




Introduction to Information Technology

(SECIT-02)

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Chapter 1: Impact and History of Computers

1.0 Learning Objectives

At the end of this unit, you should be able to:

1. Define terms and explain characteristics associated with computer technology.
2. Discuss the influence of computer technology in a society.
3. Discuss the contributions of computer technology to education.
4. Discuss the contributions of computer technology to business.
5. Discuss the contributions of computer technology to everyday living.

1.1 Introduction

Technology influences different areas of society and business, whether it is a particular age group or gender, or the entire population. We may be resistant to its influences, whether in the long or short term, until we are more aware on how this change impacts our lives, families, work, entertainment, or daily living.

This unit explains terms associated with computer technology, explains its influence, and contributions to various aspects of work and play. Then it briefly reviews the development of the technology and explains the different categories of computer systems.

1.2 Introduction to Information Technology

Let us start by understanding the concept of computer technology. Quickly, in 30 seconds, calculate the answer to $12 + 54 + 23.65 + 12.89 + 23\frac{1}{4} + 90 + 12 + 980 + 234 + 567$ in your head or on paper. Did you complete it in time? See the next page for the answer.

You may be surprised to learn that people were the first computers! The term computer means someone who computes or performs calculations. Centuries ago, people were called computers. They were usually women who worked out mathematical problems such as tidal charts or navigational tables, and so 'Computer' was actually a job title.

However, as you can imagine, performing mathematical tasks every day, every week, every month would eventually cause boredom which would cause errors in the calculations.

Therefore, the computer became a machine which automated these repetitive tasks.

A computer therefore is a machine which:

- accepts data (called INPUT);
- follows instructions given on what to do with the data (called PROCESSING);
- stores the results for future use (called STORAGE); and
- display the results (called OUTPUT).

Answer: 2008.79

By applying technology to different problems and work environments we can enhance situations or events that would have been almost inconceivable without it. For example, voice mail, satellite television or cell phones are all examples of technology that use a computer to operate the system. Computer technology therefore involves any machine, tool or piece of equipment that is essentially controlled by a computer chip that is able to make calculations.

The role of computers and computer technology is the ability to manipulate data into information or commands. Data can be in many forms, such as text, pictures or sound and can also be retrieved from the environment. An air conditioner which monitors the temperature in a room to keep it cool at a specific temperature, or turning on lights outside a building at dusk are both examples of a computer controlled environment that requires input to produce a specific result or output.

	Air Conditioner	Automated Lights
Input	Current Temperature Desired Temperature	Dusk
Output	AC adjusts temperature to desired temperature	Lights On

1.2.1 Computer Technology is Everywhere

Information has become very important as a result of the computer technology which provides it. Computer driven technology is an integral part of our daily routines, however we tend not be aware of its presence. Many of our daily tasks are automated; such as our answering machines, televisions, cable boxes, vehicles that use this technology. Similarly, as a cashier prints out our receipt for a purchased item or the mail we receive that was stamped by a machine, computer technology supported the creation of the receipt or the delivery of our mail automatically.

We therefore say that computer technology is *ubiquitous*, or everywhere (almost!) once information is present. To summarize, many utility companies are now recording our usage to prepare monthly bills, which will be printed by a machine, while a local or overseas phone companies record voice messages and the calls we missed. Also, our banks' automated systems are automatically charging us every time we use the debit or credit card. The automated systems are controlled by a computer process based on the input from your retailer, the machine itself or from the scanner.

1.3 Generating Information

Remember that computers store the results or output of processing the data. Well computer technology has enabled us to access information at our "finger tips"; from many places, in many places, at any time, and in many different forms whether printed or stored. Hence as more information is requested, more information is generated and more data stored. It seems like a never ending cycle of information growing exponentially!

Unfortunately, there is a drawback to generating information on every transaction. Imagine how one minor error can mushroom into major problems because of your computer technology, and this can have a negative impact on businesses and customers alike. In addition, most people who are not in the computer field may believe that whatever the computer produces is correct. Consider the consequences of transposing (switching) two digits in a bank account number or entering the wrong data in payroll system. This can cause embarrassment to the persons involved if deposits are made to the wrong account or employees do not receive the correct pay. Even so, it is also more difficult to locate someone who is willing to accept responsibility for an error

made by a computerized system. This lack of accountability for the error would be better addressed if the software glitch was corrected as soon as possible!

We should also realize that since information is constantly generated, then it should be possible to store it over a long period of time. It is reasonable to assume therefore that information cannot be entirely destroyed or lost.

1.4 Accessing Information

Much of the computer information that is generated and held in a database is available online. For example, customers can use the telephone or Internet to access current bank balances and perform transactions. Access to your banking information can be made from almost anywhere in the world. This has led to a new work ethic where computer technology has enabled employees to work from various geographic locations, or time zones. Computer technology has provided people with increased mobility while talking with someone on the phone, or receiving a fax.

Information can be retrieved and sent in many forms including text, voice, graphics, photos and video. Additionally, the "information superhighway" has increased the availability of these forms of information delivery methods. One major concern of the recording industry is the ability to reproduce digital material such as video tapes and DVDs, which are indistinguishable from the original. This technology has caused headaches to the industry's composers and performers since any digital file can be easily duplicated and shared.

With access to information, and digital voice and smart technologies automated voices have replaced operators who traditionally greeted customers and initially responded to their queries. It is now commonplace to call businesses and hear an automated switching system and voice-mail system instead of an actual person who can assist you.

1.5 Surveillance

Computer technology has certainly allowed surveillance or the gathering of information for different of purposes. Surveillance software allows individuals, companies and government to monitor you in a variety of locations including other countries. Surveillance equipment such as cameras and key pads now include transactional data which is collected from virtually all types

of transactions, including cash purchases and the acquisition of services to analyze trends. One example is the use of Google Earth to capture topographical pictures of different locations on the earth and more recently Google has released their street view software that allows you to wander the streets of your city using 3D technologies.

1.6 Changing the way we communicate

With the use of the computer and its technology used extensively throughout our society, you are probably aware of how computer technology has changed the way we communicate with another person or among groups of people. The use of email, instant messenger and text messages have modified the usual visual and verbal signs when communicating with someone else. This of course can be both a benefit and a detriment to the communication process. For example, the use of computer tools such as email, instant messenger and text messages mask features such as gender, race, age, and physical disability, social or marital status. Even distance learning has changed the way people are educated, as this manual and your online activities illustrate! Your relationship with the facilitator is remote and you may only hear a voice or read the words on a page written by your instructor. Much of the distance or blended learning materials and content are delivered through the use of databases, audio or video feeds and other means such as Moodle or Blackboard. This has become a reality for many who wish to further their education while employed full-time or those who are unable to access a physical campus at a local institution.

1.7 What is Information Technology(IT)

Let's start with the term information. Information refers to data that has been put into a meaningful and useful context.

Information systems refer to a set of people, procedures and resources that collects, transforms, and disseminates information in an organization. Information systems are implemented within an organization for the purpose of improving the effectiveness and efficiency of that organization.

As an entrepreneur you will need to use a system to provide for the flow of information within your business. Computers is playing a vital part in obtaining, processing and sharing information

within a business which means that an entrepreneur will have to make use of a computer-based information system.

This requires that you must have an understanding technologies used in computer-based information systems – use of hardware, software and people resources to transform data resources into information.

Information Technology (IT) is the area of managing technology and spans a wide variety of areas that include but are not limited to things such as processes, computer software, information systems, computer hardware, programming languages, and data constructs. In short, anything that renders data, information or perceived knowledge in any visual format whatsoever, via any multimedia distribution mechanism, is considered part of the domain space known as Information Technology (IT) (Wikipedia).

TechAmerica defines IT as the study, design and implementation of computer based information systems, particularly software applications and computer hardware. IT deals with the use of electronic computers and computer software to convert, store, protect, process, transmit and securely retrieve information (www.answer.com).

The discipline of Information Systems can best be described as the effective analysis, design, construction, delivery, management and use of information and information technology in organizations and society. An Information System, per se, is an organized collection of people, procedures, data, machines and services that work together to deliver information (<http://www.is.ru.ac.za/?q=content-2>).

So we can conclude that:

Information technology (IT) refers to the different ways (electronic computers and computer software) of obtaining, processing, storing, and transmitting data in the form of voice, pictures and words.

The term Information Technology (IT) is also known as Information Communication Technology (ICT), and we shall continue to use that term henceforth because it combines computing and communications. The computer is a key feature of ICT and the key to an

effective business is how the entrepreneur uses his or her ICT resources to grow and manage the business.

1.8 Impact of Information and Communication Technology (ICT) on Society

Today's society is referred to as the 'digital age'. Computers and ICT devices have become an integral part of our lives and are used everywhere. Be it the desktop computers, laptop computers or more recently tablet computers, all contribute to the activities we experience in our daily life. We use these devices in schools, at home, hospitals, institutions, businesses and even in government offices.

