the topic of open-source software. Opensource software has few or no copyright restrictions. The creators of the software publish their code and make their software available for others to use and distribute for free. This is great for software, but what about other forms of copyrighted works? If an artist or writer wants to make their works available, how can they go about

doing so while still protecting the integrity of their work? Creative Commons is the solution to this problem.

Creative Commons is a nonprofit organization that provides legal tools for artists and authors. The tools offered make it simple to license artistic or literary work for others to use or distribute in a manner consistent with the author's intentions. Creative Commons licenses are indicated with the symbol. It is important to note that Creative Commons and public domain are not the same. When something is in the public domain, it has absolutely no restrictions on its use or distribution. Works whose copyrights have expired are in the public domain.

By using a Creative Commons license, authors can control the use of their work while still making it widely accessible. By attaching a Creative Commons license to their work, a legally binding license is created. Here are some examples of these licenses:

- CC-BY. This is the least restrictive license. It lets others distribute and build upon the work, even commercially, as long as they give the author credit for the original work.
- CC-BY-SA. This license restricts the distribution of the work via the "share-alike" clause. This means that others can freely distribute and build upon the work, but they must give credit to the original author and they must share using the same Creative Commons license.
- CC-BY-NC. This license is the same as CC-BY but adds the restriction that no one can make money with this work. NC stands for "non-commercial."

- CC-BY-NC-ND. This license is the same as CC-BY-NC but also adds the ND restriction, which means that no derivative works may be made from the original.

These are a few of the more common licenses that can be created using the tools that Creative Commons makes available. For a full listing of the licenses and to learn much more about Creative Commons, visit their web site.

5.1.14 Patent

Patents are another important form of intellectual property protection. A patent creates protection for someone who invents a new product or process. The definition of invention is quite broad and covers many different fields. Here are some examples of items receiving patents:

- circuit designs in semiconductors;
- prescription drug formulas;
- firearms;
- locks;
- plumbing;
- engines;
- coating processes; and
- business processes.

Once a patent is granted it provides the inventor with protection from others infringing on his or her patent. A patent holder has the right to “exclude others from making, using, offering for sale, or selling the invention throughout the

United States or importing the invention into the United States for a limited time in exchange for public disclosure of the invention when the patent is granted."7 As with copyright, patent protection lasts for a limited period of time before the invention or process enters the public domain. In the US, a patent lasts twenty years. This is why generic drugs are available to replace brand-name drugs after twenty years.

5.1.15 Obtaining Patent Protection

Unlike copyright, a patent is not automatically granted when someone has an interesting idea and writes it down. In most countries a patent application must be submitted to a government patent office. A patent will only be granted if the invention or process being submitted meets certain conditions.

- Must be original. The invention being submitted must not have been submitted before.
- Must be non-obvious. You cannot patent something that anyone could think of. For example, you could not put a pencil on a chair and try to get a patent for a pencil-holding chair.
- Must be useful. The invention being submitted must serve some purpose or have some use that would be desired.

The job of the patent office is to review patent applications to ensure that the item being submitted meets these requirements. This is not an easy job. In 2017 the US Patent Office granted 318,849 patents, an increase of 5.2% over 2016.8 The current backlog for a patent approval is 15.6 months. Information Technology

firms have applied for a significant number of patents each year. Here are the top five I.T. firms in terms of patent applications filed since 2009. The percent indicate the percent of total I.T. patents filed since 2009. Notice that over half of patent filings come from just these five corporations.

- International Business Machines (IBM) 21.6%
- Microsoft Corporation 14.2% • AT & T, Inc. 7.1%
- Alphabet (Google), Inc. 5.0%
- Sony Corporation 4.7%

You might have noticed that Apple is not in the top five listing. Microsoft holds the lead in Artificial Intelligence (AI) patents.

5.1.16 Sidebar: What Is a Patent Troll?

The advent of digital technologies has led to a large increase in patent filings and therefore a large number of patents being granted. Once a patent is granted, it is up to the owner of the patent to enforce it. If someone is found to be using the invention without permission, the patent holder has the right to sue to force that person to stop and to collect damages.

The rise in patents has led to a new form of profiteering called patent trolling. A patent troll is a person or organization who gains the rights to a patent but does not actually make the invention that the patent protects. Instead, the patent troll searches for those who are illegally using the invention in some way and sues them. In many cases the infringement being alleged is questionable at best. For

example, companies have been sued for using Wi-Fi or for scanning documents, technologies that have been on the market for many years.

Recently, the U.S. government has begun taking action against patent trolls. Several pieces of legislation are working their way through the U.S. Congress that will, if enacted, limit the ability of patent trolls to threaten innovation. You can learn a lot more about patent trolls by listening to a detailed investigation conducted by the radio program This American Life, by clicking this link.

5.1.17 Trademark

Apple logo

A trademark is a word, phrase, logo, shape or sound that identifies a source of goods or services. For example, the Nike "Swoosh," the Facebook "f", and Apple's apple (with a bite taken out of it) are all trademarked. The concept behind trademarks is to protect the consumer. Imagine going to the local shopping center to purchase a specific item from a specific store and finding that there are several stores all with the same name!

Two types of trademarks exist – a common law trademark and a registered trademark. As with copyright, an organization will automatically receive a trademark if a word, phrase, or logo is being used in the normal course of business (subject to some restrictions, discussed below). A common law trademark is designated by placing "TM" next to the trademark. A registered trademark is one that has been examined, approved, and registered with the

trademark office, such as the Patent and Trademark Office in the US. A registered trademark has the circle-R (®) placed next to the trademark.

While most any word, phrase, logo, shape, or sound can be trademarked, there are a few limitations. A trademark will not hold up legally if it meets one or more of the following conditions:

- The trademark is likely to cause confusion with a mark in a registration or prior application.
- The trademark is merely descriptive for the goods/services. For example, trying to register the trademark “blue” for a blue product you are selling will not pass muster.
- The trademark is a geographic term.
- The trademark is a surname. You will not be allowed to trademark “Smith’s Bookstore.”
- The trademark is ornamental as applied to the goods. For example, a repeating flower pattern that is a design on a plate cannot be trademarked.

As long as an organization uses its trademark and defends it against infringement, the protection afforded by it does not expire. Because of this, many organizations defend their trademark against other companies who’s branding even only slightly copies their trademark. For example, Chick-fil-A has trademarked the phrase “Eat Mor Chikin” and has vigorously defended it against a small business using the slogan “Eat More Kale.” Coca-Cola has trademarked the contour shape of its bottle and will bring legal action against any company using a bottle design similar to theirs. Examples of trademarks that have been

diluted and have now lost their protection in the US include: “aspirin” (originally trademarked by Bayer), “escalator” (originally trademarked by Otis), and “yoyo” (originally trademarked by Duncan).

5.1.18 Information Systems and Intellectual Property

The rise of information systems has resulted in rethinking how to deal with intellectual property. From the increase in patent applications swamping the government’s patent office to the new laws that must be put in place to enforce copyright protection, digital technologies have impacted our behavior.

5.1.19 Privacy

The term privacy has many definitions, but for purposes here, privacy will mean the ability to control information about oneself. The ability to maintain our privacy has eroded substantially in the past decades, due to information systems.

5.1.20 Personally Identifiable Information

Information about a person that can be used to uniquely establish that persons identity is called personally identifiable information, or PII. This is a broad category that includes information such as:

- Name;
- Social Security Number;
- Date of birth;
- Place of birth;
- Mother‘s maiden name;

- Biometric records (fingerprint, face, etc.);
- Medical records;
- Educational records;
- Financial information; and
- Employment information.

Organizations that collect PII are responsible to protect it. The Department of Commerce recommends that “organizations minimize the use, collection, and retention of PII to what is strictly necessary to accomplish their business purpose and mission.” They go on to state that “the likelihood of harm caused by a breach involving PII is greatly reduced if an organization minimizes the amount of PII it uses, collects, and stores.”10 Organizations that do not protect PII can face penalties, lawsuits, and loss of business. In the US, most states now have laws in place requiring organizations that have had security breaches related to PII to notify potential victims, as does the European Union.

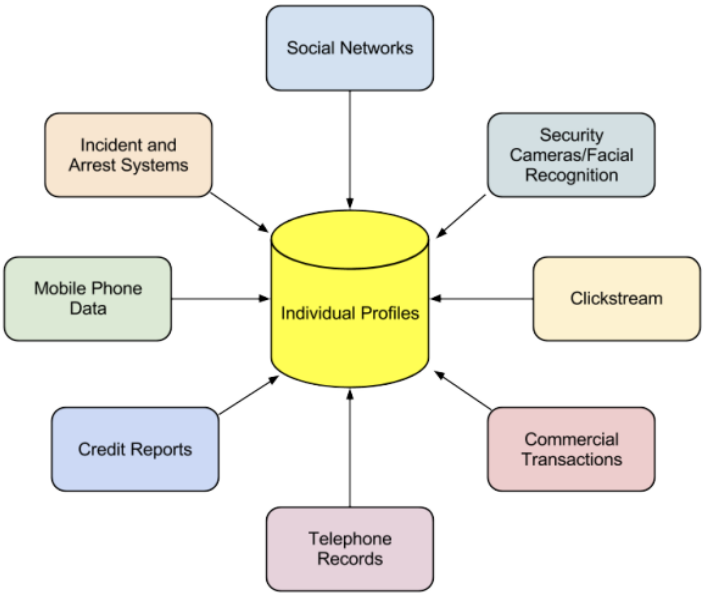
Just because companies are required to protect your information does not mean they are restricted from sharing it. In the US, companies can share your information without your explicit consent (see the following sidebar), though not all do so. Companies that collect PII are urged by the FTC to create a privacy policy and post it on their website. The State of California requires a privacy policy for any website that does business with a resident of the state (see http://www.privacy.ca.gov/lawenforcement/laws.htm).

While the privacy laws in the US seek to balance consumer protection with promoting commerce, privacy in the European Union is considered a

fundamental right that outweighs the interests of commerce. This has led to much stricter privacy protection in the EU, but also makes commerce more difficult between the US and the EU.

5.1.21 Non-Obvious Relationship Awareness

Digital technologies have given people many new capabilities that simplify and expedite the collection of personal information. Every time a person comes into contact with digital technologies, information about that person is being made available. From location to web-surfing habits, your criminal record to your credit report, you are constantly being monitored. This information can then be aggregated to create profiles of each person.



Non-obvious relationship awareness (NORA)

While much of the information collected was available in the past, collecting it and combining it took time and effort. Today, detailed information about a person is available for purchase from different companies. Even information not categorized as PII can be aggregated in such a way that an individual can be identified.

This process of collecting large quantities of a variety of information and then combining it to create profiles of individuals is known as Non-Obvious Relationship Awareness, or NORA. First commercialized by big casinos looking to find cheaters, NORA is used by both government agencies and private organizations, and it is big business.

In some settings NORA can bring many benefits such as in law enforcement. By being able to identify potential criminals more quickly, crimes can be solved sooner or even prevented before they happen. But these advantages come at a price, namely, our privacy.

5.1.22 Restrictions on Data Collecting

In the United State the government has strict guidelines on how much information can be collected about its citizens. Certain classes of information have been restricted by laws over time and the advent of digital tools has made these restrictions more important than ever.

Children's Online Privacy Protection Act

Websites that collect information from children under the age of thirteen are required to comply with the Children's Online Privacy Protection Act (COPPA), which is enforced by the Federal Trade Commission (FTC). To comply with COPPA, organizations must make a good-faith effort to determine the age of those accessing their websites and, if users are under thirteen years old, must obtain parental consent before collecting any information.

Family Educational Rights and Privacy Act

The Family Educational Rights and Privacy Act (FERPA) is a US law that protects the privacy of student education records. In brief, this law specifies that parents have a right to their child's educational information until the child reaches either the age of eighteen or begins attending school beyond the high school level. At that point control of the information is given to the child. While this law is not specifically about the digital collection of information on the Internet, the educational institutions that are collecting student information are at a higher risk for disclosing it improperly because of digital technologies.

Health Insurance Portability and Accountability Act

The Health Insurance Portability and Accountability Act of 1996 (HIPAA) singles out records related to health care as a special class of personally identifiable information. This law gives patients specific rights to control their medical records, requires health care providers and others who maintain this information to get specific permission in order to share it, and imposes penalties on the institutions that breach this trust. Since much of this information is now shared via electronic medical records, the protection of those systems becomes paramount.

General Data Protection Regulation

The European Union, in an effort to help people take control over their personal data, passed the General Data Protection Regulation (GDPR) in May 2016. While this protection applies to the countries in the EU, it is having an

GDPR Logo

impact of U.S. companies using the Internet as well. The regulation went into effect May 25, 2018.

EU and non-EU countries have different approaches to protecting the data of individuals. The focus in the U.S. has been on protecting data privacy so that it does not impact commercial interests.

In the EU, the individual's data privacy rights supersede those of business. Under GDPR data cannot be transferred to countries that do not have adequate data protection for individuals. Currently, those countries include, but are not limited to, the United States, Korea, and Japan. While the GDPR applies to countries in the EU, it is having an impact around the world as businesses in other countries seek to comply with this regulation. IEEE Spectrum. Retrieved from https://spectrum.ieee.org/telecom/internet/yourguide-to-the-gdpr11 One week prior to the effective date of May 25, 2018, only 60% of companies surveyed reported they would be ready by the deadline. Information Management retrieved from https://www.informationmanagement.com/opinion/playing-catch-up-with-the-general-dataprotection-regulation12 Clearly, the message of GDPR has gone out around the world. It is likely that greater data protection regulations will forthcoming from the U.S. Congress as well.

Sidebar: Do Not Track

When it comes to getting permission to share personal information, the US and the EU have different approaches. In the US, the "opt- out" model is prevalent. In

this model the default agreement states that you have agreed to share your information with the organization and must explicitly tell them that you do not want your information shared. There are no laws prohibiting the sharing of your data, beyond some specific categories of data such as medical records. In the European Union the “opt-in” model is required to be the default. In this case you must give your explicit permission before an organization can share your information.

To combat this sharing of information, the Do Not Track initiative was created. As its creators explain:

Do Not Track is a technology and policy proposal that enables users to opt out of tracking by websites they do not visit, including analytics services, advertising networks, and social platforms. At present few of these third parties offer a reliable tracking opt out and tools for blocking them are neither user-friendly nor comprehensive. Much like the popular Do Not Call registry, Do Not Track provides users with a single, simple, persistent choice to opt out of third- party web tracking.

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5.2: Computer Security

5.2.1 Introduction

Computer security is a branch of information technology known as information security which is intended to protect computers. Computer security has three main goals:

- Confidentiality: Making sure people cannot acquire information they should not (keeping secrets)
- Integrity: Making sure people cannot change information they should not (protecting data)
- Availability: Making sure people cannot stop the computer from doing its job.

Computer security involves telling computers what they are not to do. This makes computer security unique because most programming makes computers do things. Security takes much of a computers power.

Basic computer security methods (in approximate order of strength) can be:

- Limit access to computers to “safe” users.
- Peripherals which block any “unsafe” activity.
- Firewall and antivirus software.

An example of complexity and pervasiveness of the issue is vending machines, per Hackers Lurking in Vents and Soda Machines April 7, 2014 New York Times.

5.2.1 Malware

Malware takes over computers without a user knowing.