In general the impact of computers on society and how we live our lives is as follows:

- You can use computers to communicate with your family and friends, create a household budget, book travel and movie tickets, or manage your business. The internet has also tremendously increased people's ability to communicate with others from all over the world efficiently and relatively cheaply.
- In business and industry, you use computers to maintain accounts, create personnel records, track inventory, prepare presentations and reports, manage projects, and communicate by e-mail. You can use computers to design any type of publication ranging from simple newsletters to fashion magazines, marketing materials, books, or newspapers.
- In the field of education, trainers can use computers to deliver training through audio-visual learning aids, maintain student records to track performance, search for information on different topics, and create or submit assignments.
- In government organizations, you use computers to organize information by storing and updating records. Computers are also used for providing services to citizens. For example, you can view information on current policies and government issues on a computer.
- In the field of medicine, doctors use computers to review medical records of patients. Doctors also use computers to find information about the latest drugs available to treat a

disease. Doctors can also use computer technology to discuss and share information about various diseases.

- You can use computers to view the details of your bank account. Traders use computer technology to get instant information on stock markets, to trade stocks, and to manage investments.
- Scientists use computers for scientific research, and to gather and analyze information. For example, they use computers to view images from space and to publish information on their recent research.
- You can also use computers to create drawings and paintings. Photographers use computers to edit and enhance pictures. Writers use computers to write content for their books and to also create illustrations. By using computers, writers can make changes in the content easily and save a lot of time.
- In the field of entertainment, you can use computers to listen to music, watch movies, store and print photographs, send greetings, and play games.

[Source: Microsoft Corporation]

1.9 Threats to Information Systems

Computer-based information systems are much more vulnerable to crime and abuse, natural disaster, and even human error than manual systems that they have replaced.

1.9.1 Computer Crime

Computer Crime ranges from the use of information technology to commit an act that would be criminal no matter how committed (such as the theft of money or other property) to activities more specifically related to computers, such as the unauthorized access and use of information systems, theft of computer and telecommunications services, and the theft, intentional alteration, or destruction of data or programs. The protection of customer data and business confidential information is an issue that faces all entrepreneurs.

1.9.2 Theft of Money

As financial institutions become more and more reliant on computers, new opportunities have arisen for criminals to use computers to steal or siphon off money. Password protection and other security tools must be used to protect bank accounts, investments and other financial resources.

1.9.3 Theft of Computers and Computer Parts

As computers and the various computer parts have become smaller and smaller, it has become easier to steal. Microprocessor chips, memory chips, motherboards, modems, disk drives, and power supplies are all frequent targets. They can be removed relatively easily and sold to a readily available underground market. Physical security and effective inventory control measures should be implemented.

1.9.4 Alteration or Destruction of Data and Programs

Another form of computer crime involves the alteration or destruction of data and programs. Motives for this crime may include monetary gain, revenge or just being malicious. This ties in with computer viruses, which are a set of illicit instructions implanted within a program that passes itself onto other programs with which it comes into contact. Appropriate software must be used to protect your business files, data and other online resources from external and internal attacks by cyber criminals and hackers.

1.9.5 System Disasters

In addition to computer crime, information systems are susceptible to natural disasters (Rain, earthquakes, fire and floods), terrorist attack, electrical power and telecommunications line failure, hardware and software malfunction, even human error. Off-site backups and in some cases backups to computers in another island or nation is recommended when your region is subjected to regular natural disasters.

1.10 Computer Technology in Work and Play

Now that we have understood some terminology and features of computer technology, let us look more closely at various aspects of work and play, and how technology affects each one.

This section will allow discussion on some of the impacts in the last, and thoughts on the next decade.

Inventions already introduced into society through computer technology, have caused the society to change, with the cellular phone (or cell phone) being the most recent to reach the populations. It is now an everyday occurrence to reach anyone, anywhere with the use of a cellular phone. Not as openly known, but still commonplace however, is the use of the smart prosthesis on someone who previously could not walk after an accident. Simulations of people walking or running for example have furthered the invention of essential types of prostheses.

1.10.1 Science, Medicine, Health and Technology

Simulation and simulators are often used in scientific research to mimic the event that is being studied. These programs quickly perform number crunching calculations, so that the event can be accelerated, slowed or changed to help predict and test certain outcomes. Therefore programs can assist with the simulation of training in dangerous situations, without using expensive resources.

Since health care matters to everyone, it is not surprising that computer technology has become a natural part of our health and wellbeing, but its use and relevance has implications in everything we do...and not do! If you would like to explore how medical organizations are using simulation and other computer technologies to provide professional development to health care professionals and support science education in the schools go to the Howard Hughes Medical Institute, Bio-interactive site.

Computer technology is integral part of the health and wellness sector. CTI scanners and other diagnostic tools are driven by computer technology. Our health records are placed into databases to be used and retrieved when you visit the hospital or your local doctor.

Science has had an incredible impact within the last century. Toffler in his book “The Third Wave” has identified computer technology as a new phase in the evolution of society.

Technology has made the following medical procedures possible. Many of these procedures have generated considerable debate about the ethics of these procedures.

Some of these procedures include the use of technology to support:

- test tube babies;
- organ transplants;
- cloning;
- nuclear radiation;
- limb replacement;
- gene therapy; and
- nerve regeneration.

1.10.1.1 Telemedicine

Some of you may have previously seen or heard the terms teleconferencing or telecommuting. The Greek word 'tele' means 'distance', so teleconferencing provides opportunities to have a conference without all persons having to be in the same room, city or country. Similarly telecommuting or the less popular term, 'tele-working', was first offered in the 1960s by the information technology industry. This arrangement allowed employees to work at home and communicate with the office by methods such as phone, fax and computer.

So we now have yet another term 'telemedicine', where 'medicine'. Telemedicine involves telecommunications, where medical personnel and their patients are separated by some physical distance but are connected through technology so the professional can complete a medical procedure. Some of the services offered by telemedicine include medical diagnoses, pathology, radiology, and consultation, so that expertise can be made available in rural and remote areas.

1.10.1.2 Medical Self-Diagnoses

Many people are using knowledge-based database systems to research cures and symptoms of ailments, probably for self-diagnoses. These database systems, called expert systems perform tasks that would otherwise be performed by someone with expertise in the field. Expert systems can be used, not only to diagnose human illnesses, but also to make financial forecasts, and schedule routes for delivery vehicles. However it is important to note that while some expert systems replace human experts, there are others designed to assist them.

Having a medical complaint which is embarrassing should not be the sole reason to avoid consulting a doctor. Although there are well-documented and researched medical expert systems (such as WebMD) being able to access a website on the Internet to diagnose symptoms does not

automatically validate the authenticity or correctness of the online diagnosis. Only a doctor can do this. Database technologies are now used to store dental records, x-rays, medical insurance forms and other records for administrative, management and cross referencing. Here are some further examples of the development of database systems with associated technologies which are used as expert systems and have become tools for medical research.

1.10.1.3 Research

Research on genetics has discovered entire sets of genetic instructions in the cells of our body, their sequences and any possible unique features or abnormalities. Using computer technology has afforded:

The discovery of a gene which has the pre-disposition to develop colon cancer can save a life if genetic screening is done early. In contrast, persons in the early 1970s were either denied insurance coverage or were asked to pay increased premiums if they carried the gene for sickle cell anemia. Forensic personnel used computer technology to assist in the identification of people missing at the World Trade Centre. Tools were used to compare the victims' DNA with an item used by the victims, such as a toothbrush.

1.10.2 Education and Technology

Computer technology has moved the classroom from a teacher using a 'chalk and blackboard' to deliver passive instruction to student centred, discovery learning environments that employ a variety of computer and Internet technologies. Computer technology has allowed disenfranchised students in places like rural areas who at one time could not participate in traditional instruction to benefit from an anywhere, anyplace philosophy for the delivery of educational programs.

In Barbados, technology is now becoming a part of the classroom with the assistance of a government sponsored educational initiative called Edutech 2000. This programme is providing training in Information and Computer Technologies (ICTs) for teachers and students alike in order to develop the country's future workforce and ensure the country has suitable skills to compete in the international market.

In most countries today the typical public school program includes some instruction in computer technology, computer literacy skills and software familiarization. Most public schools throughout the Caribbean and parts of Africa have access to computers within their schools.

Technology is being used to support instruction and increase student and teacher technical knowledge and skills.

The introduction of computers to support classroom instruction has met mixed reactions. Some teachers embrace it, but many resist it because they don't have the pre-requisite skills to properly employ the technologies. Change will take time, resources and more teacher professional development. The Commonwealth of Learning is supporting the Open School Movement and the use of ICT to support instruction and student learning. Check it out.

Computer technologies and the advent of the Internet have allowed online universities to flourish. Examples of fully online universities include Indira Gandhi National Open University, Uttarakhand Open University, National Open University of Nigeria, Athabasca University and the Open University of the United Kingdom. Online universities and similar organizations around the world provide opportunities for millions of students to study anywhere and at any time.

Working professionals are now able to further their education without having to travel while maintaining full-time employment and an appropriate quality of life.

There are some disadvantages however with online activities, which include the lack of opportunity for human interaction and socialization. Many online students experience the feeling of isolation. Although the inclusion of online discussion forums and chat capabilities have somewhat alleviated this problem, there is still an issue with misinterpretation and miscommunication associated with text messages and phrases.

The online learning environment is slowly embracing new technologies like Podcasts, social networking software like Facebook, instant messaging technologies like Skype and web conferencing systems like Elluminate. Web 2.0 tools are helping close the social divide and providing more opportunities to interact with peers, learners and others in the educational communities.

1.10.3 Business and Technology

Computer technology has had a major impact on day to day business operations. Today companies that have failed to incorporate technology are viewed as being 'not-up-to-date' or archaic. Today organizations must have a presence on the Internet. Their company's goods and

services must be marketed online. Prolific use of electronic mail (or email) and electronic forms have replaced paper based forms and traditional snail mail (letters mailed through a post office). It is now the norm for business professionals to use technology to produce every memo, envelope, label and document using a word processor. Effective marketing materials require the use of graphic software and more to create and produce the layouts. Business presentations are created using computer software and delivered via laptop computers and projectors. Electronic payments and business banking accounts require the use of e-commerce software and secure Internet connections. The computer revolution has allowed traditional businesses to reduce infrastructure costs by allowing their employees to work from home. In North America over 40 million employees work from home using different types of Information and Communications Technologies (ICTs).

As traditional business practices become automated business leaders and HR personnel now demand that their current and future employees be computer literate. In the many parts of the developing world it is proving to be a challenge for those who are unable to reach the required standard thus impacting their employability.

1.10.4 Social Interactions and Relationships

The ability to text chat in a real time environment with your peers is known as Internet Relay Chat (IRC). IRC tools to support chat are available through your cell phone provider or on the Internet. Some of the more popular real time chat tools include Microsoft Live Messenger, Yahoo Messenger and others. These tools are becoming the norm for social interaction (especially among younger computer users) and it challenges in how people have traditionally interacted with each other – face to face discussions vice text chats with its own sub-culture language. As the cartoon below illustrates texting has become part of our culture.



I suspect there were smiles as you read the cartoon, but has the cartoon become a reality today? Are people unknowingly hiding behind the technology in order to minimize communicating with each other? Do people speak more freely with the use of technology or in person?

Over the years the Internet has evolved from a deliverer of static information text based technology to a platform that encourages social networking, idea exchange, collaboration and online community building. Tools like Facebook, Yahoo Groups and others allow individuals to connect with individuals of like minds and create their own virtual network of friends and colleagues. Tools like YouTube and Blogger have allowed everyone to create and share their own information. Everyone has opportunity to contribute to the world knowledge base and provide their own interpretation of personal, local, regional or national events.

This form of the Internet is known as Web 2.0 and has democratized our virtual space. Everyone is now equal and can post personal messages for the world to read.

1.10.4 Man- Machine Connection

I would hope by now that you would agree much of the world cannot live without having some form of computer technology in their lives. Does this mean that we are controlling computer technology or is the technology controlling us? During the late 1980s and 1990s, the Internet invaded our lives. Movies and TV shows included the Internet and sophisticated computers to entertain us. Some interesting ones were the 1982-1986 weekly television crime fighter series ‘Knight Rider’ which portrayed a modern-day hero who drove a high-tech smart car equipped with artificial intelligence. Sandra Bullock’s 1995 movie ‘The Net’, involved an Alfred Hitchcock style drama about having her identity electronically erased and replaced with a stranger’s information. Then in 1998, there is Will Smith starring in ‘Enemy of the State’ which speaks about the use of satellites to track people, as well as in ‘I Robot’ in 2004 about a ‘humanoid’ robot that is suspected to have murdered its creator. Whether you have seen these movies or not, the implicit use of computer technology in each of them sends the message that whether to help or hinder, that technology is everywhere. Today it is digitally generated 3D movies and animations like Avatar have caught our attention. These movies would not be possible without computer generated images and human machine interactions to capture life like character movement.

Technology has advanced so fast that more and more computers have an incredibly high fault tolerance, with robots automating the repair process, without any human intervention. One example are the robots that are used by NASA to repair the International Space Station. Seriously, we are not that far away from computers repairing themselves.

Let us now consider computer logics. Do “they” have the capability of handling complex thought processes like human ones? Almost!

1.10.4.1 An Example – Man Machine Practical Application

In 1998, a technology entrepreneur in northeastern Washington was implanted with a Radio Frequency Identification (RFID) chip into his hand in order to experiment with the technology. The chip and supporting computer technology was used to gain keyless entry to his car and

home, turn on lights, logon to his and other remote and repetitive applications. The experiment was successful and led to other applications for RFID technology..

An implantable RFID chip is a minuscule capsule containing a microchip and an antenna, all enclosed in glass. The chip is about the size of a grain of rice. RFID chips work by storing a unique identification number in the microchip. This number can be retrieved by a special RFID reader that is held within close proximity. Today there are most often implemented in animals to track their whereabouts and to include owner information that can be retrieved by a scanner used by a vet or other animal agency.

Although RFID technology is relatively old, it is still considered a controversial technology. Privacy advocates fear that the technology might be abused by governments and used to track people. Microchip implants have been used for years for tracking lost pets. Further European research in the area was recently dealt a blow when the European Group on Ethics in Science and New Technologies made a presentation to the European Union raising privacy concerns over the potential for such chips to be used to track members of the public.

When employing different technologies we must be aware of not only the technical issues, but issues of privacy, morality, society norms and ethical practices.

1.11 Summary

After reviewing this unit, reading the suggested articles and exploring the different links you should have concluded that:

- It seems that computer technology is largely responsible for the ‘emergency’ attitude of modern society. The perception that everything must be done faster, arrive sooner, or be available immediately has pushed services and information to be frequently available on a 24-hour basis.
- With computer technology, the types of negative impacts and the number of people directly affected by a single system error has grown enormously to where millions can be directly affected.
- There is unprecedented accessibility to information and communications, available to large numbers of people from nearly anywhere we happen to be.

- A computer is a machine which accepts data (called input), follows instructions given on what to do with the data (called processing), stores the results for future use (called storage) and displays the results (called output).
- The main role of computers and computer technology is the ability to manipulate data into information.
- Computer technology is ubiquitous, or (almost) everywhere.
- Computer technology has enabled us to access information at our 'finger tips', from many places, in many places, at any time, and in many different forms whether printed or stored.
- Information can be retrieved in many forms such as text, voice, graphics, and video.
- Computer technology has allowed surveillance to be made easier with the additional software that can monitor locations in other countries.
- Computer technology has changed the way we communicate with another person or among groups of people.
- Computer technology can improve our lives in health and medicine such as research in cures for diseases.
- Teleconferencing provides opportunities to have a conference without all persons having to be in the same room, city or country.
- Telecommuting allows employees to work at home and communicate with the office by methods such as phone, fax and computer.
- Telemedicine involves telecommunications, where medical personnel and the patient are separated by some physical distance.
- Expert systems perform tasks that would otherwise be performed by someone with expertise in the field.
- Databases are now used to store dental records, x-rays, medical, insurance and other records for searches and purposes of cross referencing.
- Computer technology has not completely replaced previous inventions; rather it is enhancing and improving on previous ones.

- Businesses have felt most of the impact of computer technology, such that if there is little technology incorporated then the business may be frowned upon as being ‘not-up-to-date’ or archaic.
- Internet relay chat (also known as messenger), is a common method of chatting with someone either next to you in class, or is a local phone call away.
- Many of us cannot live without having some form of computer technology in our lives.

Reference

Powley, R. (2011). *Introduction to Computers*. Retrieved Sep. 21, 2017, from http://doer.col.org/bitstream/123456789/8192/1/2011_VUSSC_Intro-Computers.pdf available under CC-BY-SA license.

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Chapter 2: The Evolution of Computer Technology

2.0 Learning Objectives

After studying this topic, you will be able to:

1. Describe the major developments in each generation of computer development.
2. Evaluate the need for different types of computer systems.
3. Distinguish between different hardware components of a computer.
4. Explain the functions/uses of the different components.

2.1 Introduction

Today many jobs mainly depend on the either the creation or collection, and distribution of information. This topic addresses the different advancements in computer technology and the various types of computers and their critical components. As each new computer generation improves on its previous generation, there have been a corresponding reduction in size (or miniaturization) of computer circuitry. In contrast to this miniaturization, the speed, power, and memory of computers have proportionally increased. Although this Topic will describe the major developments of each computer generation, it is more important to consider how the technology has influenced the development of current computer systems.

Table 1: Generations of Computer

Generation	Denoted by	Approximate range of years
1	Vacuum tube	1940s- 1950s
2	Transistor	Mid 1950s – early 1960s
3	Integrated circuit	Early 1960s – Early 1970s
4	Very Large Scale Integration/Microprocessor	Early 1970s – Mid 1980s
5	Parallel processing	Mid 1980s – Early 1990s
6	Reduced Instruction Set Chip (RISC) and more inventions to date	Mid 1990s to Present

2.2 The First Generation Computer (1940S-1950S)

2.2.1 Vacuum Tubes

These early computers comprised huge vacuum tubes (similar to light bulbs) whose main purpose was to strengthen weak signals for transmission. The vacuum tubes acted as switches to start and stop the instant flow of electricity. The concept underlying the on/off switch was the idea of ones and zeros. The combination of ones and zeros or on and off created a type of machine language that could be used to process information.