Malware, short for malicious software, is a kind of software that can be installed on a computer without approval from the computer's owner. There are different kinds of malware that can hurt computers, such as viruses and spyware. These programs can steal passwords, delete files, collect personal information, or even stop a computer from working at all. Computer security or anti-malware software is usually good at stopping malware from installing itself. When security software isn't installed, malware can get into the computer. Getting rid of malware can be difficult, even when using programs designed to remove it.

History

People first started writing malware in the 1970s and early 1980s. Computers were very simple then. They did not have any interesting information for malware to take. Instead, people wrote malware for fun[1] or just to show that they could.[2] Even the most common piece of malware from this time did not do damage to people's computers.[3] In fact, malware was so rare that the word "malware" was not coined until 1990.[4]

More people started using the computers in the late 1990s and early 2000s. Computers were getting more complex just as fast.[5] People saw that they could use malware to get useful information now, like passwords and credit card

information. So, more programmers started writing malware. The number of malware programs on the Internet has grown very quickly ever since then the late 1990s and is still growing today.[6] Experts think that 31.5% of the world's computers have some type of malware installed.[7]

Purposes

The main reason people write malware is to hurt others and make money, usually by stealing or deleting important information. The Cryptolocker computer virus, for example, makes it so a person cannot use their own computer until they pay the malware writers for a software key to unlock it.[8] Another virus, CIH, tries to make it so the victim can never use their files or turn on their computer again.[9] Malicious keystroke logging software remembers everything a user types in and gives it to the malware author to read.[10]

World governments have written malware to hurt their enemies. Experts think that the United States government made a virus named Stuxnet to stop an important place in Iran from working.[11] The Chinese government probably used a virus to stop people from protesting its decisions.[12]

How Malware Gets Installed

There are a lot of ways malware can get onto someone's computer. One common way is through email attachments. These attachments are usually sent from other computers that already have malware on them.[13] When someone downloads and opens the attachment, the virus installs and uses their computer to send itself to even more people.

Another way malware installs itself is when a victim gets malware just by going to a website with the malware hidden on it. This is called drive-by downloading. A user does not have to click anything for their computer to get infected from a drive-by download.[14] This kind of malware attack is usually found on websites that are not used a lot or whose security methods are very old. However, even current websites that people use all the time can host drive-by downloads when someone hacks the site.

People who write malware also get their programs onto computers by attaching them to real programs that people want. This is most common with pirated programs. This is because the downloader was doing something illegal and cannot complain to the authorities without getting in trouble themselves.[15] However, some non-piracy websites also put malware (or other unwanted programs that are almost as bad as malware) in a download with real, legal software in a process known as bundling. Computer security experts complain about websites that bundle real software with malware. Their complaints do not always stop the websites from bundling.[16]

Kinds of Malware

There are many different kinds of malware. Each acts a different way.

- Viruses are a kind of malware that need a user-run program to work.[17] They cannot copy themselves or move from one computer to another without a program to host it. Viruses are very common in pirated programs.[18] They can harm computers in many different ways, like deleting files and stealing passwords.[19]

- Worms are a lot like viruses and can cause the same kinds of damage. However, they're able to move through the internet and copy themselves onto computers without help from a host program. This makes them more dangerous than a virus.[20] Worms are usually found in emails and drive-by downloads.[21]
- Trojan horses are like a much more dangerous version of a virus. They need a user to agree to run a program to work and cannot copy themselves from one computer to another. However, trojan horses can make the same problems a normal virus can make. They can also allow the malware writer to control the victim's computer, install more malware, steal bank data, and more.[22] For example, ransomware is a type of trojan horse that stops a victim from using their files until they pay the person who wrote the malware.[23] Experts think that trojan horses are the most common type of malware in existence.[24]
- Adware is a type of malware that earns the program authors money with advertising. These programs show users ads and force them to use websites that make money for the malware writers. Adware will also find personal information about the victim (such as their age, race, and job). This is so the malware authors can sell the information to other people.[25] A user can usually uninstall adware easier than most malware. However, this is still difficult to do without a specially-designed program.[26]

Spyware is a more dangerous kind of adware that steals more information from a user. Spyware can steal someone's Internet traffic, account passwords, and

anything they have typed into their computers. Spyware is also much harder to uninstall than adware is.[27]

Why Computers get Malware

There are a few reasons why computers get programs a user didn't mean to install. One common reason is because of regular programs that have software bugs. Malware can use bugs, such as a buffer overflow, to make a program do something it was not designed to do.[28] Malware can also get onto a computer if it tricks a user into putting it there themselves. This can happen when a user plugs in a USB flash drive that has a virus on it already.[29] Malware also commonly uses social engineering to get users to run it, like pretending to be an important email attachment for work. Some malware even pretends to be an anti-malware program to get people to run it.[30]

How Malware is Stopped

Since malware is such a big problem, many companies make programs to try to stop it. These anti-malware programs have a lot of different ways to find malware. One is static analysis, which looks at the source code of a program before it is run. Then, if the program is similar to malware the static analysis program has seen before, the anti-malware program will stop the code from running. Another way of finding malware is dynamic analysis. Dynamic analysis runs only part of a program it is checking. If this part of the program tries to do anything that could be bad or harmful, the anti-malware program will not let the program run.[31]

Malware can also be stopped without a program. This can be done by not letting a computer connect to the Internet or other computers, called creating an air gap.[32] However, these computers can still get malware if someone puts it there another way. One example is when someone plugs in a USB drive that was already plugged into a computer with a virus.[33]

5.2.2 HTTP Cookie

An HTTP cookie (usually just called a cookie) is a simple computer file made of text. The information stored in cookies can be used to personalize the experience when using a website. A website can use cookies to find out if someone has visited a website before and record information (data) about what they did.

When someone is using a computer to browse a website, a personalized cookie file can be sent from the website's server to the person's computer. The cookie is stored in the web browser on the person's computer. At some time in the future, the person may browse that website again. The website can send a message to the person's browser, asking if a cookie from the website is already stored in the browser. If a cookie is found, then the data that was stored in the cookie before can be used by the website to tell the website about the person's previous activity. Some examples where cookies are used include shopping carts, automatic login and remembering which advertisements have already been shown.

Cookies have been a problem for Internet privacy. This is because they can be used to track browsing behavior. Because of this, laws have been made in some

countries to protect people's privacy. There are many other options than cookies, but each option has its own problems.

Cookies have often been mistaken for computer programs. But cookies cannot do much on their own. They are simply a piece of data. They are often called spyware or viruses, but they are not either of these.

Most web browsers allow users to choose whether to accept cookies. If the user does not allow cookies, some websites will become unusable. For example, shopping baskets which use cookies do not work if the user does not allow cookies.

5.2.3 Protocols

Hypertext Transfer Protocol

Hypertext Transfer Protocol (often abbreviated to HTTP) is a communications protocol. It is used to send and receive webpages and files on the internet. It was developed by Tim Berners-Lee and is now coordinated by the W3C. HTTP version 1.1 is the most common used version today. It is defined in RFC 2616.

HTTP works by using a user agent to connect to a server. The user agent could be a web browser or spider. The server must be located using a URL or URI. This always contains http:// at the start. It normally connects to port 80 on a computer.

A more secure version of HTTP is called HTTPS. This contains https:// at the beginning of the URL. It encrypts all the information that is sent and received.

This can stop malicious users such as hackers from stealing the information. HTTPS is often used on payment websites.

Request Message

The request message contains the following:

- Request line, such as GET /images/logo.gif HTTP/1.1, which requests the file logo.gif from the /images directory
- Headers, such as Accept-Language: en
- An empty line
- An optional message body

The request line and headers must all end with two characters: a carriage return followed by a line feed, often written <CR><LF>. The empty line must consist of only <CR><LF> and no other whitespace. In the HTTP/1.1 protocol, all headers except Host are optional.

A request line containing only the path name is accepted by servers to maintain compatibility with HTTP clients before the HTTP/1.0 standard. Even this site has a HTTP at its beginning.

Wired Equivalent Privacy

Wired Equivalent Privacy (also known as WEP) is a standard to use encryption in Wireless LANs. It was introduced in 1999.

In 2001, mathematicians showed that WEP is not very strong. A WEP connection could be decoded, with software that can be easily found, within minutes.[34] Because of this finding, IEEE created a new 802.11i group to fix the problems. By

2003, the Wi-Fi Alliance announced that Wi-Fi Protected Access (WPA) would replace WEP, which was a subset of then upcoming 802.11i amendment. Finally in 2004, they made it official and said that it would go ahead. It was part of the full 802.11i standard (also known as WPA2), the IEEE declared that both WEP-40 and WEP-104 are not recommended because they are not secure enough.[35]

Even though it only offers low security, WEP is still widely in use.[36] WEP is often the first security choice presented to users by router configuration tools even. Today, WEP provides a level of security that deters only accidental use. As a result, people can invade and enter the network.[37]

People sometimes call it Wireless Encryption Protocol, which is wrong.

Wi-Fi Protected Access

Wi-Fi Protected Access (also known as WPA and WPA2) is the name for a number of standards to use encryption on a Wireless LAN. The standards were created because researchers had found several weaknesses in Wired Equivalent Privacy. Wired Equivalent Privacy, or WEP was the standard that came before it. The protocol WPA2 implements most of the standard IEEE 802.11i.

Products that have the label WPA were designed to work with most cards, even those that came out before there was WPA. This is not true for access points though.

Products with the WPA2 implement all of the standard. This is more secure, but it may not work with some older cards.

5.2.4 Protection

Encryption

Encryption is a method which allows information (for example, a secret message) to be hidden so that it cannot be read without special knowledge (such as a password). Once this is done, using a secret code or cypher, the information is encrypted. Decryption is a way to change an encrypted piece of information back into unencrypted form. This is called the decrypted form. The study of encryption is called cryptography.

Examples

A simple kind of encryption for words is ROT13. In ROT13, letters of the alphabet are changed with each other using a simple pattern. For example, A changes to N, B changes to O, C changes to P, and so on. Each letter is “rotated” by 13 spaces. Using the ROT13 cipher, the words Simple English Wikipedia becomes Fvzcyr Ratyvfu Jvxvcrqvn. The ROT13 cipher is very easy to decrypt. Because there are 26 letters in the English alphabet, if a letter is rotated two times by 13 letters each time, the original letter will be obtained. So applying the ROT13 cipher a second time brings back the original text. When he communicated with his army, Julius Caesar sometimes used what is known as Caesar cipher today. This cipher works by shifting the position of letters: each letter is rotated by 3 positions.

Most kinds of encryption are more complex. Some are made only for text. Others are made for binary computer files like pictures and music. Today, the

asymmetric encryption system used the most is RSA. Any computer file can be encrypted with RSA. AES is a common symmetric algorithm.

One-Time Pad

Most types of encryption can theoretically be cracked: an enemy might be able to decrypt a message without knowing the password, if he has clever mathematicians, powerful computers and lots of time. The one-time pad is special because, if it is used correctly, it is impossible to crack. There are three rules that must be followed:

- The secret key (password) must be longer than the secret message: if the message has 20 letters then the key must also have at least 20 letters.
- The secret key must be a random list of letters (e.g. KQBWLDA…)
- The secret key must only be used once. To send more than one message, a different key must be used for each one.

If these three rules are obeyed, then it is impossible to read the secret message without knowing the secret key. For this reason, during the Cold War, embassies and large military units often used one-time pads to communicate secretly with their governments. They had little books (“pads”) filled with random letters or random numbers. Each page from the pad could only be used once: this is why it is called a “one-time pad”.

Encryption on the Internet

Encryption is often used on the Internet, as many web sites use it to protect private information. On the Internet, several encryption protocols are used, such

as Secure Sockets Layer (SSL), IPsec, andSSH. They use the RSA encryption system and others. The protocol for protected web browsing is called HTTPS. Mostly URL encryption contain MD5 Algorithm. Various algorithms are used in the internet market depending upon the need.

Antivirus Software

Antivirus software, if properly installed on a computer system, can prevent access to computer systems by unwanted computer programs. Viruses, worms or Trojan Horses can be used by criminals or mischievous people (called Crackers). They can be used to steal information or damage computer systems. If no antivirus software is installed, hackers may be able to access the information in the computer.

Most tests and experts claim that antivirus software is unable to prevent all attacks.[38] There are many different types of antivirus software. Many Antivirus programs can be downloaded for free. These versions usually have some features missing. The missing features are only available to those who buy the "full" version.

Antivirus software uses many ways to protect the computer. They often search for signs of viruses in every website that is visited. Most also do a regular scan of all the data and files on the computer's hard disk.

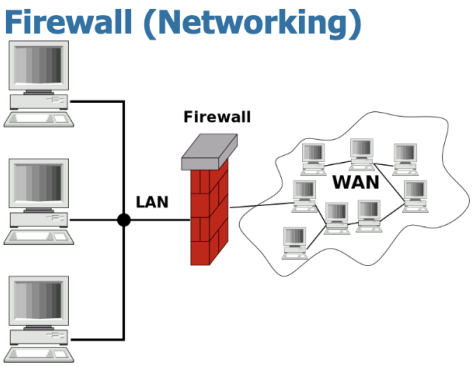
Installing more than one antivirus is not a good idea. The 2 different antivirus software can interfere with each other.

Problems with Antivirus Software

Antivirus software can not always detect all viruses on a computer.

Sometimes antivirus software sees viruses in files that do not really have viruses. This is called a false positive.[39] The antivirus software will sometimes remove files from the computer that should not be removed. This may cause other programs to not work properly.

Firewall (Networking)



A Firewall protects a number of computers on a LAN against unauthorised access.

Originally, a firewall was a wall that was built to stop (or slow down) the spread of a fire. In terms of computer security, a firewall is a piece of software. This software monitors the network traffic. A firewall has a set of rules which are applied to each packet. The rules decide if a packet can pass, or whether it is discarded. Usually a firewall is placed between a network that is trusted, and one that is less trusted. When a large network needs to be protected, the firewall software often runs on a dedicated hardware, which does nothing else.

A firewall protects one part of the network against unauthorized access.

Different Kinds of Firewalls

- **Packet filtering**. Data travels on the internet in small pieces; these are called packets. Each packet has certain metadata attached, like where it is coming from, and where it should be sent to. The easiest thing to do is to

look at the metadata. Based on rules, certain packets are then dropped or rejected. All firewalls can do this.it is known as network layer

- **Stateful packet inspection**. In addition to the simple packet filtering (above) this kind of firewall also keeps track of connections. A packet can be the start of a new connection, or it can be part of an existing connection. If it is neither of the two, it is probably useless and can be dropped.
- **Application-layer firewalls**. Application-layer firewalls do not just look at the metadata; they also look at the actual data transported. They know how certain protocols work, for example FTP or HTTP. They can then look if the data that is in the packet is valid (for that protocol). If it is not, it can be dropped.

Other Things Firewalls Are Used For

Firewalls can provide a secure connection between two networks. This is called tunnelling. The data may be encrypted. It is unencrypted at the other end. Since the firewalls are doing this, the rest of the network is unaware of it. An alternative is to provide a secure access (to the corporate network).

Network Address Translation

Very often, firewalls can translate IP addresses. That way, many computers can share a few public IP addresses. The firewall translates between the public and the private IP addresses.

Types of Firewalls

In general, there are two types of firewalls:

- Software-based firewalls: these are often run as additional programs on computers that are used for other things. They are often known as personal firewalls which can be updates on personal computers.
- Hardware-based firewalls: Hardware based firewalls run on a dedicated computer (or appliance). Often, these offer a better performance than software firewalls, but they are also more expensive.