The first computer, the Mark 1, was so huge that it filled a typical stadium field and was said to have used more than 500 miles of wire. Its success however was its processing power, such as a mathematical problem that normally took 40 hours to solve, only took the Mark 1, 20 seconds to produce a result. It was used by the U.S. Navy during World War II, to help solve strategic military mathematical problems such as cracking secret codes and creating complex fire tables for naval guns and artillery. Scientists used the computer to predict weather patterns and for analyzing problems in airplane design. As noted earlier the language of this first generation was called machine language, which comprised zeros and ones for programming the computer.

The next computer, the ENIAC (Electronic Numerical Integrator and Computer) was an improvement on the Mark 1, since its processing power was about 1,000 times faster. The ENIAC was about 80 feet (24.4 m) long by 3 feet (0.9 m) wide, and used about 18,000 vacuum tubes. Unfortunately, the tubes were very hot, had to be replaced frequently, and were costly in using much electricity to keep them cool. The UNIVAC (Universal Automatic Computer) soon replaced the ENIAC by containing a compact 5000 tubes, a reduction from the 18,000 used in the ENIAC.

2.3 The Second Generation Computer (Mid 1950s – early 1960s)

2.3.1 Transistors

During this generation the significantly smaller transistors (a new technology) eventually replaced vacuum tubes as the processing component of the computer. This allowed engineers to

dramatically reduce the size and space needed to house a computer. Transistors proved to be cheaper to produce and emitted no heat, thus reducing the costs of manufacturing and making the technology more reliable since they conducted electricity faster vacuum tubes and failed less often.

This generation was noted for making space travel possible, and for the development of more sophisticated programming languages that allowed programmers to use short specific terms (e.g. ADD) to represent certain computer processing instructions. Higher level programming languages such as FORTRAN, ALGOL and COBOL, which use short English-like words, were developed during this generation. During this generation computer hardware and software was created that allowed users to store and retrieve programming instructions.

2.4 The Third Generation Computer (Early 1960s – Early 1970s)

2.4.1 Integrated Circuits

This generation improved on the previous one by miniaturizing the transistor and building several onto a single chip of silicon. This compacting of millions of transistors in a small space, also called an integrated circuit, greatly increased the power of computer, the processing speed, lowered its production costs even more and reduced the size of the computer.

During this generation the creation of new input and output devices were created. Keyboards, monitors, and the mouse made the computer a more user friendly environment and eliminated the need for huge stacks of punch cards to input data into a main frame computer. Output of the computer calculations could be read on screen vice printing out large amounts of paper with graphic symbols on them

2.5 The Fourth Generation Computer (Early 1970s – Mid 1980s)

2.5.1 The Microprocessor

Again an improvement on the previous generation, this generation continued to reduce the size of the silicon chip comparable to the size of a pencil eraser while vastly increasing its

computational speeds. This single chip with the components and processing speeds of a computer was called a micro-processor and was initially intended for use in calculators, not computers.

During this generation the silicon chip technology was harnessed by the chip manufacturer Intel. Intel in partnership with IBM created the first microcomputer, or personal computer. A few years later Apple in partnership with Motorola introduced the Macintosh to compete against the IBM personal computer. Only recently has Apple recognized the need for standardization and has embraced the Pentium technologies currently supported by Intel. During this periods new and more powerful programming languages developed. This included Pascal, C and compilers which converted the program to a lower level language that the machine could process. The UNIX operating system was also developed during this time to manage system resources.

2.6 The Fifth Computer Generation Computer (Mid 1980s – Early 1990s)

2.6.1 Artificial intelligence and Parallel Processing

The goal of this generation is to develop devices that are capable of responding sensibly to a user's natural language and also capable of learning and self-organization. It is characterized by the introduction of computers with hundreds of processors that could be assigned to work on different sections of a single program. This is called parallel processing, and is being used to develop communication between a computer in natural spoken language and its user, through access to a vast knowledge database to make intelligent inferences and draw logical conclusions in the way that humans do.

Several programming languages known as artificial intelligence (AI) languages have been developed simply because they are used almost exclusively for AI applications. The two most commonly used languages are LISP and Prolog. The linking of computers together, called computer networks, and the increasing use of workstations were also developed during this generation.

2.7 The Sixth Generation (Mid 1990s to Present)

2.7.1 Computers and Video Games

This era refers to the generation of computer and video games which became popular around 1998. The Nintendo Game Cube, Sony PlayStation 2, and Microsoft's Xbox are noted to have dominated game playing in all age groups.

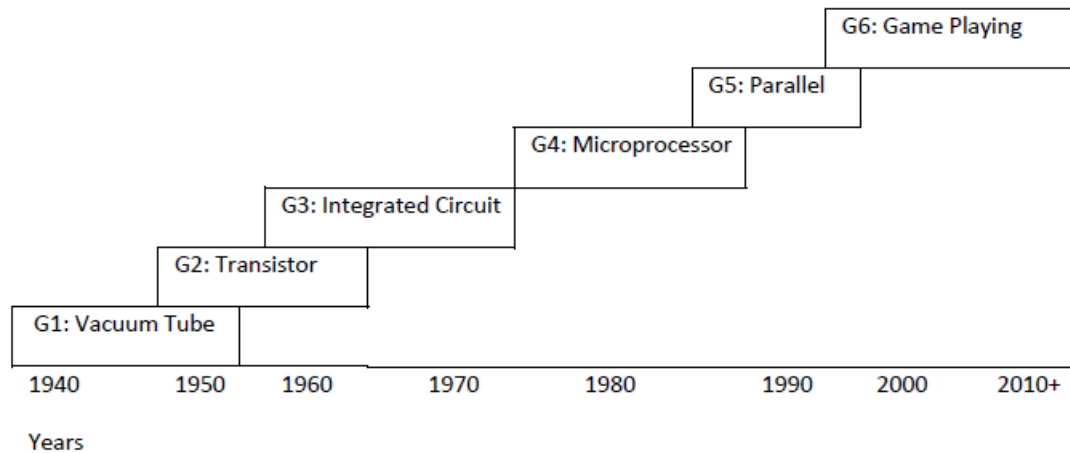


Figure 1: General Timelines of Generations of Computer

2.8 Types of Computer Systems

In the past computers were classified as microcomputers, minicomputers, or main-frame computers, based on their size. Today these distinctions are rapidly disappearing as the capabilities of even the smallest units rival that of their earlier big brothers. Today's microcomputers are faster, more powerful and more versatile than the minicomputers and the main-frame computers were a few years ago. Table below describes the terms used to classify today's computers and computing devices.

Type of Computer System	Brief Description
Desktop Computer	A PC that is expected to be placed on the top of a computer or other desk. Desktops usually are powerful and have reasonably large secondary storage. Desktops require a number of input and out devices to make them useful.

Laptop	Compared to the desktop, laptops are portable computers that have their monitor, keyboard, and other memory and storage devices all included in a packages that is up 17 inches in size and is powered by a special battery. Laptops are also called notebooks.
Mainframe	Mainly associated with large companies, that process millions of transactions calculations from multiple sources at one time, mainframes previously filled large rooms, but today consist of a number of linked components that allow the different processors to communicate with one another and share their total computing power.
Minicomputer	Minicomputers are powerful and can support many users at once. Their size is between microcomputers (PCs) and mainframes.
Palmtop	More commonly called Personal Digital Assistants (PDAs). They are compact computers that often use special secondary flash memory instead of a typical hard drive for storage. Palmtops usually have optional keyboards but mainly use touch screens for input. They are typically the size of a paperback novel or even smaller and are very lightweight and use battery power.
Personal Computer	Personal Computers (PC) was designed to be used by individuals for general use. The PC is not usually associated with the Apple Mac although it is a PC. Often the term desktop and PC are used interchangeably.
Server	A computer that has been optimized to provide services to other computers over a network. Servers usually have powerful processors, lots of memory and large hard drives. They often provide custom services such as an e-mail server, a backup server, a database server, etc.
Supercomputer	Supercomputers have the world's fastest processors and are

	able to perform millions of computations a minute. Supercomputers are normally comprised of multiple high performance computers working in parallel as a single system. The best known supercomputers are built by Cray Supercomputers.
Wearable Computer	This is the latest trend in computing where common computer applications such as electronic mail, are integrated into watches, cell phones, visors and even clothing.
Workstation	A workstation is a desktop computer with a more powerful processor, and more memory for performing a special functions, such as 3D Graphics

2.9 Computer Hardware and Peripherals

2.9.1 INPUT Devices

You use input devices to provide information to a computer, such as typing a letter or giving instructions to a computer to perform a task. Some examples of input devices are described in the following list.

1. Mouse: A device that you use to interact with items displayed on the computer screen. A standard mouse has a left and a right button.
2. Trackball: This is an alternative to the traditional mouse and is favoured by graphic designers. It gives a much finer control over the movement of items on the screen. Other screen pointing devices are pointing stick, touch pad, joystick, light pen, digitizing table.
3. Keyboard: A set of keys that resembles a typewriter keyboard. You use the keyboard to type text, such as letters or numbers into the computer.
4. Scanner: A device that is similar to a photocopy machine. You can use this device to transfer an exact copy of a photograph or document into a computer. A scanner reads the page and translates it into a digital format, which a computer can read. For example, you can scan photographs of your family using a scanner.