What Firewalls Cannot Protect Against

Firewalls can protect against some problems (viruses and attacks) that come from the internet. They cannot protect against viruses, that come from infected media (like an infected office document on an USB flash drive).

5.2.5 Backup


This computer was used to store files, before the fire hit

A backup is a copy of some data. This copy can be used when the original data is changed, or lost. Losing data is common: A 2008 survey found that two thirds of respondents had lost files on their home PC.[40] Another purpose of backing up data is to have a copy that represents an earlier state of the data, before it was changed. Organizations may have rules which state how long data should be kept, and what kinds of data these rules apply to. In many countries, there are rules that specify that certain kinds of data need to be kept for a given time. An example of this is the data used for accounting.

Backups are a simple form of disaster recovery. Even though they are commonly seen as disaster recovery, they should be part of a disaster recovery plan. A disaster recovery plan is a documented set of procedures and tasks to perform to protect the consistency and integrity of a corporate IT system.

Different Backup Media

A portable hard drive

There are different types of backup systems that use different kinds of media. Common backup media includes:

- Different kinds of tapes, for example Digital Audio Tape, or LTO
- Hard disks
- Optical disks like CDs and DVDs
- Magneto-Optical Discs
- Emails

Some of the backup media are portable, and can easily be stored in a safe location. The problem with storing tapes in a bank safe, for example is that they are only available during the opening hours of the bank.

Another issue has commonly been the speed of the backup. Media such as digital tapes can store a lot of data, but accessing them is realtively slow. Tapes can only be read or written in sequence, while media such as hard disks or optical drives are basically random access. When data is backed up, its encoding

is often changed. This makes it possible to use codes such as Cyclic redundancy checks, which can detect, and sometimes repair an error.

Reasons for Doing a Backup

Backups are usually done for one of the following reasons:

- Prevent data loss if there is a disaster (like a fire or hardware failure, or an intentional or unintentional deletion)
- Computer viruses or other programs make data unusable
- There is a logical error in the data
- Sudden computer shutdown which can be caused by power shortage.

Different Types of Backup

- A full backup copies all of the data. This means that if the main copy of the data is lost, we can bring it all back simply by copying the data back from the backup.
- A differential backup only copies the data that has changed since the last full backup. The reason we do this is that sometimes only a small amount of data has changed since the last full backup; this means we can do a differential backup much more quickly. If someone loses their data, and needs to get it back from a differential backup, they need to use the last full backup, to bring back all of their data. They then need to use the last differential backup to bring back everything that was changed between the full backup and the differential backup.

- An incremental backup only copies the data that has changed since the last incremental backup. This makes each backup quicker, because we are only copying what has changed since the last backup. To bring the data back, if the main copy of the data is lost, we need the last full backup, as well as all of the incremental backups that have been done since then. This means that bringing data back from an incremental backup is slower and more risky than differential or full backups.

How Long to Keep a Backup

The Grandfather-father-son system means that we keep different types of backup for different amounts of time. For example, we might do a backup every day, and keep a week's worth of backups. We might then keep one backup for each week for a month, and one backup from each month for a year. This means that we have a backup of our data from a year ago, so that if we realise we need some data from a long time ago, we have that data available. We also have several copies of our recent data, in case one of them doesn't work.

End of Chapter Summary

- This chapter navigates the ethical dimensions and privacy implications stemming from the influence of information systems.
- The text introduces the ACM's Code of Ethics and discusses the merits and drawbacks of such codes, drawing parallels with Acceptable Use Policies.
- Intellectual property, crucially affected by digital advancements, is examined in detail, emphasizing copyright, patent, and trademark protections.
- The chapter also scrutinizes patents and the emergence of patent trolls.
- Concluding, it underscores the evolving landscape of ethics and privacy, emphasizing the ongoing need for adaptation to confront emerging challenges.
- This chapter provides a comprehensive overview of computer security, covering the fundamental goals of confidentiality, integrity, and availability.
- Dives into security measures like access restrictions, peripherals, firewalls, and antivirus software.
- Encryption methods, including ROT13, RSA, AER, and the one-time pad are highlighted for secure communication.
- The role and limitations of antivirus software are outlined, and firewalls are introduced, emphasizing their functions in network security.
- This section on backups underscores their importance in data management and disaster recovery, addressing various types of backup media, reasons for performing backups, and strategies like the grandfather-father-son system for effective backup management over time.

Security Summary

- This chapter provides a comprehensive overview of computer security, covering the fundamental goals of confidentiality, integrity, and availability.
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- The role and limitations of antivirus software are outlined, and firewalls are introduced, emphasizing their functions in network security.
- This section on backups underscores their importance in data management and disaster recovery, addressing various types of backup media, reasons for performing backups, and strategies like the grandfather-father-son system for effective backup management over time.

Key Terms

"Safe harbor" Provision: limits the liability of online service providers when someone using their services commits copyright infringement.

Acceptable User Policy (AUP):

Antivirus software: if properly installed on a computer system, can prevent access to computer systems by unwanted computer programs.

Backup: a copy of some data.

Children's Online Privacy Protection Act (COPPA): required the federal trade commission to issue and enforce regulations concerning children's online privacy.

Code of Ethics: a set of official standards of conduct that the members of a group are expected to uphold.

Common law trademark: is a trademark established solely through use in commerce in a specific geographical area.

Computer Security: is a branch of information technology known as information security which intended to protect computers.

Copyright law: allows the holder of a copyright to authorize someone else to make the work public.

Copyright: the protection given to songs, computer programs, books, and other creative works.

Creative Commons: is a nonprofit organization that provides legal tools for artists and authors.

Decryption: is a way to change an encrypted piece of information back into unencrypted form.

Differential Backup: only copies the data that has changed since the last full back up.

Digital Millennium Copyright Act (DMCA): extended copyright law to take into consideration digital technologies.

Electronic Frontier Foundation (EFF): is the leading nonprofit organization defending civil liberties in the digital world.

Encryption: is a method which allows information to be hidden so that it cannot be read without special knowledge.

Ethical Dilemma: a situation in which a difficult choice has to be made between two courses of action, either of which entails transgressing a moral principle.

Ethics: moral principles that govern a person's behavior or the conducting of an activity.

Family Educational Rights and Privacy Act (FERPA): is a US law that protects the privacy of student education records.

Federal Trade Commission (FTC): a federal agency, established in 1914, that administers antitrust and consumer protection legislation in pursuit of free and fair competition in the marketplace.

Firewall: a part of a computer system or network which is designed to block unauthorized access while permitting outward communication.

Full Backup: copies all of the data.

Grandfather-father-son: means that we keep different types of backup for different amounts of time.

Health Insurance Portability and Accountability Act (HIPAA): this law gives patients specific rights to control their medical records, requires health care providers and

others who maintain this information to get specific permission in order to share it, and imposes penalties on the institutions that breach this trust.

HTTP Cookie: is a simple computer file made of text.

Hypertext Transfer Protocol (HTTP): is a communications protocol. It is used to send and receive webpages and files on the internet.

Incremental backup: only copies the data that has changed since the last incremental backup.

Malware (Malicious Software): is a kind of software that can be installed on a computer without approval from the computer's owner.

Non-Obvious Relationship Awareness (NORA): process of collecting large quantities of a variety of information then combining it to create profiles of individuals.

Patents: creates protection for someone who invents a new product or process.

Personally Identifiable Information (PII): information about a person that can be used to uniquely establish that persons identity.

Privacy: means the ability to control information about oneself.

Registered trademark: the name or symbol of a product or company, shown by the sign ®, which is officially recorded and cannot legally be used by another producer or company.

Trademark: a word, phrase, logo, shape or sound that identifies a source of goods or services.

User Agent: a computer program representing a person. (*Example: a browser in a web context.)*

Wi-Fi Protected Access (WPA): is the name for a number of standards to use encryption on a Wireless LAN.

Wired Equivalent Privacy (WEP): is a standard to use encryption in Wireless LANs.

End of Chapter Discussions

1. What is the meaning of the term “Information systems ethics”?
2. What safeguards are offered by a patent, and how can one be obtained?
3. What safeguards are offered by copyright, and how can one be obtained?
4. Reflecting on your code of ethics, would you initiate a business with the same ethical principles. What is one advantage or disadvantage of having a code of ethics?
5. When considering computer security, what are the three primary objectives?
6. What are some fundamental methods for computer security that can be employed?
7. What types of malwares exist, and which is considered the more effective option?
8. Do you consider it essential to back up your electronic data? What are the primary reasons for implementing a backup?

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6: ERP, CRM , System and Application Software Programs

Chapter Learning Outcomes:

1. Define and explain the key components of an Enterprise Resource Planning (ERP) system.
2. Assess the advantages and challenges associated with implementing an ERP system in an organization.
3. Define and identify application software and its purpose to achieve specific goals.
4. Ability to list and explain the functions of various productivity applications.
5. Gain awareness of the legal aspects of software ownership and licensing.
6. Introduced to CRM systems as software applications designed to manage customer relationships.

Chapter 6: ERP Systems

6.1 Introduction

An enterprise resource planning (ERP) system is a software application with a centralized database that can be used to run an entire company. Let's take a closer look at the definition of each of these components:

- An ERP system
- A software application: The system is a software application, which means that it has been developed with specific logic and rules behind it. It has to

be installed and configured to work specifically for an individual organization.

- With a centralized database: All data in an ERP system is stored in a single, central database. This centralization is key to the success of an ERP – data entered in one part of the company can be immediately available to other parts of the company.
- That can be used to run an entire company: An ERP can be used to manage an entire organization's operations. If they so wish, companies can purchase modules for an ERP that represent different functions within the organization, such as finance, manufacturing, and sales. Some companies choose to purchase many modules, others choose a subset of the modules.

An ERP system not only centralizes an organization's data, but the processes it enforces are the processes the organization adopts. When an ERP vendor designs a module, it has to implement the rules for the associated business processes. A selling point of an ERP system is that it has best practices built right into it. In other words, when an organization implements an ERP, it also gets improved best practices as part of the deal!

For many organizations, the implementation of an ERP system is an excellent opportunity to improve their business practices and upgrade their software at the same time. But for others, an ERP brings them a challenge: Is the process embedded in the ERP really better than the process they are currently utilizing? And if they implement this ERP, and it happens to be the same one that all of

their competitors have, will they simply become more like them, making it much more difficult to differentiate themselves?

Registered trademark of SAP

This has been one of the criticisms of ERP systems: that they commoditize business processes, driving all businesses to use the same processes and thereby lose their uniqueness. The good news is that ERP systems also have the capability to be configured with custom processes. For organizations that want to continue using their own processes or even design new ones, ERP systems offer ways to support this through the use of customizations.

But there is a drawback to customizing an ERP system: organizations have to maintain the changes themselves. Whenever an update to the ERP system comes out, any organization that has created a custom process will be required to add that change to their ERP. This will require someone to maintain a listing of these changes and will also require retesting the system every time an upgrade is made. Organizations will have to wrestle with this decision: When should they go ahead and accept the best-practice processes built into the ERP system and when should they spend the resources to develop their own processes? It makes the most sense to only customize those processes that are critical to the competitive advantage of the company.

Some of the best-known ERP vendors are SAP, Microsoft, and Oracle.

Section Attributions

6.2 Application Software

6.2.1 Application Software

The second major category of software is application software. Application software is, essentially, software that allows the user to accomplish some goal or purpose. For example, if you have to write a paper, you might use the application-software program Microsoft Word. If you want to listen to music, you might use iTunes. To surf the web, you might use Internet Explorer or Firefox. Even a computer game could be considered application software.

6.2.2 The "Killer" App

VisiCalc running on an Apple II. (Public Domain)

When a new type of digital device is invented, there are generally a small group of technology enthusiasts who will purchase it just for the joy of figuring out how it works. However, for most of us, until a device can actually do something useful we are not going to spend our hard-earned money on it. A "killer" application is one that becomes so essential that large numbers of people will buy a device just to run that application. For the personal computer, the killer application was the spreadsheet. In 1979, VisiCalc, the first personal-computer spreadsheet package, was introduced. It was an immediate hit and drove sales of the Apple II. It also solidified the value of the personal computer beyond the relatively small

circle of technology geeks. When the IBM PC was released, another spreadsheet program, Lotus 1-2-3, was the killer app for business users.

6.2.3 Productivity Software

Along with the spreadsheet, several other software applications have become standard tools for the workplace. These applications, called productivity software, allow office employees to complete their daily work. Many times, these applications come packaged together, such as in Microsoft's Office suite. Here is a list of these applications and their basic functions:

- Word processing: This class of software provides for the creation of written documents. Functions include the ability to type and edit text, format fonts and paragraphs, and add, move, and delete text throughout the document. Most modern word-processing programs also have the ability to add tables, images, and various layout and formatting features to the document. Word processors save their documents as electronic files in a variety of formats. By far, the most popular word-processing package is Microsoft Word, which saves its files in the DOCX format. This format can be read/written by many other word-processor packages.
- Spreadsheet: This class of software provides a way to do numeric calculations and analysis. The working area is divided into rows and columns, where users can enter numbers, text, or formulas. It is the formulas that make a spreadsheet powerful, allowing the user to develop complex calculations that can change based on the numbers entered. Most spreadsheets also include the ability to create charts based on the

data entered. The most popular spreadsheet package is Microsoft Excel, which saves its files in the XLSX format. Just as with word processors, many other spreadsheet packages can read and write to this file format.

- Presentation: This class of software provides for the creation of slideshow presentations. Harkening back to the days of overhead projectors and transparencies, presentation software allows its users to create a set of slides that can be printed or projected on a screen. Users can add text, images, and other media elements to the slides. Microsoft's PowerPoint is the most popular software right now, saving its files in PPTX format.
- Some office suites include other types of software. For example, Microsoft Office includes Outlook, its e-mail package, and OneNote, an information-gathering collaboration tool. The professional version of Office also includes Microsoft Access, a database package. (Databases are covered more in a different chapter)

Microsoft popularized the idea of the office-software productivity bundle with their release of Microsoft Office. This package continues to dominate the market and most businesses expect employees to know how to use this software. However, many competitors to Microsoft Office do exist and are compatible with the file formats used by Microsoft (see table below). Recently, Microsoft has begun to offer a web version of their Office suite. Similar to Google Drive, this suite allows users to edit and share documents online utilizing cloud-computing technology. Cloud computing will be discussed later in this chapter.

Comparison of office application software suites

6.2.4 *Utility Software and Programming Software*

Two subcategories of application software worth mentioning are utility software and programming software. Utility software includes software that allows you to fix or modify your computer in some way. Examples include antivirus software and disk defragmentation software. These types of software packages were invented to fill shortcomings in operating systems. Many times, a subsequent release of an operating system will include these utility functions as part of the operating system itself.

Programming software is software whose purpose is to make more software. Most of these programs provide programmers with an environment in which they can write the code, test it, and convert it into the format that can then be run on a computer.

6.2.5 *Sidebar: "PowerPointed" to Death*

As presentation software, specifically Microsoft PowerPoint, has gained acceptance as the primary method to formally present information in a business setting, the art of giving an engaging presentation is becoming rare. Many presenters now just read the bullet points in the presentation and immediately bore those in attendance, who can already read it for themselves.

The real problem is not with PowerPoint as much as it is with the person creating and presenting. Author and thinker Seth Godin put it this way: "PowerPoint could be the most powerful tool on your computer. But it's not. It's actually a dismal failure. Almost every PowerPoint presentation sucks rotten eggs."[1] The software used to help you communicate should not duplicate the presentation you want to

give, but instead it should support it. I highly recommend the book Presentation Zen by Garr Reynolds to anyone who wants to improve their presentation skills.

Software developers are becoming aware of this problem as well. New digital presentation technologies are being developed, with the hopes of becoming "the next PowerPoint." One innovative new presentation application is Prezi. Prezi is a presentation tool that uses a single canvas for the presentation, allowing presenters to place text, images, and other media on the canvas, and then navigate between these objects as they present. Just as with PowerPoint, Prezi should be used to supplement the presentation. And we must always remember that sometimes the best presentations are made with no digital tools.

6.2.6 Sidebar: I Own This Software, Right? Well . . .

When you purchase software and install it on your computer, are you the owner of that software? Technically, you are not! When you install software, you are actually just being given a license to use it. When you first install a software package, you are asked to agree to the terms of service or the license agreement. In that agreement, you will find that your rights to use the software are limited. For example, in the terms of the Microsoft Office Excel 2010 software license, you will find the following statement: "This software is licensed, not sold. This agreement only gives you some rights to use the features included in the software edition you licensed."

For the most part, these restrictions are what you would expect: you cannot make illegal copies of the software and you may not use it to do anything illegal. However, there are other, more unexpected terms in these software agreements.

For example, many software agreements ask you to agree to a limit on liability. Again, from Microsoft: “Limitation on and exclusion of damages. You can recover from Microsoft and its suppliers only direct damages up to the amount you paid for the software. You cannot recover any other damages, including consequential, lost profits, special, indirect or incidental damages.” What this means is that if a problem with the software causes harm to your business, you cannot hold Microsoft or the supplier responsible for damages.

6.2.7 Applications for the Enterprise

As the personal computer proliferated inside organizations, control over the information generated by the organization began splintering. Say the customer service department creates a customer database to keep track of calls and problem reports, and the sales department also creates a database to keep track of customer information. Which one should be used as the master list of customers? As another example, someone in sales might create a spreadsheet to calculate sales revenue, while someone in finance creates a different one that meets the needs of their department. However, it is likely that the two spreadsheets will come up with different totals for revenue. Which one is correct? And who is managing all of this information?

Enterprise Resource Planning

In the 1990s, the need to bring the organization’s information back under centralized control became more apparent. The enterprise resource planning (ERP) system (sometimes just called enterprise software) was developed to bring together an entire organization in one software application. Simply put, an

ERP system is a software application utilizing a central database that is implemented throughout the entire organization. Let's take a closer look at this definition:

- "A software application": An ERP is a software application that is used by many of an organization's employees.
- "utilizing a central database": All users of the ERP edit and save their information from the data source. What this means practically is that there is only one customer database, there is only one calculation for revenue, etc.
- "that is implemented throughout the entire organization": ERP systems include functionality that covers all of the essential components of a business. Further, an organization can purchase modules for its ERP system that match specific needs, such as manufacturing or planning.

Registered trademark of SAP

ERP systems were originally marketed to large corporations. However, as more and more large companies began installing them, ERP vendors began targeting mid-sized and even smaller businesses. Some of the more well-known ERP systems include those from SAP, Oracle, and Microsoft.

In order to effectively implement an ERP system in an organization, the organization must be ready to make a full commitment. All aspects of the organization are affected as old systems are replaced by the ERP system. In general, implementing an ERP system can take two to three years and several

million dollars. In most cases, the cost of the software is not the most expensive part of the implementation: it is the cost of the consultants!

So why implement an ERP system? If done properly, an ERP system can bring an organization a good return on their investment. By consolidating information systems across the enterprise and using the software to enforce best practices, most organizations see an overall improvement after implementing an ERP. Business processes as a form of competitive advantage will be covered in a different chapter.

6.2.8 Sidebar: Y2K and ERP

The initial wave of software-application development began in the 1960s, when applications were developed for mainframe computers. In those days, computing was expensive, so applications were designed to take as little space as possible. One shortcut that many programmers took was in the storage of dates, specifically the year. Instead of allocating four digits to hold the year, many programs allocated two digits, making the assumption that the first two digits were "19". For example, to calculate how old someone was, the application would take the last two digits of the current year (for 1995, for example, that would be "95") and then subtract the two digits stored for the birthday year ("65" for 1965). 95 minus 65 gives an age of 30, which is correct.

However, as the year 2000 approached, many of these "legacy" applications were still being used, and businesses were very concerned that any software applications they were using that needed to calculate dates would fail. To update our age-calculation example, the application would take the last two digits of the

current year (for 2012, that would be “12″) and then subtract the two digits stored for the birthday year (“65″ for 1965). 12 minus 65 gives an age of -53, which would cause an error. In order to solve this problem, applications would have to be updated to use four digits for years instead of two. Solving this would be a massive undertaking, as every line of code and every database would have to be examined.

This is where companies gained additional incentive to implement an ERP system. For many organizations that were considering upgrading to ERP systems in the late 1990s, this problem, known as Y2K (year 2000), gave them the extra push they needed to get their ERP installed before the year 2000. ERP vendors guaranteed that their systems had been designed to be Y2K compliant – which simply meant that they stored dates using four digits instead of two. This led to a massive increase in ERP installations in the years leading up to 2000, making the ERP a standard software application for businesses.

6.2.9 Customer Relationship Management

A customer relationship management (CRM) system is a software application designed to manage an organization’s customers. In today’s environment, it is important to develop relationships with your customers, and the use of a well-designed CRM can allow a business to personalize its relationship with each of its customers. Some ERP software systems include CRM modules. An example of a well-known CRM package is Salesforce.

6.2.10 Supply Chain Management

Many organizations must deal with the complex task of managing their supply chains. At its simplest, a supply chain is the linkage between an organization's suppliers, its manufacturing facilities, and the distributors of its products. Each link in the chain has a multiplying effect on the complexity of the process: if there are two suppliers, one manufacturing facility, and two distributors, for example, then there are 2 x 1 x 2 = 4 links to handle. However, if you add two more suppliers, another manufacturing facility, and two more distributors, then you have 4 x 2 x 4 = 32 links to manage.

A supply chain management (SCM) system manages the interconnection between these links, as well as the inventory of the products in their various stages of development. A full definition of a supply chain management system is provided by the Association for Operations Management: "The design, planning, execution, control, and monitoring of supply chain activities with the objective of creating net value, building a competitive infrastructure, leveraging worldwide logistics, synchronizing supply with demand, and measuring performance globally."[2] Most ERP systems include a supply chain management module.

Section Attributions

End of Chapter Summary

- This chapter explores Enterprise Resource Planning (ERP) and Customer Relationship Management (CRM) systems, fundamental in computer information science.
- The ERP system is defined as a software application with a centralized database, enabling comprehensive management of an entire company.
- It emphasizes centralizing data and processes, offering best practices and customization options.
- Discussed ERP implementation challenges, costs, and the potential for process commoditization.
- Shifting focus to application software, the text introduces productivity software, including word processing, spreadsheets, and presentation tools.
- The discussion extends to the ownership of software licenses and concerns about limitations and liabilities.
- The ERP's role in centralizing organizational information is highlighted, addressing the need for control and the potential for improved business practices.
- The chapter concludes by introducing CRM systems, emphasizing their role in managing customer relationships, and briefly touching on Supply Chain Management (SCM) within ERP systems.

Key Terms

A “Killer” application: is one that becomes so essential that large numbers of people will buy a device just to run that application.

Customer Relationship Management (CRM): An approach to managing a company’s interactions with current and future customers. It often involves using technology to organize, automate, and synchronize sales, marketing, customer service, and technical support.

Enterprise Resource Planning (ERP): a software application with a centralized database that can be used to run an entire company.

Productivity Software: several software applications that have become standard tools for the workplace. (*Example: spreadsheet, word processing, other Microsoft Office suite applications)*

Programming Software: is a software whose purpose is to make more software.

Supply Chain Management (SCM): the optimization of a product’s creation and flow from raw material sourcing to production, logistics and delivery to the final customer.

Systems Applications and Products (SAP): is a widely-used enterprise resource planning software.

Utility Software: software that allows you to fix or modify your computer in some way. (*Example: antivirus software and disk defragmentation software)*

Chapter Discussions

1. What is the primary purpose of an ERP system?
2. What categories of productivity software exist, and do you personally use any?
3. What functions do CRM systems serve?
4. Can you explain the purpose of supply chain management?

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7: Social & Cloud Computing

Chapter Learning Outcomes:

1. Learners will be able to define cloud computing and recognize its components, including applications, services, and data storage on the Internet.
2. They will gain insights into the convenience of cloud services, such as no software installation, accessibility from any Internet-connected device, scalability, and potential risks associated with data storage on external servers.
3. Ability to understand the transformative potential of cloud technology in managing organizational technology.
4. Ability to understand the fundamental concept of social computing as the intersection of human social behavior and computational systems.
5. They will comprehend the transformative impact of social computing on knowledge access, information sharing, communication efficiency, and cost reduction in both individual and organizational contexts.

Chapter 7.1 Cloud Computing

7.1.1 Introduction

Historically, for software to run on a computer, an individual copy of the software had to be installed on the computer, either from a disk or, more recently, after

being downloaded from the Internet. The concept of “cloud” computing changes this, however.

To understand cloud computing, we first have to understand what the cloud is. “The cloud” refers to applications, services, and data storage on the Internet. These service providers rely on giant server farms and massive storage devices that are connected via Internet protocols. Cloud computing is the use of these services by individuals and organizations.

You probably already use cloud computing in some forms. For example, if you access your e-mail via your web browser, you are using a form of cloud computing. If you use Google Drive’s applications, you are using cloud computing. While these are free versions of cloud computing, there is big business in providing applications and data storage over the web. Salesforce (see above) is a good example of cloud computing – their entire suite of CRM applications are offered via the cloud. Cloud computing is not limited to web applications: it can also be used for services such as phone or video streaming.

7.1.2 Advantages of Cloud Computing

- No software to install or upgrades to maintain.
- Available from any computer that has access to the Internet.
- Can scale to a large number of users easily.
- New applications can be up and running very quickly.
- Services can be leased for a limited time on an as-needed basis.
- Your information is not lost if your hard disk crashes or your laptop is stolen.

- You are not limited by the available memory or disk space on your computer.

7.1.3 Disadvantages of Cloud Computing

- Your information is stored on someone else's computer – how safe is it?
- You must have Internet access to use it. If you do not have access, you're out of luck.
- You are relying on a third-party to provide these services.

Cloud computing has the ability to really impact how organizations manage technology. For example, why is an IT department needed to purchase, configure, and manage personal computers and software when all that is really needed is an Internet connection?

7.1.4 Using a Private Cloud

Many organizations are understandably nervous about giving up control of their data and some of their applications by using cloud computing. But they also see the value in reducing the need for installing software and adding disk storage to local computers. A solution to this problem lies in the concept of a private cloud. While there are various models of a private cloud, the basic idea is for the cloud service provider to section off web server space for a specific organization. The organization has full control over that server space while still gaining some of the benefits of cloud computing.

7.1.5 *Virtualization*

One technology that is utilized extensively as part of cloud computing is "virtualization." Virtualization is the process of using software to simulate a computer or some other device. For example, using virtualization, a single computer can perform the functions of several computers. Companies such as EMC provide virtualization software that allows cloud service providers to provision web servers to their clients quickly and efficiently. Organizations are also implementing virtualization in order to reduce the number of servers needed to provide the necessary services. For more detail on how virtualization works, see this informational page from VMWare.

Section Attribution

Chapter 7.2 Social Computing

Social computing is defined as the intersection of human social behavior and computational systems that reconstruct social conventions to facilitate interaction, informed decision-making, and collaboration. The historical evolution of social computing is traced from early systems like ARPANET and bulletin board systems to the emergence of social networking platforms such as GeoCities, Friendster, and LinkedIn. The integration of web technologies in the mid-1990s led to the migration of online communities, while advancements in compression technology broadened the range of shareable media from text to images and videos.

7.2.1 What is Social Computing?

As you read, Social computing is a prominent branch of computer science, that investigates the dynamic interplay between individuals and computational systems, highlighting the inherently social nature of computing. It encompasses various online activities, contrasting personal computing by emphasizing the social and interactive dimensions. Examples include blogs, wikis, Twitter, and social networking sites, all aimed at enhancing user social engagement with technology. The term "social computing" should not be confused with artificial

intelligence, as its primary focus is to imbue computers with social capabilities and create a more socially engaging experience for users.

7.2.2 Benefits of Social Computing

Social computing brings forth numerous benefits, transforming the way individuals and organizations interact with technology. It accelerates knowledge access and information sharing, leading to more efficient communication. Additionally, it plays a pivotal role in cost reduction by minimizing travel expenses and lowering overall operation costs. In the business realm, social networking facilitates the dissemination of information, reduces interruptions, and connects users with experts, ultimately contributing to increased performance and service quality. The positive impact extends to areas such as enhanced web/mobile business performance, improved marketing strategies, and increased economic revenue.

7.2.3 Types of Social Computing

The study of social computing involves two main research themes: sociological study and applied research. In the realm of computational social science, social networks analysis and the application of computer technology to societal studies take precedence. This involves the use of methods such as agent-based modeling, theoretical physics methods, and graph theory. On the other hand, application-oriented social computing involves the practical application of principles and technologies like communities, social networks, and sociology. This field has evolved through stages such as group software, social software,

and the advent of social media in the Web 2.0 era. Examples include collaborative technologies, social media platforms, and various interactive applications.

The principles constant in social computing systems may have broader applications in the design of networked computer systems. The discussion extends to the importance of cognitive diversity in solving complex problems, citing the rise of the web as a catalyst for research on the "wisdom of crowds" phenomenon. The collective achievement in science and technology is explored, suggesting that diversity and independence play critical roles in advancing fields.

7.2.4 Conclusion

In conclusion, social computing stands at the forefront of technological evolution, fundamentally altering the way individuals, businesses, and societies engage with computational systems. Its broad spectrum, ranging from sociological study to practical application, underscores its significance in shaping the digital landscape. As we navigate the interconnected world of blogs, wikis, social networks, and beyond, the importance of social computing in enhancing innovation, increasing productivity, and improving user relations becomes increasingly evident. This chapter equips learners with a comprehensive understanding of social computing, preparing them for the challenges and opportunities presented by the continually evolving intersection of technology and society.

Future Readings Summary:

James Evans created a resource that elaborated the history, the current, and the future of social computing. He explained the intersection of social computing and Computer Supported Cooperative Work (CSCW), emphasizing a design orientation incorporating social and behavioral sciences to augment productive cooperation with computation. Highlighted the growing research areas within social computing, such as mechanism design in economics, blockchain protocols, and socially intelligent computing, which examines how systems unleash or inhibit collective intelligence.

Evans concluded by posing a design challenge for computer science, considering the potential for diverse weight initialization approaches to enhance the optimization of complex, networked models in deep learning. The overarching theme is the interconnectedness of networking and social computing, offering valuable insights for the design and optimization of future computing systems.

See the full Open Access Peer Reviewed article here as a PDF

See IEEE Xplore: https://ieeexplore.ieee.org/abstract/document/9241509

Reference:

Evans, J. (2020). Social Computing Unhinged. *Journal of Social Computing*, *1*(1), 1–13. https://doi.org/10.23919/JSC.2020.0002

End of Chapter Summary

Chapter 7 of our computer information science textbook covers two essential topics: Cloud Computing and Social Computing.

- In the first section, "Introduction to Cloud Computing," the concept of cloud computing is introduced as a revolutionary shift in how software operates on computers.
- The cloud encompasses applications, services, and data storage on the Internet, utilizing giant server farms.