5. Barcode Readers: When used in a business barcodes provide a lot of information. Made up of columns of thick and thin lines, at the bottom of which a string of numbers is printed.
6. Multimedia devices: This is the combination of sound and images with text and graphics. To capture sound and image data, special input devices are required.
 - a. Microphone: Voice input, for instance, can be recorded via a microphone. A device that you can use to talk to people in different parts of the world. You can record sound into the computer by using a microphone. You can also use a microphone to record your speech and let the computer convert it into text.
 - b. Webcam: A device that is similar to a video camera. It allows you to capture and send the live pictures to the other user. For example, a webcam allows your friends and family to see you when communicating with them.
 - c. Digital cameras: record photographs in the form of digital data that can be stored on a computer. These are often used to record photographs on identity cards.

2.9.2 OUTPUT Devices

Output devices in the computer system are the equipment whereby the result of a computer operation can be viewed, heard or printed. You use output devices to get feedback from a computer after it performs a task.

1. Monitor: A device that is similar to a television. It is used to display information, such as text and graphics, on the computer.



Figure 2: Monitor

2. Printer: A device that you use to transfer text and images from a computer to a paper or to another medium, such as a transparency film. You can use a printer to create a paper copy of whatever you see on your monitor.

- a. Impact printers: Dot matrix printers are an example of impact printers. They form characters from patterns of dots. They are inexpensive, but the output can be difficult to read.



Figure 3: Impact printer

- b. Non impact printers: Inkjet printers work by shooting a jet of ink in the shape of the character required, they provide good, low-cost colour printing.



Figure 4: Non-impact printer

- c. Laser printer: a laser beam is directed at an electro-statically charged surface, creating a template of the page to be printed. This template is then used to transfer the ink to the page. Toner sticks to the light images and is transferred to paper.



Figure 5: Laser Printer

3. Plotter: A plotter is an output device similar to a printer, but normally allows you to print larger images. It is used for printing house plans and maps.



Figure 6: Plotter

4. Multimedia Output Device: The most common multimedia output is sound, including music. The audio output device on a computer is a speaker. Headphones can also be used to receive audio output.



Figure 7: Multimedia Output Device

2.10 Process and Storage Devices

The system unit is the name given to the main computer box that houses the various elements as illustrated in the picture below. How do we get the different computer parts to work together so that your computer can work? Let's start of our discussion with the process devices.

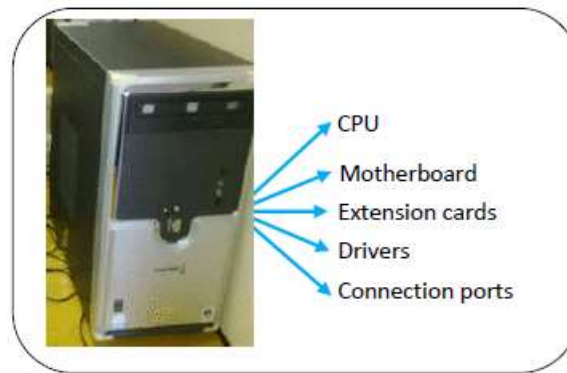


Figure 8: System device

2.10.1 Mother Board

Inside the systems unit is a circuit board with tiny electronic circuits and other components which is called a mother board. It is sometimes called a system board. The motherboard connects input (keyboard, mouse and scanner), output (monitor, speakers, and printer), processing (CPU, RAM and ROM) and storage (hard drive, CD-ROM/DVD-ROM and flash drives) components together and tells the CPU how to run (Lubbe and Benson, 2010:18). Other components on the motherboard include the video card, the sound card, and the circuits that allow the computer to communicate with devices like the printer.



Figure 9: Motherboard

2.10.2 Expansion Cards

Yes you can play music and video files on your computer. But how is it possible?

Inside the computer system box you also find an expansion card which is another circuit board that can be attached to the motherboard to add features such as video display and audio capability to your computer. Expansion cards are also called expansion boards that enable your computer to use the multimedia devices. An expansion card either improves the performance of your computer or enhances its features. Examples of expansion cards that can be added include:

- 1. Video Card:** It is connected to the computer monitor and is used to display information on the monitor.
- 2. Network Interface Card (NIC):** The NIC allows the computer to be connected to other computers so that information can be exchanged between them.
- 3. Sound Card:** It converts audio signals from a microphone, audio tape, or some other source to digital signals, which can be stored as a computer audio file. Sound cards also convert computer audio files to electrical signals, which you can play through a speaker or a headphone. The microphone and the speakers or the headphones connect to the sound card.

2.11 Storage Devices

All computers need to store and retrieve data for processing. The CPU is constantly using memory from the time that it is switched on until the time you shut it down. There are two types of storage devices as illustrated in the flow chart below.

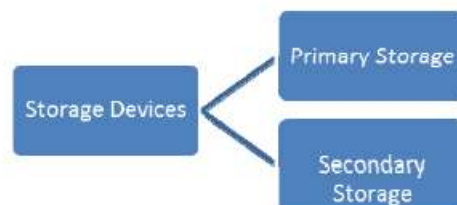


Figure 10: Types of storage devices

Primary Storage is also called main memory or immediate access store (IMAS). This is necessary since the processing unit can only act on data and instructions that are held in primary storage. Primary storage consists of two types of memory chips:

- Random Access Memory (RAM)
- Read Only Memory (ROM)

2.11.1 Random Access Memory (RAM)

Random Access Memory (RAM) is the main working memory. RAM is only filled after computer has been turned on and is given something to do. It holds data and instructions temporarily while processing takes place. RAM is volatile – this means that if the power is turned off or the computer reboots (start up again) all the information held in RAM will be lost. RAM is measured in MB (megabytes) and most entry level computers will have 1024 MB RAM but you also find some computers having up to 3 GB RAM. RAM chips are expensive and the price of a computer is determined by the amount of RAM space in the chip.



Figure 11: RAM

2.11.2 Read Only Memory (ROM)

Read Only Memory (ROM) holds data and instructions necessary for starting up the computer when it is switched on. These instructions are hard-wired at the time of manufacture. ROM is permanent and cannot be deleted but can only be accessed or read, hence the name Read Only Memory. Data stored in ROM is non-volatile – meaning that memory will not be lost when power is turned off.



Figure 12: ROM

2.11.3 Units of Storage

The memory of all digital computers is two-state (bi-stable) devices. Computers operate using a **binary number system** – and therefore use *binary digits (bits)*. Bits have only two values by 0 and 1. **A bit** is the smallest unit of storage in a computer. The amount of data and instructions that can be stored in the memory of a computer or secondary storage is measured in bytes.

A byte is made up of a combination of eight (8) **bits** and has the storage power to represent one character (a character is a letter or symbol or punctuation mark or blank space).

Units of Storage	
1 byte	8 bits
1 kilobyte (K)	1024 bytes
1 megabyte (MB)	1000 kilobytes (approx. 1 million bytes)
1 gigabyte (GB)	1000 megabytes (approx. 1 billion bytes)
1 terabyte (TB)	1000 gigabytes (approx. 1 trillion bytes)

2.11.4 Secondary Storage Devices

PCs use a simple method of designating disk drives to store data. These drives are assigned letters of the alphabet.

A Drive	Floppy drive. Still found in older computers
C Drive	Internal hard drive (hard disk drive) situated inside the system case.
D Drive	Usually the CD-ROM/DVD-ROM drive although can also be used for another virtual or physical hardware if a second one is deployed.
E Drive or Higher	Usually use for any other disks, such as CD-writer, USB flash drive, external hard drive, etc.

Data and information stored on a permanent basis for later use. Secondary storage is cheaper to purchase and access. Hard disks, Zip drives, Optical disks (CD's and DVD's) are all examples of secondary storage.

1. **Internal Hard Disks** are rigid inflexible disks made of highly polished metal. Data is stored magnetically. They can contain a single disk or two or disks stacked on a single spindle. They come in a variety of sizes but all have a very high storage capacity compared to floppy disks. An average computer has a hard disk of about 80 -250GB. It provides direct access to information.



Figure 13: Internal hard disc

2. **External hard Disks/Drive** - same features as the internal hard disks, but are external to the system unit and therefore can be carried around.



Figure 14: External hard Disc

3. **USB flash drive** consists of a flash memory data storage device integrated with a USB (Universal Serial Bus) interface. USB flash drives are typically removable and rewritable. They come in a variety of sizes to include 128MB, 256MB, 512MB, 1G, 2G, 8G etc.



Figure 15: USB flash drive

4. **Memory Card** - Use mainly with digital cameras, cellular phones and music players (MP3, MP4 and iPods). They offer high-re-record ability and fast and power-free storage. Data can be access by linking the card to a computer using a USB cable or a memory card reader.



Figure 16: Memory card

5. **Optical Disks** are disks that are read by laser beams of lights. The three main types are CD-R, CD-RW and DVD.



Figure 17: Optical disc

- a. **CD-R** or CD-ROM (Compact Disk – Read Only Memory) are so called because you can only read the information on the CD-ROM. They are particularly useful for storing multimedia (texts, graphics, sound and videos), application software packages.
- b. **CD-R** or Compact Disk Recordable allows you to write information onto the disk only once using a CD recordable burner.
- c. **CD-RW** or Compact Disk Rewriteable, allows you to write and erase information from the disk many times. They are used to store large volumes of information such as texts, graphics, sound and video.
- d. **DVD** disks or Digital Versatile Disks are specifically created to store movies. A typical DVD disk can hold between 4.7GB and 17GB of information.