- The advantages and disadvantages of cloud computing are explored, emphasizing benefits such as easy scalability, quick application deployment, and data security concerns.
- The chapter also delves into private clouds, providing organizations control over their data while enjoying cloud benefits.
- Virtualization, a technology integral to cloud computing, is discussed, allowing a single computer to simulate multiple devices.
- In the second section, Social computing is identified as the convergence of human social behavior and computational systems, reshaping social conventions for interaction, informed decision-making, and collaboration
- Social computing, a vital branch of computer science, explores the dynamic interplay between individuals and computational systems.
- It enhances knowledge access, information sharing, and communication efficiency.
- In conclusion, social computing emerges as a transformative force at the forefront of technological evolution.

Key Terms

Advanced Research Projects Agency Network (ARPANET): the forerunner of the internet, was a pioneering long-haul network funded by the U.S. Department of Defense's Advanced Research Projects Agency.

Cloud computing: the practice of using a network of remote servers hosted on the internet to store, manage, and process data, rather than a local server or a personal computer.

Cloud: refers to applications, services, and data storage on the internet.

Private Cloud: is a cloud computing environment dedicated to a single organization.

Social computing: refers to systems that support the gathering, representation, processing, use, and dissemination of information that is distributed across social collectivities such as teams, communities, organizations, and markets.

Virtualization: the process of using software to simulate a computer or some other device. (*Example: using virtualization, a single computer can perform the functions of several computers)*

Chapter Discussions

1. What are both the advantages and disadvantages of utilizing cloud computing? Give an example.
2. In your own words, explain the concept of social computing.
3. Can you outline some strengths and weaknesses inherent in computing?
4. Where do you see both social and cloud computing happening in your daily life?

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8: Trends in Information Systems

Chapter Learning Outcomes:

1. Define Artificial Intelligence and the history behind AI.
2. Compare machines, humans, and AI.
3. Distinguish between the types of AI and learning methods.
4. Differentiate between the types of extended reality.

Chapter 8: Emerging Technology

8.1 Introduction

Information systems have evolved at a rapid pace ever since their introduction in the 1950s. Today devices that you can hold in one hand are more powerful than the computers used to land a man on the moon in 1969. The last 10 years has seen the proliferation of intelligent devices, devices that can process information and make suggestions or provide responses. How does Netflix seem to know what types of programs or movies we like? How does Amazon post product displays to our account that sparks our interest? How does YouTube seem to provide video feeds that align with what we have previously watched and protect

younger viewers from harmful content? This is achieved through artificial intelligence using algorithms and machine learning.

Artificial intelligence, the ability of a computer or machine to think and learn, and mimic human behavior is changing the way companies do business. AI uses software algorithms to simulate human intelligence processes such as reasoning and speaking within computers and other IoT devices. AI simulates human intelligence processes through robotics, intelligent agents, expert systems, algorithms, and natural-language processing.

This chapter will provide an introduction to artificial intelligence and provide some examples of how businesses are leveraging this technology. It will also explore other types of emerging technology. **Emerging technology** includes new technology and technology that is continuously evolving.

8.2 AI Evolution

To understand where the development of intelligent systems is heading, it is important to explore it's evolution. One of the first articles discussing the possibility of intelligent machines dates back to 1950, when Claude Shannon published Programming a Computer for Playing Chess which discuss the development of a chess playing program.[1]

Around the same time, Alan Turing, a young British mathematician, explored the possibility of artificial intelligence in his 1950 paper, Computing Machinery and Intelligence in which he discussed how to build intelligent machines and how to test their intelligence.

The Turing Test: Can Machines Think?

"Mosaic portrait of Alan Turing" by Charis Tsevis CC-BY-NC-ND 2.0

The Turing Test (referred to as the Imitation Game) attempts to differentiate humans and machines. In the test, a human judge asks a human and a machine questions. If the judge cannot reliably tell the difference between the machine and the human (imitating human behavior), the machine is said to have passed the test, and therefore have the ability to think. There have been criticisms of the test, and Turing responded to some. He stated that he did not intend for the test to measure the presence of "consciousness" or "understanding", as he did not believe this was relevant to the issues that he was addressing. The test is still referred to today.

The first official usage of the term "AI" was in 1956, at which point AI systems were used mainly to solve simple mathematical problems that were too tedious for humans. From 1957 to 1974, AI flourished. Computers could store more information and became faster, cheaper, and more accessible. Machine learning algorithms also improved and people got better at knowing which algorithm to apply to their problem. Early demonstrations such as Newell and Simon's *General Problem Solver* and Joseph Weizenbaum's ***ELIZA*** showed promise toward the goals of problem solving and the interpretation of spoken language respectively.

In the 1980's expert systems, which mimicked the decision making process of a human expert were introduced. The Japanese government heavily funded

expert systems and other AI related endeavors as part of their *Fifth Generation Computer Project* (FGCP).

In 1997, reigning world chess champion and grand master Gary Kasparov was defeated by IBM's *Deep Blue*, a chess playing computer program. In the same year, speech recognition software, developed by Dragon Systems, was implemented on *Windows*. Even human emotion was fair game as evidenced by Kismet, a robot developed by Cynthia Breazeal that could recognize and display emotions.

In 2011, IBM's Watson competed against two "Jeopardy!" winners, Ken Jennings and Brad Rutter, and emerged victorious. In 2014, a Chatbot named Eugene Goostman becomes the first computer that passed the Turing Test developed by Alan Turing himself. In 2017, Google's *Alpha Go* was able to defeat Chinese Go champion Ke Jie.

See some of these major events in the evolution of AI in the timeline below.

Section Attributions

1. Reynoso, R. (2021, May 25). A complete history of artificial intelligence. G2.https://www.g2.com/articles/history-of-artificial-intelligence ↵
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3. https://ecampusontario.pressbooks.pub/informationsystemscdn/chapter/13-2-can-machines-think-n/

8.3 Machines, AI & Humans

Current development of intelligent machines is focused on mimicing human behavior to perform complex tasks. Applications of AI are proliferating, and being integrated into our every day lives. Explore the examples in the activity below. Which of these examples of everyday technology incorporate AI?

8.3.1 Machines vs AI

Machines and AI systems may appear to be the same, but their systems and mode of operation are vastly different.

- Machines that incorporate AI are typically capable of analyzing data, and they appear to “make decisions”, similar to humans.
- Regular machines simply execute a series of commands and are unable to improve based on the data they receive.

Example: Machine vs AI

A great example of the difference between machines and AI systems is the platform Grammarly versus your typical spell check. While a spelling checker is able to correct your spelling, grammar, and punctuation, Grammarly can do all that, as well as check for issues in sentence structure, misused words, and more through the power of AI.

A key distinction between a computer following the code vs an AI system executing this is that with AI, the algorithm would become smarter as more data is entered and the number of errors would decrease over time. AI models are created through **algorithms**, which are a set of rules or processes to solve a specific problem or task.[1]

Example: Algorithm

Imagine you were given some numbers and were tasked with developing an algorithm that sorts the numbers from lowest to highest. What would be the set of steps that you would need to follow to accomplish this task?

One solution would probably be to first define the range of numbers and set some criteria for the computer to follow. Next, write a specific set of instructions on how you would like to order the numbers. For example, you may want the computer to sort the numbers lowest to highest. If there are several datasets, sometimes a **loop,** which is a part of code that allows a command to run again and again would be used to ensure the computer completes the command over and over until all datasets are sorted. The algorithm would then execute the commands one by one and any errors would be attributed to a mistake in the code.

8.3.2 AI vs Humans

The distinction between AI and simple machines has been made, but how is AI different from humans? AI and Humans are different in a number of ways. Apart from humans being biological, live organisms, a key difference is the type and level of intelligence we possess.[2] We are able to make decisions based on our intelligence, emotions, self-awareness, and creativity, whereas most machines simply perform tasks based on code written by programmers. The main goal behind the advancement of machines and computers is to make these systems more efficient and "smarter" to support humans, which is now being accomplished through AI.

However, tasks that involve emotional intelligence or intuition cannot be automated. A machine will make decisions based on facts and statistical data but cannot, for example, recognize emotions, and thus would not be able to make rational decisions. AI lacks the "Human Factor". The table below compares natural (human) and artificial intelligence for a range of different abilities on a scale of achievement (low to high).

Ability	Natural	Artificial
Creativity and imagination	high	low
Learn from experience	high	med
Use sensors	high	med
Adapt to new situations	high	med
Perform complex calculations	high	high
Transfer information	high	high
Perform calculations accurately and efficiently	high	high

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8.4 Types of AI

AI systems are different from humans and machines, and the degree of variation helps in classifying the different types of AI. AI can be classified based on ability, and functionality. There are three categories of AI based on ability: narrow AI, general AI and super AI.

8.4.1 Types of AI: Based on Ability

Types of Artificial Intelligence Based on Ability

Artificial Narrow Intelligence (A.N.I)	A form of weak AI refers to a computer's ability to perform a single task well. This is the type of AI we see today. Natural language processing used in smart assistants like Siri and Google are examples of narrow AI.
Artificial General Intelligence (A.G.I)	A form of strong AI that mimics human intelligence. It means that machines have the ability to apply what they have learned across different tasks, take in new information, and apply reason.
Artificial Super Intelligence (A.S.I)	A form of supernatural AI that exceeds human capabilities.

Despite having developed complex machines and applications such as Siri, Alexa, or other virtual assistants, all AI systems that currently exist are classified as A.N.I. According to a general consensus among researchers, A.G.I and A.S.I are still decades away.[1]

Example: Chatbots

Chat-bots and/or virtual assistants (i.e. Siri, and Alexa) are computer programs that use AI and natural language processing (NLP) to understand customer questions and automate responses to them, simulating human conversation.[2] These bots are cloud-based and able to gather information, such as user preferences or browsing history, to provide solutions that are specific to each individual. Chat-bots improve the individual customer experience as the Cloud is able to provide personalized and relevant information.

In the hospitality industry, Best Western in collaboration with IBM Watson Advertising managed to use AI and NLP to create a more personalized customer experience for those looking to book Best Western hotels for their holidays. Specifically, “Conversations”, an AI-powered advertising model from IBM, was used to provide one-on-one connections and recommend options based on the user’s intent.[3] For example, Conversations was able to provide users with ads containing information on their destination, and other tips and tricks!

8.4.2 Types of AI: Based on Functionality

AI can also be categorized based on functionality: reactive machines, limited memory, theory of mind, and self-awareness.

Categories of Artificial Intelligence Based on functionality include reactive machines, limited memory, theory of mind and self awareness

Reactive Machines	AI that conducts tasks for specific objectives. It is the first step of any AI system where no learning takes place. An example of this type of AI is Deep Blue the IBM program that beat chess champion Garry Kasparov.
Limited Memory	Is the ability of AI to use past experience and information to make predictions.
Theory of Mind	AI with the awareness that others have their own beliefs, objectives, and intentions. This type of AI is not yet developed and will be able to distinguish and understand emotion.
Self-Aware	AI with the sense of self and consciousness. This type of AI is not yet developed.

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8.5 Machine Learning and Deep Learning

Now that you understand how AI systems differ from humans and machines, and their evolutionary arc, the next question is how do they work? Intelligent systems are created through **machine learning** and **deep Learning** techniques. These techniques are used to train, test, and validate AI models that can be implemented into different systems in an effort to automate simple

tasks, process massive amounts of data and even develop new products. Let’s look at the relationship between artificial Intelligence, machine Learning, and deep Learning, as illustrated in the image below. It is important to understand the relationship between these terms as they are similar and can be confusing.

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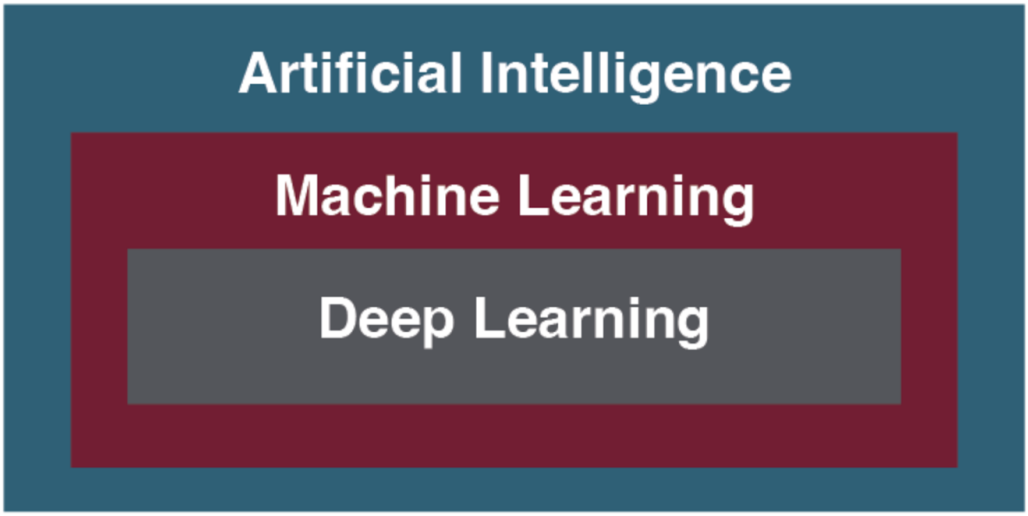
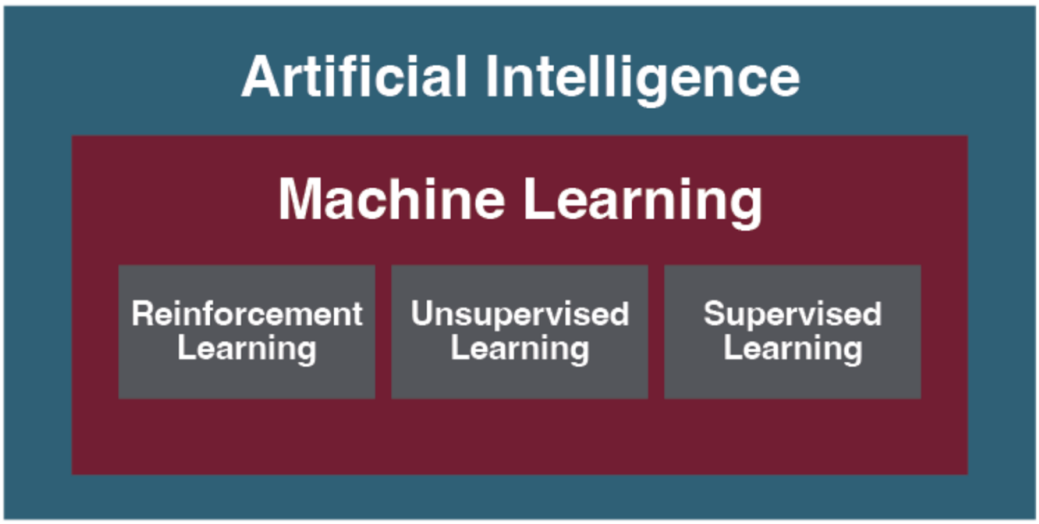


Relationship between AI, Machine Learning and Deep Learning

Artificial Intelligence	Refers to a machine mimicking human behavior.
Machine Learning	A technique in which a computer is able to solve problems using sets of data.
Deep Learning:	A subset of Machine Learning – Deep Learning refers to when computers are able to solve more complex problems that cannot be solved using the traditional Machine Learning method [1]

8.5.1 Machine Learning

Machine learning is a technique that is used by an AI system to analyze data, find patterns and make decisions automatically or with minimal human support. Machine Learning enables a system to sort, organize, and analyze data in order to draw important conclusions and make predictions. Machine learning techniques can be subdivided into three categories: supervised learning, unsupervised learning, and reinforcement learning.