2.12 Activity

1. Consider the advantages and disadvantages of the development of artificial intelligence in this generation.
2. Reflect upon what facilitated the increase in speed, power or memory in each of the computer generations.
3. Explain, with reasons, which computer system(s) would be most appropriate in the following examples:
 - a. Business executive who travels often
 - b. Student who needs to prepare a History project report
 - c. A multi-million dollar company with six branches in the country and three in other countries
 - d. Banking system with many tellers who access the same customer database

4. Look around in your immediate environment (shops, government institutions, at home, etc) and see if you can recognize any of the above discussed input devices. Can you remember the functions of each of the devices that you have identified?

2.13 Summary

1. Since the 1940s when computer technology was used to support the creation of firing tables for the artillery and to the introduction of the World Wide Web network of computers in the 1980s computer technologies have become a large part of our everyday life. The use of computers is accelerating. They are now in our cars, our phones, our refrigerators. Almost every type of electronic device has a computer chip in it. Each chip relays on commands. Commands must be input using different devices. The next topic will examine some of these input and output devices.
2. Computer hardware consists of input, output, process and storage devices.
3. You use input devices such as keyboard, mouse, scanner and multimedia devices to provide information to a computer.
4. Output devices are use to get feedback from a computer after it performs a task.
5. Examples include monitor, printer and multimedia devices.
6. CPU takes raw data and turns it into information. The CPU is made up of Control Unit, Arithmetic Logic Unit (ALU) and the main memory.
7. Storage devices are divided in primary and secondary storage devices.
8. Primary/main memory is subdivided into ROM and RAM.
9. Random Access Memory (RAM) is the main memory and allows you to temporarily store commands and data.
10. Read Only Memory (ROM) retains its contents even after the computer is turned off.
11. A bit is the smallest unit of storage in a computer.
12. The amount of data and instructions that can be stored in the memory of a computer or secondary storage is measured in bytes. A byte is made up of a combination of eight bits and has the storage power to represent one written character.
13. Hard disks, CD-R, CD-RW and DVD are secondary storage devices.

Reference

Powley, R. (2011). *Introduction to Computers*. Retrieved Sep. 21, 2017, from http://doer.col.org/bitstream/123456789/8192/1/2011_VUSSC_Intro-Computers.pdf available under CC-BY-SA license.

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Chapter 3: Computers and Computing

3.0 Learning Objectives

After studying this topic, you will be able to:

1. Distinguish between a computer and a computer system.
2. Explain the term general computer system.
3. Explain the term embedded system.
4. Show diagrammatically the components of a computer system.
5. Describe a central processing unit (CPU).
6. Explain arithmetic and logic unit (ALU).
7. Define primary memory and how it functions.

3.1 General Purpose Computer System

When you look at a desktop computer, it comprises a monitor, keyboard, mouse, and a vertical or horizontal box called a system unit. It is acceptable to refer to all of these components as a computer. Technically the systems unit houses the actual ‘computer’ or programmable machine (hardware, firmware and software), which executes (carries out) or responds to a sequence of program instructions. A computer system then is a collective term for a computer (housed within the system unit), as well as these other components that are attached to it to allow the user to input data and view output using different devices. Some of these components include a monitor, keyboard, mouse, printer, disk drives, scanners, microphones, and speakers, which are also referred to as peripherals. The peripherals work together to help the user accomplish a given task effectively. Therefore, as an example, when you perform a calculation, the keyboard – a peripheral device- is used to input the data.

It is the system unit that accepts and processes the data, and generates the results. Other peripheral devices such as the hard drive store the data and results, which can be viewed on the monitor.



Figure 18: General Purpose Computer System

The peripheral devices mentioned above are collectively called hardware devices, since they can be physically attached to the computer. However, computer systems also include software, or programs that are integral in the functioning of some of these peripheral devices and are necessary to make the computer operate. Every computer system, for example, requires an operating system. An operating system is a program that establishes communications with the various peripherals and acts as a bridge to other application specific software programs. An operating system is like the command centre of the ship. It makes all of the decisions about how the computer will function and work with others.

3.2 Embedded Computer Systems

The typical personal computer or laptop described in the last discussion is categorized as a general-purpose computer system. This section will explore a special type of computer system called an embedded system. Embedded systems are designed to perform a very small number of very specific functions. For example a GPS computer in a car only provides driving instructions. It cannot perform any other computing function. A typical embedded system also uses certain types of hardware, and limited resources, such as small keyboards, screen and reduced memory. These systems are also actually built into the device they are controlling.

Compared to a typical computer, embedded systems are often smaller in size, tend to be cheaper, and as a result many are mass-produced. Embedded systems range from small portable devices to large complex systems. The major difference is that they are single purpose devices with only one form of input or output. Some may also have simple user interfaces or displays which include buttons, or touch screens, while others have none at all.

Table 2: Examples of systems and devices which comprise embedded systems

Portable devices	Large complex systems
Digital watches	Traffic lights
MP3 players	Systems controlling nuclear power plants
Microwave ovens	Controllers used in remote machine operation
Washing machines	Navigation Systems
Television sets	Military Weapons Systems
DVD players	
Air conditioners	
Sprinklers	
Security monitoring system	
Handheld computers	
Thermostats	

Mobile (cellular) phones and handheld computers may be categorized as embedded systems, but since these devices can be enhanced with the addition of other applications and peripherals, they are better suited to the category of general purpose computer systems and not really embedded systems.

3.3 Computer System- How it Works

The major components of a computer system include input and output devices as well the important processor or central processing unit (CPU). The CPU comprises a set of electronic circuits kept within the system unit. The CPU is the brain of a computer system and is responsible for processing the data that is input from a peripheral device and output to another peripheral device. Figure 19 illustrates the major components of a system unit that is attached to an input and output device.

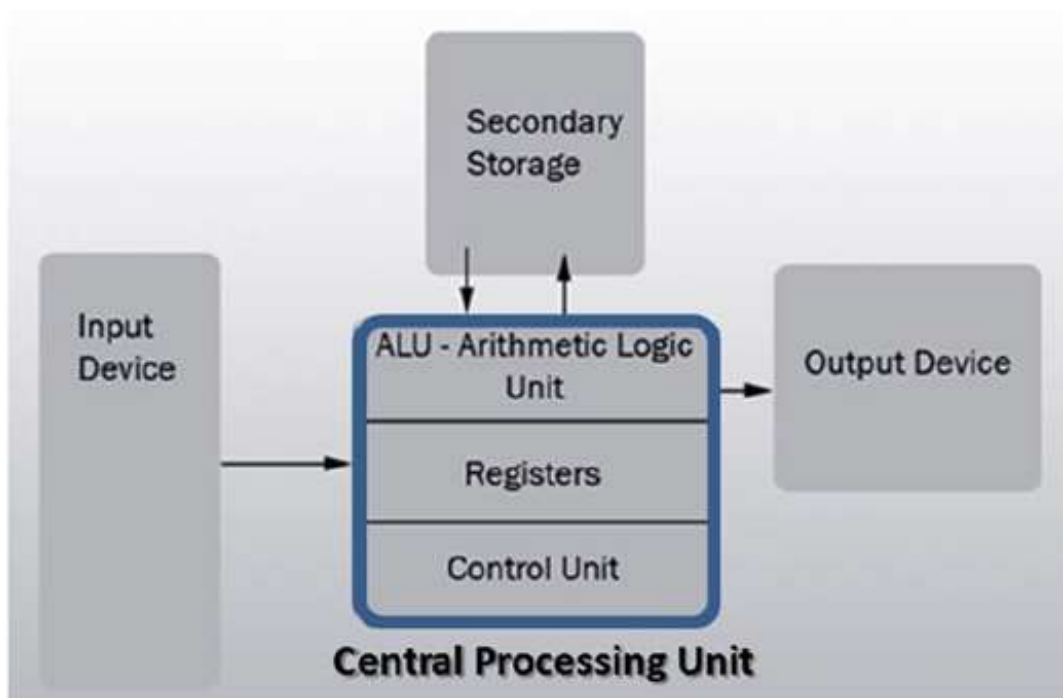


Figure 19: Central Processing Unit

The Central Processing Unit (CPU), also known as the processor or microprocessor has components that control the operating system and other software installed on the computer. The CPU also sends commands and data to the peripherals attached to the computer, such as the monitor or printer.

Therefore the speed (how fast the electrons move around the chip) at which the CPU executes its tasks (or commands) determines how quickly you can view or hear the output from the command; such as printing a page or allowing you to view a letter on the monitor. This speed is called 'clock speed', and is measured in megahertz (MHz). A computer system that responds to commands quicker means that its clock speed is working faster to execute these commands. Table 2 compares some common CPUs and their clock speeds. Different CPUs use different silicon chips to execute the commands and process data. Different types of chips have different clock speeds based on the technology that was used to create them. Some examples are provided below.

Table 3: Typical CPU Speeds Based on Chip Type

Name of CPU	Average CPU Speed
Intel Celeron	500 MHz - 800 MHz ¹
Intel Pentium II	233 MHz - 450 MHz
Intel Pentium III	450 MHz - 1 GHz ²
Intel Pentium 4	1.4 GHz - 2 GHz
Intel Core i7	3.6 Ghz
AMD Athlon XP	1.4 GHz - 1.8 GHz
Macintosh G4	733 MHz

Now let's look deeper into the operation of the CPU. All computer systems have a CPU which comprises (1) a control unit and (2) arithmetic and logic unit (ALU).

3.3.1 The Control Unit (CU)

The control unit is similar to an efficient manager. It is responsible for directing other parts of the computer system in order to carry out the instructions for the task required. The control unit (CU) must interact with the arithmetic and logic unit (ALU) and memory to complete its tasks. As instructions are fetched from memory, the CU interprets the instruction. The CU then sends commands to other components to gather data that may be needed to complete the instruction, even if it involves a transfer of data from other components and devices. The CU then determines where to send the result. This may include activating the printer, showing the result on the monitor or playing a sound on the speakers.

3.3.2 Arithmetic and Logic Unit (ALU)

The Arithmetic and Logic Unit (ALU) is the part of the CPU which performs all arithmetic and logic operations this involves arithmetic calculations including addition, subtraction and multiplication. As calculations are required, the Control Unit sends them to be performed in the ALU which sends the result back to the Control Unit. It also performs logic operations such as comparisons of numbers or letters to test for, such as equal-to (=), less-than (<), greater-than (>) and other combinations, such as less-than or equal-to (<=).

3.3.3 Memory

Primary memory is necessary to store instructions and data for processing, but they are not part of the CPU. Memory is a separate chips stored on a mother board which connects all the hardware together. Program instructions or data are kept in primary memory for only as long as the program currently using them. In human terms this would be considered "short term memory". The original instructions and data are lost once the computer is turned off; therefore primary memory is deemed volatile. In later units we discuss those non-volatile devices which allow data and instructions to be permanently stored in a computer system for use later on. Primary memory is also as – memory, main memory, primary storage, main storage, internal storage, computer memory and RAM (Random Access Memory).

3.4 Processing Data

Processing data is the most important activity in the computer, and so the task of the processor is to interpret and execute program instructions, in order to transform data into information. The processor is also responsible for interacting with the input, output and storage devices. Keeping instructions and data in primary memory when a program is not in use is not feasible for three reasons:

- The processed data may be too much to be held in primary memory.
- Generally primary memory only stores data and instructions while the computer is turned on, but once the computer is turned off, the data and instructions are lost.
- If more than one program or application is opened at the same time, then, a single program should not exclusively use all the memory; some memory should be available for the other programs to use.

The amount of memory available to hold the data and instruction is measured in *megabytes* or MB. A personal computer with a minimal amount of memory of say less than 512 MB may not be able to perform efficiently and may be rather slow in executing the applications. Memory is also loosely known as RAM which is an acronym for *Random Access Memory*. It should be noted there that the word *random* implies that data can be retrieved quickly, and in the same length of time, regardless of where the data is located (that is, the address of the data).

3.4.1 Read Only Memory (ROM)

Read-only memory or ROM is an integrated circuit, programmed with specific data when it is manufactured. It is used in computer systems and other electronic devices. RAM and ROM are different since data stored in ROM cannot be modified easily. In other words, ROM is ideally suitable for storing a set of data for the life of the device, and is therefore non volatile. Modern types of ROM include such as Programmable ROM (PROM), Erasable Programmable ROM (EPROM), Electrically Erasable Programmable ROM (EEPROM) and flash memory can be erased and re-programmed many times, although they are still called ROM because the reprogramming process is usually rarely done. Many ROM chips are often identified by the prominent circular ‘window’ which allows ultraviolet (UV) light to enter and erase its contents.

Flash memory (or simply flash) is a modern type of EEPROM which can be erased and rewritten faster than EEPROM. Flash memory is mainly used in memory cards, USB flash drives, memory stick, flash stick and jump drive), which are used for general storage and transfer of data between computers and other digital products.



3.4.2 Function of the Machine Cycle

Consider a user who needs to add two numbers, 10 and 15. These numbers may be input at the keyboard and the results shown on a screen. The processing of this simple addition is carried out in the CPU.

Let us examine how a single instruction is executed or carried out in the central processing unit. Of course, computers today generally execute one instruction at a time, although as quickly as a fraction of a second.

In order to carry out an instruction, the program instructions and data must be moved into memory from either an input device or a secondary storage device. Once in memory, the control unit and ALU in the CPU work together to perform the following four steps (fetch, decode, execute, and store) for each instruction. These steps are collectively known as the machine cycle or the processing cycle. This machine cycle has two phases, the instruction cycle (instruction time, or I-Time) and the execution cycle (execution time or E-Time). Let us examine these cycles in more detail.

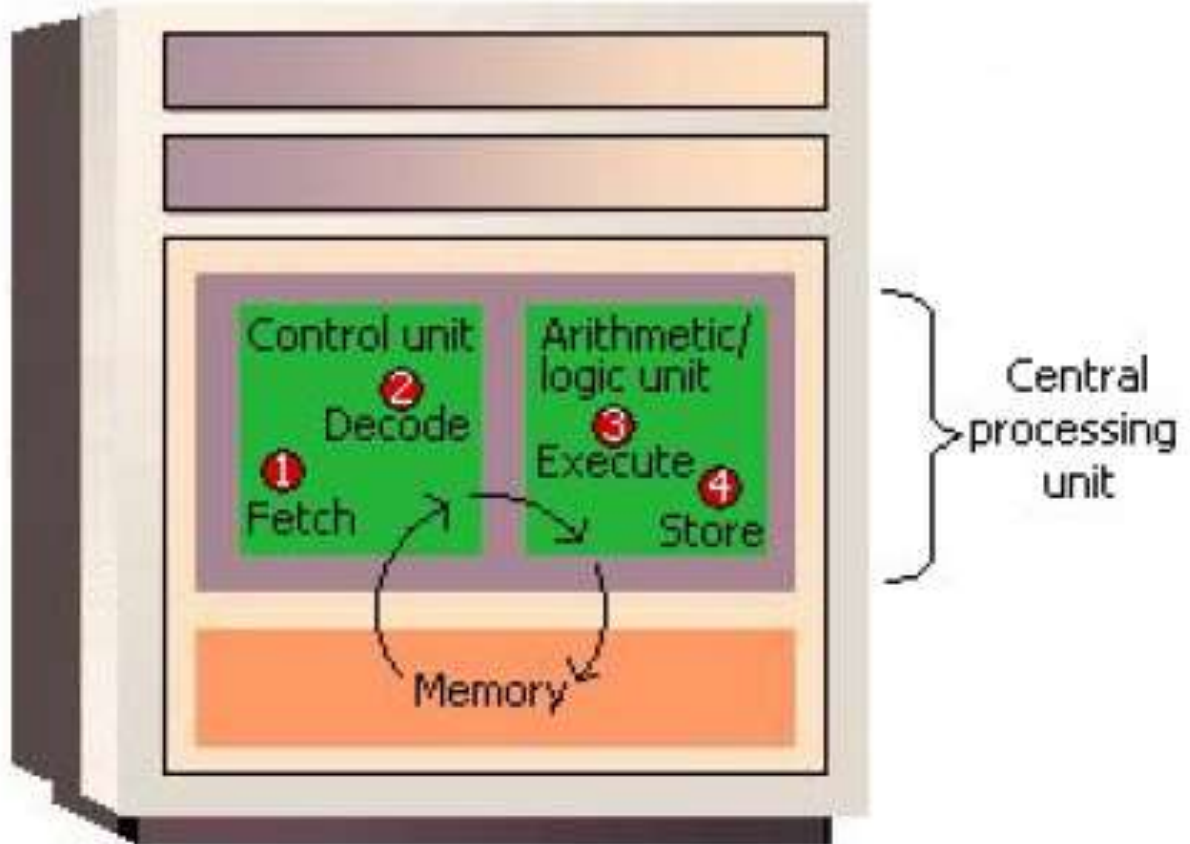


Figure 20: Machine Cycle

Phase A: Instruction Cycle

1. **Fetch Instruction:** The control unit fetches (gets) the program instruction from memory.
2. **Decode Instruction:** The control unit decodes the instruction (decides what it means) and then moves the necessary data from memory to the ALU.

Phase B: Execution Cycle

3. **Execute Instruction:** The ALU performs the requested action, by executing the arithmetic or logical instructions on the data.
4. **Store (write) Result:** The ALU writes or stores the result of this operation in memory or in a temporary register.

Once these two phases are complete, the control unit instructs memory to send the result to an output device or a secondary storage device. The figure below illustrates how these cycles interact to produce a result.

We have already noted that the Control Unit is ideally the brain of the CPU, and must be very organized. For all instructions to be processed the Control unit must have the data ready and the cycles working like, well, like clock work! If the control unit is regarded as the brain, then the clock is regarded the heart of the computer. Every operation in the processor takes place like the ticking of a typical old-fashioned mechanical clock. Each 'tick' may indicate the beginning and each 'tock' the end of a basic interval of time in the processor during a clock period. During this beginning and end phase, data moves as directed from the CU.