Supervised Learning	The form of Machine Learning in which data is labeled and categorized into groups by humans such as fruits and vegetables or engineers and doctors. Algorithms are used to classify data based on labels. Techniques can include decision trees, neural networks, and regression.
Unsupervised Learning	The form of Machine Learning in which a machine is given unlabelled data and must find its own connections through analysis, clustering, and identifying patterns.
Reinforcement learning	The trial and error-based Machine Learning method in which a machine learns from mistakes and improves upon them. Uses unlabeled data and learns through a series of trial and error actions.

Supervised learning is typically used to create algorithms where the model must learn how the inputs affect the outputs, therefore these models are used in instances like predicting the prices of houses, image classification, and even weather prediction.

AI systems created through **unsupervised learning** algorithms are given unlabelled data and like the human brain, the model is expected to connect information together, sort of like detecting patterns within data sets. The data

given to the machine is unorganized, and the machine does the work of drawing inferences and conclusions from existing data points to sort it out into groups or clusters.

Example: Supervised and Unsupervised Learning

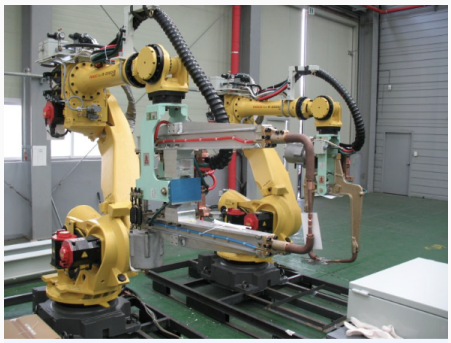
If a company wants to create a new marketing campaign for a particular product line, they may look at data from past marketing campaigns to see which of their consumers responded most favorably. Once the analysis is done, a machine learning model is created that can be used to identify these new customers. It is called “supervised” learning because we are directing (supervising) the analysis towards a result (in our example: consumers who respond favorably).

If a retailer wants to understand purchasing patterns of its customers, an unsupervised learning model can be developed to find out which products are most often purchased together or how to group their customers by purchase history. Is it called “unsupervised” learning because no specific outcome is expected.

Machine learning models can form the core of logistics and supply chain solutions in terms of optimizing the product packet size, delivery vehicle selection, delivery route selection, and delivery time computation. For instance DHL uses Amazon’s Kiva robotics (improve speed, accuracy) for the network management.

Reinforcement learning is similar to how humans learn: they learn from mistakes. Systems created using reinforcement learning become smarter over time as more data is collected, and the machine learns from any mistakes it makes. In this type of algorithm, there is no supervision involved as it is based on a reward or goal-driven system where the machine is rewarded (assigned positive values) for desired behaviors and punished (assigned negative values) for undesired ones. Therefore, this type of algorithm is optimal to be used in instances where a very specific behavior needs to be automatically determined.

Example: Reinforcement Learning



"FANUC robots" by Mixabest CC-BY-SA 3.0

Fanuc, a Japanese industry-based robotics company, has been leading with their innovation in this field – they are working actively to develop reinforcement learning in their own robots. They use reinforcement training so that the robots can train themselves on how to pick an object from one box and place it into another box. They use this process for different tasks, and as a result, they can build robots that can complete complex tasks way quicker than humans. [2]

8.5.2 Deep Learning

Deep Learning is a subfield of Machine Learning and is another technique in which a machine is trained with massive datasets, however, there is significantly less human work involved. In **Deep Learning**, the model is able

to extract features and classify the data itself instead of having a human identify the features. We can view Deep Learning as an intelligent technique that uses multiple layers of a computing system known as Artificial Neural Networks to categorize information within a data set. Much like the neural pathways in a brain, scientists and engineers created a web of connected paths for electrical messages, which are called **Artificial Neural Networks (A.N.N)**. These neural networks function similarly to the neurons that fire electrical impulses within the brain, which then send messages to and from the brain in living organisms to accomplish tasks. The data in A.N.Ns are activated and sent to other layers through a series of mathematical calculations to simulate decision-making in computers.

Neural Networks

Algorithms that process information in a similar way to the human brain. Contain a collection of interconnected nodes.

Deep learning and neural networks have been deployed in several fields, such as computer vision, natural language processing, and speech recognition. It has been used in many healthcare applications for the diagnosis and treatment of many chronic diseases. These algorithms have the power to avoid outbreaks of illness, recognize and diagnose illnesses, and minimize running expenses for hospital management and patients. While machine learning, deep learning, and neural networks are all subsets of artificial

intelligence; deep learning is actually a subset of machine learning, and neural networks are a subset of deep learning.

Deep learning can be thought of as the automation of predictive analytics. Deep learning is essentially a neural network with three or more layers which allows it to learn from a large amount of data. Deep learning is behind many artificial intelligence applications improving on automation and analytics. It is used in such applications as voice activated electronics, self-driving cars, and credit card fraud detection. The evolution of deep learning started after the invention of neural networks, by adding more neurons and additional hidden layers to neural networks makes deep learning more cultivated. Like machine learning, deep learning is also categorized into subcategories, i.e., supervised, and unsupervised.

8.5.3 Machine Learning vs Deep Learning

Machine learning focuses on developing algorithms that can alter themselves without human involvement to take defined data and generate a required output. Deep learning uses neural networks to learn unsupervised from unstructured or unlabeled data.

Machine learning uses algorithms to analyze data, learn from it, and make smart decisions based on the knowledge learned, while deep learning organizes the algorithms into layers to form artificial neural networks that can learn and make intelligent decisions independently.

	Deep Learning	Machine Learning
Data Requirements	Requires a large dataset	Works well with a small to a medium dataset
Hardware Requirements	May require machines with a GPU	Works with low-end machines
Training Time	Longer training times (ranging from a few hours to weeks)	Shorter training times (from a few seconds to hours)
Processing Time	Faster processing times	Slower processing times
Number of Algorithms	Fewer Algorithms required	More algorithms required
Data Interpolation	Difficult	Difficulty Varies

Table: A summary of the differences between Deep Learning and Machine Learning

[3]

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8.6 Applications of AI

8.6.1 Autonomous Technology

One of the most widely used applications of AI is autonomous technologies. By combining software, sensors, and location technologies, devices that can operate themselves to perform specific functions are being developed. Some

examples include: medical nanotechnology robots (nanobots), self-driving cars, or unmanned aerial vehicles (UAVs).

A **nanobot** is a robot whose components are on the scale of about a nanometer, which is one-billionth of a meter. While still an emerging field, it is showing promise for applications in the medical field. For example, a set of nanobots could be introduced into the human body to combat cancer or a specific disease.

A **UAV**, often referred to as a "drone," is a small airplane or helicopter that can fly without a pilot. Instead of a pilot, they are either run autonomously by computers in the vehicle or operated by a person using a remote control. While most drones today are used for military or civil applications, there is a growing market for personal drones.

8.6.2 Robots

Robots are automated machines that can execute specific tasks with very little or no human intervention and are able to accomplish tasks with both speed and precision [1]. The development and deployment of robots is most common in manufacturing in the replacement of humans in repetitive tasks. Robots are also used in medicine, education, restaurants and hotels, and entertainment. Some of

Photo by Phasmatisnox via Wikipedia CC-BY

the most popular robots are ASIMO by Honda and Boston Dynamics robots like ATLAS. Robots can increase productivity and accuracy, but are costly. For more advantages and disadvantages, see the table below.

Advantages	Disadvantages
• Reduction of risk. Tasks that are dangerous to humans can be done by robots (i.e. defusing bombs, travelling to space). • Error reduction and increased level of precision. • No downtime. Robots can work everyday all day. • Good at performing repetitive tasks that may otherwise injure humans • Faster decisions can be made by robots programed with artificial intelligence than humans as they are able to process complex data at a much higher speed	• Reduction in specific employment opportunities in jobs being replaced by robots • High capital investment required by organizations to utilize and maintain • Lack of creativity and emotion in the performance of tasks or decision-making processes • Reduction in human interaction • Require constant power to run and maintain

With artificial intelligence, robots will be able to independently estimate the events around them and to make decisions on actions which they're required to make for their given objective. Robots can already both record human movement skills and replicate them as machine learning improves drive efficiency and mobility. [2]

8.6.3 Intelligent Agents

Intelligent agents process the inputs it receives, and makes decisions/ takes action based on that information. Sensors allow intelligence agents to perceive their surroundings, while actuators allow them to act on that

perception. A software agent, a human agent, and a robotic agent are all examples of agents, each with its own set of sensors and actuators to sense its environment and then perform actions through its actuators.

AI agents that can learn from their previous experiences or have learning capabilities are known as learning agents. Beginning by acting on basic knowledge, learning agents subsequently learn to act and adapt on their own automatically. Conversational intelligence tools are tools that have the ability to auto-record meetings, transcribe, and apply AI to speech. They can be helpful for individuals working in sales, and could possibly replace some functions performed by customer relationship management systems.

Siri, Alexa and Google Assistant are examples of intelligent agents that can be accessed from smartphones. These tools can allow users to open applications, send messages, make calls, play voicemails and check the weather.

IOS 7 Siri by Kavakavins111 on Wikipedia CC-BY-SA

8.6.4 Natural Language Processing (NLP)

Natural Language Processing (NLP) allows computers to extract meaning from human language. Natural Language Processing's goal by design is to read, decipher, and comprehend human language. In Natural Language Processing, humans converse with the machine which records the conversation and converts the audio to text. After that, the system analyses the data and converts it to audio. The machine then plays the audio file back in response to the human.

Algorithms use natural language processing to detect natural language rules, resulting in the conversion of unstructured language input into a format that computers can recognize. Natural Language Processing (NLP) is used in many translation applications such as Google Translate, various interactive voice response (IVR) applications found in call centres, and software tools that check for grammatical accuracy of texts, like Microsoft Word and Grammarly. Additionally, it is also used in personal assistant tools like Siri, Cortana and Alexa.

8.6.5 Expert Systems

Expert systems (ES) are designed to emulate the human ability to make decisions in specific contexts. An expert system, by means of a reasoning, can perform at a level comparable to or better than a human expert does

within a specified area. The goal of ES is therefore to solve complex problems by following a line of reasoning that is derived from human knowledge. This reasoning is normally represented by if–then–else statements, instead of conventional procedural code. Expert systems have been reliably used in the business world to gain competitive advantages and forecast market conditions. In a time where every decision made in the business world is critical for success; the assistance provided from an expert system can be an essential and highly reliable resource.

Expert Systems in Fraud Detection

Expert systems can be used in fraud detection. A company can establish rules for detecting fraud and then allow the system to identify fraudulent behaviour based on the set of rules created. For example, a rule can be created to look for transactions that are originating from a particular location (one that may been known for criminal activity) and are over a certain amount. Since expert systems are based on rules that are programmed, it may be easy for cybercriminals to circumvent the system. However, expert systems can still be useful as part of a larger fraud defense strategy that may also incorporate more intelligent systems [3]

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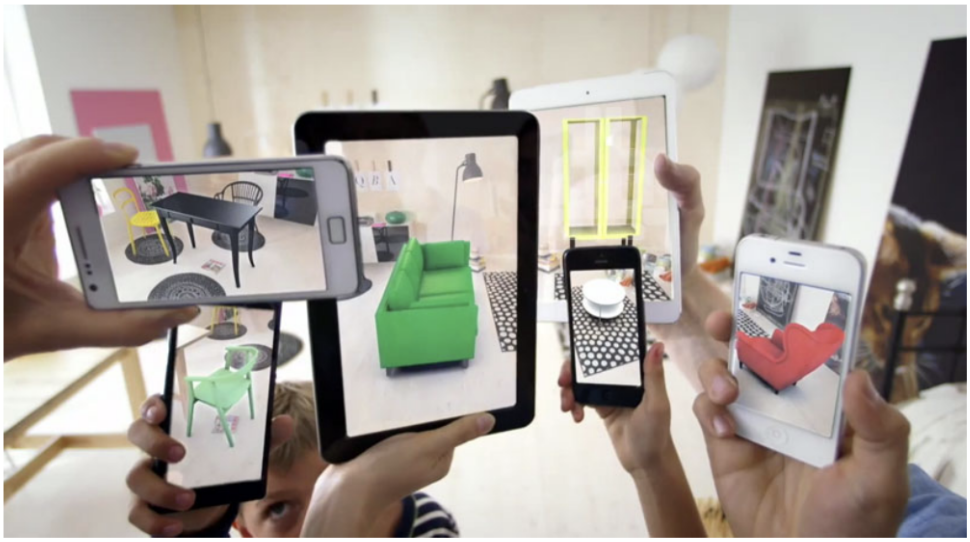
8.7 Extended Reality

Another category of emerging technology is **extended reality** or XR. XR is an umbrella term that covers all forms and combinations of real and virtual environments. This includes: augmented reality (AR), virtual reality (VR) and a combination of the two or mixed reality (MR). [1]

8.7.1 Augmented Reality



Augmented-reality by OyundariZorigtbaatar WikiCommons CC-BY-SA

Augmented reality (AR) enhances one's view of the real world with layers of digital information added to it. With AR there is no created scenario; instead,

an actual event is being altered in real time.[2] Some examples of this are Snapchat lenses and the game Pokémon Go. AR is being used in e-commerce to help purchasers visualize and interact with the products before purchasing them.

IKEA Augmented Reality Game

Escape the Clutter is a an AR escape room game for Snapchat developed by IKEA. In the game, a cluttered 3D room will appear on screen. The object of the game is to remove the clutter by adding in IKEA organization solutions. The organization products act as the 'keys' to the escape room. As users add the products they can learn more about them and their benefits. [3]

8.7.2 Virtual Reality

Virtual reality (VR) is a computer interaction in which a real or imagined environment is simulated. This allows users to both interact with and alter that reality within the environment. The popularity and development of virtual and augmented reality has grown due to advances in VR technology and devices based on smartphones like Google Cardboard. Some people view virtual reality as a gimmick to enhance video game playing at home, but the technology is being used in innovative ways.

One way in which businesses are leveraging VR technology is for training and education. This technology is especially valuable in high risk industries like the military, space exploration, and medicine where one wrong move can have disastrous consequences. As well, it can be helpful to simulate interview scenarios, or difficult conversations allowing users to role play and practice in varied scenarios. VR can also simulate in-person meetings for those working remotely through the use of avatars. Avatars are computer representation of people.

Photo by Minh Pham on Unsplash

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8.8 Emerging Technology Trends

In addition to AI; a number of other emerging technologies are forecast to have an impact on how businesses operate and communicate. The following are some trends that are driving these new and innovative technologies.

8.8.1 Wearable

The last section explored VR technologies, which include devices that can be worn to simulate virtual environments. Technology that can be worn or '**wearables**' have been around for a long time, with applications such as hearing aids and, later, bluetooth earpieces. Product lines have expanded to include the Smartwatch, body cameras, sports watch, and various fitness monitors and other wellness devices. Energy harvesting and haptic devices are examples of future developments in wearable technology. Energy harvesting allows body heat to be converted to solar power, and haptic devices allow one to control virtual objects. Wearable haptic devices will be integrated into clothing to help with directions, or to assist individuals navigate the virtual world [1]

8.8.2 Connected

As discussed in an earlier chapter, the **Internet of Things (IoT)** refers to devices that have been embedded into a variety of objects including appliances, lamps, vehicles, lightbulbs, toys, thermostats, jet engines, etc. and then connecting them via Wi-Fi, BlueTooth, or LTE to the internet. Think of IoT as devices that you wouldn't normally consider being connected to the internet, and the connection is independent of human intervention. This interconnectedness or uploading of data is virtually automatic. So a PC is not an IoT, but a fitness band could be. Interconnected devices are becoming ubiquitous, meaning they are everywhere. Today there are IoTs for monitoring traffic, air quality, soil moisture, bridge conditions, consumer electronics, autonomous vehicles, and the list seemingly never stops.

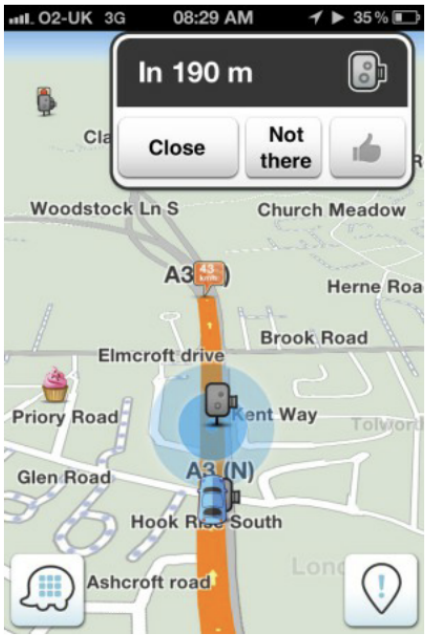
Principally three factors have come together to give us IoT: inexpensive processors, wireless connectivity, and a new standard for addresses on the internet known as IPv6. Processors have become both smaller and cheaper in recent years, leading to their being embedded in more devices. Consider technological advancements in your vehicles. Your car can now collect data about how fast you drive, where you go, radio stations you listen to, and your driving performance such as acceleration and braking. Insurance companies are offering discounts for the right to monitor your driving behavior. On the positive side, imagine the benefit of being informed instantly of anticipated traffic delays each time you adjust your route to work in the morning. Benefits from IoTs are virtually everywhere. Here is a quick list.

Optimization of Processes	IoTs in manufacturing monitor a variety of conditions that impact production including temperature, humidity, barometric pressure – all factors which require adjustment in application of manufacturing formulas.
Component Monitoring.	IoTs are added to components in the manufacturing process, then monitored to see how each component is performing.
Home Security Systems.	IoTs make the challenge of monitoring activity inside and outside your home are now easier.
Smart Thermostats.	Remote control of home thermostats through the use of IoTs allows the homeowner to be more efficient in consumption of utilities.
Residential Lighting	IoTs provide remote control of lighting.

While there are many benefits to these constantly connected devices privacy and security of personal data and information should also be considered.

8.8.3 Collaborative

As more people use smartphones and wearables, it will be simpler than ever to share data with each other for mutual benefit. Some of this sharing can be done passively, such as reporting your location in order to update traffic statistics. Other data can be reported actively, such as adding your rating of a restaurant to a review site. The smartphone app Waze is a community-based tool that keeps track of the route you are traveling and how fast you are making your way to your destination. In return for providing your data, you can benefit from the data being sent from all of the other users of the app. Waze directs you around traffic and accidents based upon real-time reports from other users.



"Waze Screen Shot" (click to enlarge) by D. Bourgeois CC-BY-NC

8.8.4 Super

Quantum computing, a technology that applies quantum mechanics to build novel supercomputers, high performance computers used to solve large scale computational tasks. Quantum computers can operate at speeds that are exponentially faster than common computers and can make calculations based on the probability of an object's state before it is measured. Google demonstrated that their quantum computers can solve a problem that no classical computer could ever solve. For the third year in a row, IBM managed to double its quantum computing power. Additionally, several web service providers, including Amazon, announced plans for cloud-based quantum

computing services. Quantum computers can make drug development, power storage, manufacturing, and agriculture better, faster, and more sustainable. They may also unravel cybersecurity infrastructure around the world making them a potential threat to national security. The field of quantum computing is still in its infancy, and the question of scale remains unsolved.

Section Attributions

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8.9 The Future: A Cautionary Approach

As outlined in this chapter, applications of AI and other emerging technology are increasing rapidly. However, the advancement of these technologies also raises questions with respect to governance and regulations to its development. Concerns over ethical and privacy issues along with military development are among some issues to consider. Remember from a previous chapter, **ethics** means a set of moral principles. There are several events that reiterate just how easy it is to exploit AI for unethical uses.

8.9.1 Example: AI and Privacy

Examples like the breaking of privacy laws by Google's DeepMind and the failure to protect Facebook users' personal data in the Facebook – Cambridge Analytica scandal generated a lot of concern about the use of AI. In both of these examples, the data stored by the AI in DeepMind and Facebook was released to third-party users without the patients' (DeepMind) or Facebook users' knowledge or consent. [1]

8.9.1 Example: ChatGPT and Ethical Implications

ChatGPT is a conversational chatbot that was launched by OpenAI in November 2022. It can be used to produce written work as well as write code by responding to prompts or instructions. Following it's release, news articles proliferated criticizing the tool over the ethical concerns of its use. Some concerns shared include the increased risk of misinformation, the ability to perpetuate bias, and its ability to impersonate individuals. [2]Academic institutions across the world expressed their concerns around the use of the tool for cheating. Some schools have even banned its use. [3]

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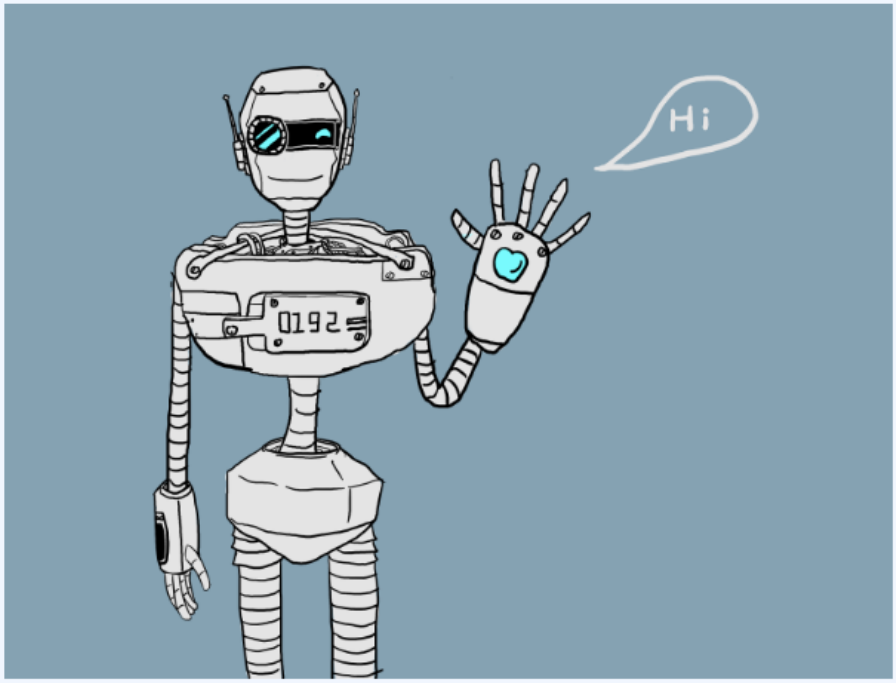

Image by scarlett_z10 Pixabay License

However, despite the setbacks, AI appears to be an exponentially growing field. Today, because of the Internet of Things, data volumes have significantly increased since almost every device we use has the ability to gather and store data such as pedometers on our phones, thermostats, and voice assistants like Alexa or Siri. To keep up with these large amounts of data, AI has been upgraded to increase processing speeds and computational capacity. Nowadays, AI systems are much more efficient, widely available, and are easily accessible in contrast to their earlier developmental stages. With the

rapid growth in the development of AI, it is important to consider the ethical implications of its use.

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End of Chapter Summary

- It traces the rapid development of information systems since the 1950s, comparing modern handheld devices to early computers.
- The narrative unfolds the power of AI in processing information through algorithms and machine learning, showcasing its ability to mimic human behavior and impact businesses.
- The chapter covers significant achievements such as IBM's Deep Blue defeating a chess champion in 1997, speech recognition software, and recent successes like IBM's Watson winning "Jeopardy!" in 2011 and Google's AlphaGo defeating a Go champion in 2017.
- The chapter then delves into the intricate workings of AI systems, focusing on their development through machine learning and deep learning techniques.
- Deep learning, identified as a subset of machine learning, is presented as a technique requiring significantly less human involvement, utilizing artificial neural networks to independently extract features and classify data.
- The narrative extends to applications of AI, exploring autonomous technologies like medical nanobots, self-driving cars, and unmanned aerial vehicles (UAVs). The use of robots in manufacturing, medicine, education, and entertainment is discussed, emphasizing their potential impact on efficiency and mobility.
- The chapter concludes with an exploration of extended reality (XR) and emerging technology trends. XR, covering augmented reality (AR), virtual reality (VR), and mixed reality (MR), is examined for its applications in e-commerce, gaming, and training.
- Wearables, the Internet of Things (IoT), collaborative technologies, and supercomputing, including quantum computing, are discussed, highlighting their potential impact on various sectors.

Key Terms

- Algorithms: which are a set of rules or processes to solve a specific problem or task.
- Artificial Intelligence: The ability of a computer or machine to think and learn, and mimic human behavior.
- Augmented reality (AR): Enhances one's view of the real world with layers of digital information added to it. With AR there is no created scenario; instead, an actual event is being altered in real-time.
- Autonomous Technologies: Autonomous robots and vehicles that work by combining software, sensors, and location technologies. Devices that can operate themselves.
- Chat-bots: are computer programs that use AI and natural language processing (NLP) to understand customer questions and automate responses to them, simulating human conversation.
- Collaborative Technology: To share data for mutual benefit. Some of this sharing can be done passively and other data can be reported actively.
- Deep Learning (DL): A subset of Machine Learning – Deep Learning refers to when computers can solve more complex problems without human intervention.
- Emerging technology: includes new technology and technology that is continuously evolving.
- Expert Systems (ES): Designed to emulate the human ability to make decisions in specific contexts and have had a large impact in the world of AI.
- Extended Reality or XR: XR is an umbrella term that covers all forms and combinations of real and virtual environments. This includes augmented reality (AR), virtual reality (VR), and a combination of the two or mixed reality (MR).
- Intelligent Agents: Process the inputs it receives, and makes decisions/ takes action based on that information.
- Internet of Things: The idea of physical objects being connected to the Internet, embedded with electronics, software, sensors, and network connectivity, which enables these objects to collect and exchange data.

- Loop: a part of software code that allows a command to run again and again.
- Machine Learning (ML): is a technique that is used by an AI system to analyze data, find patterns, and make decisions automatically or with minimal human support.
- Nanobot: Is a robot whose components are on the scale of about a nanometer, which is one-billionth of a meter. While still an emerging field, it is showing promise for applications in the medical field.
- Natural Language Processing (NLP): Allows computers to extract meaning from human language. Natural Language Processing's goal by design is to read, decipher, and comprehend human language.
- Reinforcement Learning: A form of Machine Learning in which a machine is given unlabeled data and must find its own connections through analysis, clustering, and identifying patterns.
- Robots: These are automated machines that can execute specific tasks with very little or no human intervention and can accomplish tasks with both speed and precision.
- Supervised Learning: A form of Machine Learning in which data is labeled and categorized into groups by humans and algorithms are used to classify data based on labels.
- Unsupervised Learning: The trial and error-based Machine Learning method in which a machine learns from mistakes and improves upon them.
- Virtual Reality (VR): Computer interaction in which a real or imagined environment is simulated. This allows users to both interact with and alter that reality within the environment.
- Wearable Technology: A category of technology devices that can be worn by a consumer and often include tracking information related to health and fitness.

End of Chapter Discussions

1. Reflecting on today's technology landscape, what do you perceive as one of the most significant impacts?
2. Considering the chapter's content, what are the potential benefits and drawbacks associated with the integration of robots in business operations?
3. Can you identify instances in the restaurant industry where technology is replacing human interaction?
4. What is the difference between XR, AR, and VR?
5. What is artificial intelligence, and what are some of the capabilities?

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Glossary

Sometimes we want to learn more, here is a list of key term definitions, many of which are listed at the end of each chapter.

1. **Acceptable User Policy (AUP):**Guidelines outlining acceptable behavior and usage of computer systems, networks, and the internet by users.
2. **Advanced Research Projects Administration (ARPA):** An experimental network that eventually became known as the Internet.
3. **Algorithms**: A set of rules or processes to solve a specific problem or task.
4. **Analog Signals:** Continuous signals represented by smooth wave patterns.
5. **Android**: A mobile operating system (OS) based on the Linux kernel and currently developed by Google.
6. **Antivirus Software:** If properly installed on a computer system, can prevent access to computer systems by unwanted computer programs.
7. **Application Software:** Allows the user to perform tasks such as creating documents, recording data in spreadsheets, or messaging a friend.
8. **Artificial Intelligence (AI):** The ability of a computer or machine to think and learn, and mimic human behavior.
9. **Augmented Reality (AR):** Enhances one's view of the real world with layers of digital information added to it. With AR, there is no created scenario; instead, an actual event is being altered in real-time.
10. **Backup**: A copy of some data.
11. **Big Data:** Extremely large data sets that may be analyzed computationally to reveal patterns, trends, and associations.
12. **Binary**: A number expressed in the binary numeral system, representing numeric values using two symbols: typically 0 (zero) and 1 (one).
13. **Bit**: The smallest unit of data in a computer, represented by one or zero.
14. **Bluetooth**: A wireless technology standard for exchanging data over short distances.
15. **Brick-and-Click Business**: Selling products to consumers via several channels, one of which is usually a tangible shop, and the other one an e-business.
16. **Business Intelligence (BI)**: Combines business analytics, data mining, data visualization, data tools and infrastructure to help organizations make more data-driven decisions.
17. **Business to Business (B2B):** When a business sells a good or service to another business.
18. **Business to Consumer (B2C)**: When a business sells a good or service to an

individual consumer.
19. **Business to Government (B2G)**: E-commerce transactions with the government.
20. **Byte**: A unit of data that computers use to represent a character with a group of eight bits.
21. **Central Processing Unit (CPU):** The “brains” of the device, carries out the commands sent to it by the software and returns results to be acted upon.
22. **Chat-bots:** Computer programs that use AI and natural language processing (NLP) to understand customer questions and automate responses.
23. **Children’s Online Privacy Protection Act (COPPA):** Requires the Federal Trade Commission to issue and enforce regulations concerning children’s online privacy.
24. **Cloud**: Refers to applications, services, and data storage on the internet.
25. **Cloud Computing:** The practice of using a network of remote servers hosted on the internet to store, manage, and process data.
26. **Code of Ethics:** A set of official standards of conduct that the members of a group are expected to uphold.
27. **Collaborative Systems:** Systems that allow users to brainstorm ideas together without the necessity of physical, face-to-face meetings.
28. **Common Law Trademark**: A trademark established solely through use in commerce in a specific geographical area.
29. **Competitive Advantage:** A condition or circumstance that puts a company in a favorable or superior business position.
30. **Computer Network:** A group of two or more computer systems linked together by communications channels to share data and information.
31. **Computer Security:** A branch of information technology known as information security intended to protect computers.
32. **Consumer to Business (C2B)**: When a consumer sells their own products or services to a business or organization.
33. **Consumer to Consumer (C2C)**: When a consumer sells a good or service to another consumer.
34. **Consumer to Government (C2G)**: E-commerce transactions between the government and individuals.
35. **Creative Commons**: A nonprofit organization that provides legal tools for artists and authors.
36. **CRM (Customer Relationship Management)**: An approach to managing a company’s interactions with current and future customers.
37. **Data**: The raw facts and devoid of context or intent data can be quantitative or qualitative.
38. **Data Communication:** The exchange of data between two or more networked or connected devices.
39. **Data Integrity:** The accuracy, completeness, and quality of data as it’s maintained over time and across formats.
40. **Data Mining:** The practice of analyzing large databases to generate new information.
41. **Data Redundancy:** When multiple copies of the same information are stored in

more than one place at a time.

42. **Data Resource Management:** Deals with computer science and information systems.
43. **Data Visualization:** The graphical representation of information and data.
44. **Data Warehouses:** A large store of data accumulated from a wide range of sources within a company and used to guide in management decisions.
45. **Database**: A structured set of data held in a computer, especially one that is accessible in various ways.
46. **Database Management System (DBMS):** Stores and retrieves the data that an application creates and uses.
47. **Database Technology:** Takes information and stores, organizes, and processes it in a way that enables users to go back easily and intuitively and find details they are searching for.
48. **Deep Learning (DL):** A subset of Machine Learning – Deep Learning refers to when computers can solve more complex problems without human intervention.
49. **Decryption**: A way to change an encrypted piece of information back into unencrypted form.
50. **Differential Backup:** Only copies the data that has changed since the last full backup.
51. **Digital Devices:** An electronic device that uses discrete, numerable data and processes for all its operations.
52. **Digital Millennium Copyright Act (DMCA)**: Extended copyright law to take into consideration digital technologies.
53. **E-commerce:** Commercial transactions conducted electronically on the internet.
54. **E-commerce Business Model:** The method that a business uses to generate revenue online.
55. **E-commerce Platform:** A way to build and create an online experience that allows a company to make sales and fulfill orders.
56. **E-Payment:** Any payment done electronically.
57. **Enterprise Database:** Must be able to keep track of all operations on the database that are applied by a certain user during each log-in session.
58. **Enterprise Resource Planning (ERP):** A software application with a centralized database that can be used to run an entire company.
59. **Enterprise Software:** Refers to applications that address the needs of multiple, simultaneous users in an organization or workgroup.
60. **Ethical Dilemma:** A situation in which a difficult choice has to be made between two courses of action, either of which entails transgressing a moral principle.
61. **Ethics**: Moral principles that govern a person's behavior or the conducting of an activity.
62. **Extended Reality or XR:** An umbrella term that covers all forms and combinations of real and virtual environments.
63. **Expert Systems (ES):** Designed to emulate the human ability to make decisions in specific contexts and have had a large impact in the world of AI.
64. **Family Educational Rights and Privacy Act (FERPA):** A US law that protects

the privacy of student education records.
65. **Federal Trade Commission (FTC):** A federal agency that administers antitrust and consumer protection legislation.
66. **Firewall**: A part of a computer system or network designed to block unauthorized access while permitting outward communication.
67. **Full Backup:** Copies all of the data.
68. **Grandfather-Father-Son:** Means that we keep different types of backup for different amounts of time.
69. **Hardware**: Includes the physical parts of the computer, such as the case, central processing unit, random access memory, monitor, mouse, keyboard, computer data storage, graphics card, sound card, speakers, and motherboard.
70. **Health Insurance Portability and Accountability Act (HIPAA):** A law that gives patients specific rights to control their medical records.
71. **HTTP Cookie:** A simple computer file made of text.
72. **Hypertext Transfer Protocol (HTTP):** A communications protocol used to send and receive webpages and files on the internet.
73. **Hypertext Transfer Protocol Secure (HTTPS):** A secure version of HTTP, the protocol over which data is sent between your browser and the website that you are connected to.
74. **Incremental Backup:** Only copies the data that has changed since the last incremental backup.
75. **Information Security:** The state of being protected against the unauthorized use of information, especially electronic data.
76. **Information Systems (IS):** A formal, sociotechnical, organizational system designed to collect, process, store, and distribute information.
77. **Information Technology (IT):** Any computer-based tool that people use to work with information and support the information and support the information and information-processing needs of an organization.
78. **Intangible**: Unable to touch or grasp; not having a physical presence.
79. **Intelligent Agents:** Process the inputs it receives and make decisions/take action based on that information.
80. **Internet**: A network of networks.
81. I**nternet of Things (IoT):** Refers to a network of physical devices, vehicles, appliances, and other physical objects embedded with sensors, software, and network connectivity.
82. **iOS (iPhone OS):** An operating system used for mobile devices manufactured by Apple Inc.
83. **Killer App (Killer Application):** An application viewed as so desirable by consumers that it can influence them to purchase devices or applications that include it.
84. **Knowledge:** Is human beliefs or perceptions about relationships among facts or concepts relevant to that area.
85. **Knowledge Management:** Efficient handling of information and resources within a commercial organization.
86. **LAN (Local Area Network):** A computer network that interconnects computers within a limited area.

87. **LINUX/UNIX:** Linux is a version of the Unix operating system that runs on the personal computer.
88. **Machine Learning (ML):** A technique used by an AI system to analyze data, find patterns, and make decisions automatically or with minimal human support.
89. **Malware (Malicious Software):** A kind of software that can be installed on a computer without approval from the computer's owner.
90. **Manufacturing Resources Planning (MRP):** An information system used by businesses involved in manufacturing goods.
91. **Memory**: Specifically, Computer Memory. Any physical device capable of storing information temporarily or permanently.
92. **Meta Base:** An open-source tool that allows for powerful data instrumentation, visualization, and querying.
93. **Metropolitan Area Network (MAN):** Spans a larger area like a city or region.
94. **Mobile Applications:** Programs that run on tablet computers and smartphones.
95. **Mobile Wallet:** An application on your mobile device that stores your payment information to allow contactless payments.
96. **Modem**: Converts the format of the data so it may be transmitted between computers.
97. **Moore's Law:** The observation that over the history of computing hardware, the number of transistors in a dense integrated circuit has doubled approximately every two years.
98. **Motherboard**: The main circuit board on the computer that connects to the CPU, memory, and storage components, among other things.
99. **MRP (Manufacturing Resources Planning):** Refers to an information system that is used by businesses involved in manufacturing goods.
100. **Nanobot**: A robot whose components are on the scale of about a nanometer.
101. **Natural Language Processing (NLP):** Allows computers to extract meaning from human language.
102. **Network**: A connecting system (wireline or wireless) that enables multiple computers to share resources.
103. **Network Connection:** Provides connectivity between your computer and the Internet, a network, or another computer.
104. **Non-Obvious Relationship Awareness (NORA):** The process of collecting large quantities of a variety of information then combining it to create profiles of individuals.
105. **Normalization**: The process of organizing data in a database.
106. **Open Source:** Software that can be freely used, changed, and shared by anyone.
107. **Operating Systems:** Software that provides the interface between the hardware and the application software.
108. **Output Devices:** An output device sends data from a computer to another device or user.
109. **Patents**: Creates protection for someone who invents a new product or process.

110. **Peer-to-Peer (P2P)**: Denoting or relating to computer networks in which each computer can act as a server for the others, allowing shared access to files and peripherals without the need for a central server.
111. **Personally Identifiable Information (PII)**: Information about a person that can be used to uniquely establish that person's identity.
112. **Privacy**: Means the ability to control information about
113. **Patents**: Creates protection for someone who invents a new product or process.
114. **Peer-to-peer (P2P)**: Denoting or relating to computer networks in which each computer can act as a server for the others, allowing shared access to files and peripherals without the need for a central server.
115. **Personally Identifiable Information (PII)**: Information about a person that can be used to uniquely establish that person's identity.
116. **Privacy**: Means the ability to control information about oneself.
117. **Private Cloud**: A cloud computing environment dedicated to a single organization.
118. **Productivity Software**: Several software applications that have become standard tools for the workplace. (Example: spreadsheet, word processing, other Microsoft Office suite applications)
119. **Programming Software**: Software whose purpose is to make more software.
120. **Protected Health Information (PHI)**: Any information about health status, provision of health care, or payment for health care that can be linked to an individual.
121. **Protocol**: A set of rules that govern how communications take place on a network.
122. **Public Cloud**: A cloud computing environment in which resources are shared among multiple organizations.
123. **Pure-play Business**: A company that focuses on only one industry.
124. **Pyramid Scheme**: An illegal and unsustainable business model where financial returns are based on recruiting new members rather than product sales.
125. **Python**: A high-level programming language known for its readability and versatility.
126. **Quadcopter**: A type of drone with four rotors.
127. **Quantitative Data**: Numeric data, the result of a measurement, count, or other mathematical calculation.
128. **Query-by-Example (QBE)**: A database query language for relational databases.
129. **Quick Response (QR) Code**: A two-dimensional barcode that can store information, often scanned by smartphones.
130. **Quality Assurance (QA)**: The process of ensuring that a product or service meets specified standards before it reaches the customer.
131. **Quantum Computing**: A type of computing that uses the principles of quantum mechanics to perform certain types of calculations much faster than classical computers.

132. **Quarantine**: Isolating or restricting the movement of individuals, software, or data to prevent the spread of a disease, malware, or other threats.
133. **Query**: A request for information from a database.
134. **QuickTime**: A multimedia framework developed by Apple that can handle various formats of digital video, picture, sound, panoramic images, and interactivity.
135. **Queue**: A data structure that follows the First-In-First-Out (FIFO) principle, where the first element added is the first to be removed.
136. **Quality of Service (QoS)**: A set of technologies that manage data traffic to reduce packet loss, latency, and jitter on a network.
137. **Quad HD (QHD)**: A display resolution of 2560x1440 pixels, providing higher image quality than Full HD.
138. **Quantum Encryption**: A method of secure communication using quantum mechanics to provide encryption keys.
139. **Query Language**: A language used to interact with and retrieve information from databases.
140. **QR Code Scanner**: A device or application that can read Quick Response (QR) codes.
141. **Quantum Mechanics**: A branch of physics dealing with the behavior of matter and energy at the quantum level.
142. **Quality Control (QC)**: A process that ensures the quality of a product or service during and after production.
143. **Query Optimization**: The process of improving the efficiency of database queries to enhance performance.
144. **Query String**: A part of a URL that contains data to be passed to web applications.
145. **Queue Management System**: Software or system that controls the flow of people or tasks in a queue.
146. **Ransomware**: Malicious software that encrypts files and demands payment for their release.
147. **Real-time Processing**: Immediate processing and analysis of data as it is generated or received.
148. **Registered Trademark**: The name or symbol of a product or company, shown by the sign ®, which is officially recorded and cannot legally be used by another producer or company.
149. **Reinforcement Learning**: A form of Machine Learning in which a machine learns from trial and error.
150. **Relational Data Model**: A logical data structure where data tables, views, and indexes are separate from physical storage structures.
151. **Remote Desktop**: A technology that allows a user to connect to and control a remote computer.
152. **Responsive Web Design (RWD)**: Designing web pages to ensure optimal viewing across various devices and screen sizes.
153. **Robotics**: The design, construction, and operation of robots for various tasks.
154. **Robots**: Automated machines that can execute specific tasks with little or

no human intervention.

155. **Rootkit**: Malicious software that provides unauthorized access to a computer.
156. **Router**: A device that directs data traffic between computer networks.
157. **Ruby on Rails:** A web application framework written in Ruby programming language.
158. **SaaS (Software as a Service)**: Software that is rented rather than purchased on a subscription basis.
159. **Safe Harbor Provision**: Limits the liability of online service providers when someone using their services commits copyright infringement.
160. **Scalability**: The ability of a system to handle increased workload or demand.
161. **Scanner**: A device that converts physical documents or images into digital data.
162. **Search Engine Optimization (SEO)**: The process of optimizing a website to rank higher on search engine results pages.
163. **Server**: Manages network resources or performs special tasks such as storing files, managing printers, or processing database queries.
164. **Smart Home**: A residence equipped with smart devices for automation and control.
165. **Smartphone**: A mobile phone with advanced features, such as internet connectivity and applications.
166. **Social Engineering**: Manipulating individuals to divulge confidential information.
167. **Social Media**: Online platforms for creating and sharing content, connecting with others, and networking.
168. **Solid State Drive (SSD)**: A storage device that uses flash memory for faster data access.
169. **Spam**: Unwanted or irrelevant messages, often sent in bulk, typically through email.
170. **Spyware**: Software that secretly collects user information without their knowledge.
171. **Supply Chain Management (SCM):** The optimization of a product's creation and flow from raw material sourcing to delivery.
172. **System Software**: Software that provides a platform for running application software and managing computer hardware.
173. **Tablet Computer**: A portable computing device with a touchscreen interface.
174. **TCP/IP (Transmission Control Protocol/Internet Protocol)**: A communications standard for exchanging messages over a network.
175. **Trademark**: A word, phrase, logo, shape, or sound that identifies a source of goods or services.
176. **Transmission Control Protocol (TCP)**: Part of the TCP/IP protocol suite, responsible for reliable data transmission.
177. **Trojan Horse**: Malicious software disguised as legitimate to gain unauthorized access.

178. **URL (Uniform Resource Locator)**: A web address that specifies the location of a resource on the internet.
179. **User Agent**: A computer program representing a person, such as a browser in a web context.
180. **User Interface (UI)**: The visual elements and interactions of a software application.
181. **Virtual Reality (VR)**: Computer interaction in which a real or imagined environment is simulated.
182. **Virtualization**: The process of creating a virtual version of a computer or network.
183. **Virus**: Malicious software that infects and spreads within computer systems.
184. **VoIP (Voice over Internet Protocol)**: Technology for making voice calls over the internet.
185. **VPN (Virtual Private Network)**: A secure network connection over the internet.
186. **Wearable Technology**: Devices worn by consumers, often with health and fitness tracking capabilities.
187. **Web 2.0**: The social web era between 2000-2010, emphasizing user-generated content and collaboration.
188. **Web 3.0**: The semantic web era after 2010, enabling more intelligent web interactions.
189. **Web 4.0**: The future intelligent web, involving the Internet of Things and connected devices.
190. **Web Browser**: Software for accessing and navigating the World Wide Web.
191. **Wi-Fi (Wireless Fidelity)**: Technology for wireless local area networking.
192. **Windows**: Microsoft's operating system.
193. **Wireless LAN (WLAN)**: A local area network that uses wireless communication.
194. **World Wide Web (WWW)**: An information system on the internet that allows documents to be linked by hypertext.
195. **Worm**: A self-replicating computer program that spreads without human intervention.
196. **WPA (Wi-Fi Protected Access)**: A set of security protocols for wireless networks.
197. **Wearable Technology**: A category of technology devices worn by consumers, often including health and fitness tracking.
198. **XML (eXtensible Markup Language)**: A markup language that defines rules for encoding documents in a format that is both human-readable and machine-readable.
199. **XSS (Cross-Site Scripting)**: A type of security vulnerability that allows attackers to inject malicious scripts into web pages.
200. **Yottabyte**: A unit of information equal to one septillion (10^24) bytes.
201. **YouTube**: A popular online video-sharing platform.
202. **Zettabyte**: A unit of information equal to one sextillion (10^21) bytes.

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