We have discussed instructions, data, and memory, as well as the machine cycle functions in two phases. Let us now briefly mention how the control unit is able to retrieve the correct data and instructions from memory. This is done by giving each instruction and each piece of data an address, just as persons have an address for their home. So the addresses say the same, but just as people move to new addresses, different instructions and data are moved to new addresses or locations when the old data is no longer needed in memory. Just like a mailbox for an address can hold so many letters and packages, similarly each memory location can also only contain a fixed amount of data. Finally as mailboxes may have a label or number affixed to it, so do memory addresses have representative address names such as Hours, Age, or Name.

3.5 Summary

The following concepts were covered in this unit:

- A computer is a device that accepts data, uses a program to process the data, and generate results.
- A computer system is a collective term that includes a computer and all peripheral devices attached to it, such as a monitor, keyboard and mouse.
- An embedded system is a special-purpose computer system designed to perform a dedicated function.

- The main components of a computer system include the Central Processing Unit (CPU), primary memory, input and output devices, and secondary storage.
- The Central Processing Unit (CPU) comprises the Arithmetic and Logic Unit (ALU) and the Control Unit (CU).
- The ALU is the part of the CPU which performs all arithmetic and logic operations this involves arithmetic calculations including addition, subtraction and multiplication, as well as comparison of numbers and text.
- The control unit is responsible for directing other parts of the computer system in order to carry out program instructions.
- Both primary memory and secondary storage are also necessary to store instructions and data for processing, but they are not part of the CPU.
- Each new computer generation improves on its previous generation, by reduction in size (or miniaturization) of computer circuitry.
- First Computer Generation is characterized by the huge vacuum tubes whose main purpose was to strengthen weak signals for transmission, and used switches to start and stop the instant flow of electricity.
- Second Computer Generation replaced vacuum tubes by a much smaller transistor.
- Third Computer Generation produced and compacted millions of transistors on to an integrated circuit.
- Fourth Computer Generation is instrumental in the invention of the microcomputer, also known as a personal computer.
- Fifth Computer Generation is developing communication between a computer in natural spoken language and its user.
- Sixth Generation refers to the generation of computer and video games.
- Primary storage is used to temporarily hold data and instructions.
- Primary memory is known by other terms which are used interchangeably – memory, main memory, primary storage, main storage, internal storage, and RAM (Random Access Memory).
- In order to carry out an instruction, the program instructions and data must be moved into memory from either an input device or a secondary storage device.

- The control unit and ALU in the CPU work together to perform the following four steps (fetch, decode, execute, and store) for each instruction

In this unit, the evolution of computer systems through a number different generations was considered. Although it may have appear to many as simply a historical perspective, it is important to view this history as clues for the underlying trend that brought computer systems to what they are today. This trend illustrates the reduction in size at each stage which also coincided with increased speed of the system designed to handle the many tasks required of it in this latest generation.

We also explored the distinction between a computer and a computer system along with introducing the concept of special-purpose computer systems. We also explored the components of a general computer system and their inter-connections and reliance on each other. Finally a description of how a computer processes data was explained.

Reference

Powley, R. (2011). *Introduction to Computers*. Retrieved Sep. 21, 2017, from http://doer.col.org/bitstream/123456789/8192/1/2011_VUSSC_Intro-Computers.pdf available under CC-BY-SA license.

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Chapter 4: Software

4.0 Learning Objectives

At the end of this unit, you should be able to:

1. Explain the purpose of system software.
2. Distinguish among the three major categories of system software.
3. Explain the interaction between the user and the computer and the role of system software to support this interaction.
4. Explain the different types of useful application software.
5. Explain the word processing document life cycle.
6. Explain the purpose of spreadsheets in business.
7. Describe a statistical application that is used to analyze data.

4.1 Operating Systems, Utility Programs and Language Translators

There are three different types of software that are part of all computer systems and that ensure that the hardware and application programs can effectively communicate with each other. This software is classified as operating systems, utility programs and language translators.

4.1.1 Operating System

A computer cannot work without an operating system! The operating system comprises a set of coded programs that work with the peripheral devices and computer hardware to control and organize the general operating functions of the computer. Some of these functions include:

- Starting the computer (also called ‘booting’),
- Managing and monitoring other programs, memory management, communications management and the management of peripheral devices,
- Enabling interaction between the user and the computer system through the use of external input devices, and
- monitoring and security of access to data and applications.

4.1.1.1 Starting the Computer

Starting the computer, also called *booting*, is the process of loading the operating system into the computer's memory so it can execute the different operations and manage the hardware devices. When the power button on the computer is turned on to load the operating system, this process is called a cold boot.

If the computer system is already on and the system needs to be re-started for a number of reasons (like the hardware stops operating or the user gets an error message), then the process of reloading the operating system is called a warm boot (because the computer was already on). A warm boot in a Windows based PC is normally done by holding down the CTL-ALT-DEL keys at once.

4.1.1.2 Managing Other Programs

The computer system needs to manage the programs that the computer user needs to complete business or personal tasks such as a word processing, Internet research, spreadsheet production and others. The operating system must therefore be able to manage one or more software application programs at the same time. This is known as multi-tasking and the computer is considered a multi-tasking operating environment. For example, multitasking operating systems run more than one application program at a time. Suppose a user has a word processing program, Internet browser and a spreadsheet open at the same time and the computer user is currently typing a report, using the word processing program. The word processing program is called the active program, since it is the current program in use while the other programs – the Internet browser and spreadsheet – are called inactive programs since they are running in the background and are not currently in use.

Since computers use primary memory to increase processing efficiency, the operating system allocates memory spaces for each running program so that the individual programs do not interfere with each other. In order to accomplish this, the operating system uses 'virtual memory' or secondary storage, as an extension of random access memory (RAM).

This is illustrated in the figure 3.1. Sometimes, if there are too many applications opened, then the operating system is unable to allocate adequate memory to each application. When this

happens, none of the applications may appear to work and the computer system may need a warm boot.

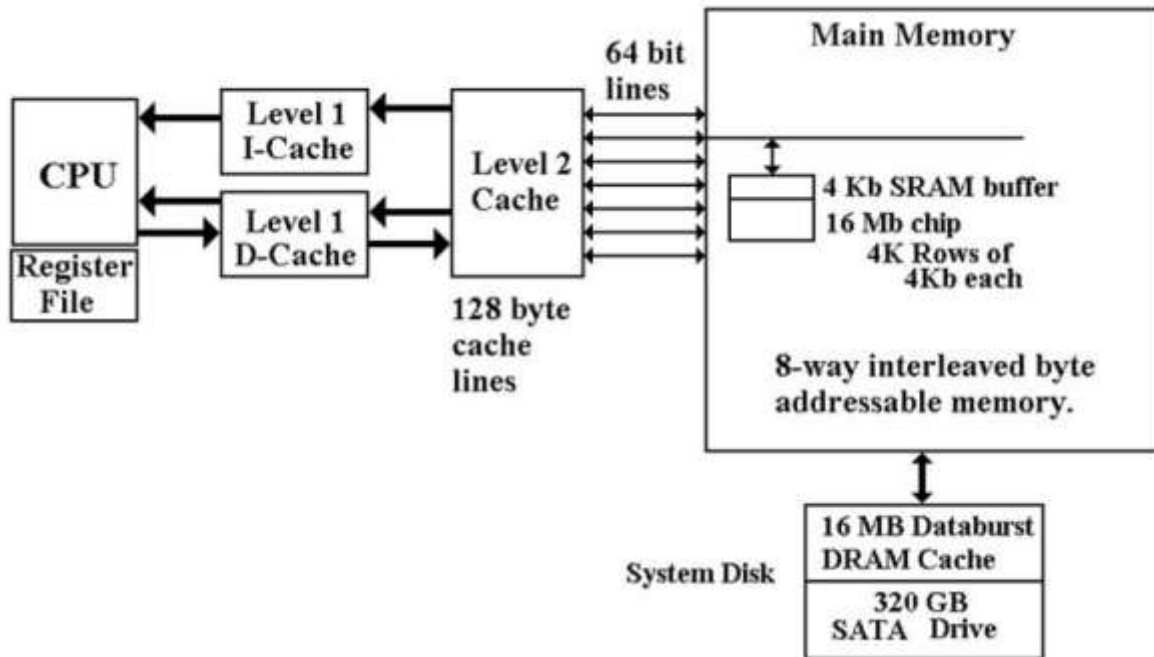


Figure 21: Memory CPU Interaction

4.2 Types of Operating Systems

Now that the purpose of an operating system has been explained, let us examine some operating systems that were developed for specific purposes. The Macintosh (or Mac) and the IBM personal computer operate with hardware and software configurations. This is known as the platform. The platform of a computer system is the underlying hardware and software that it allows it to function. For example, the Apple computer was developed with a Mac platform using Motorola chips and unique operating software called “Mac OS” The original IBM computer uses Intel chips and originally employed an operating system called “DOS” or Disk Operating System. Today’s PCs now use a Windows based operating system that incorporates many of the original concepts in DOS. Operating systems differ in functionality, flexibility and ease of use. Today there are a number of different operating systems in use. They can be classified as either personal operating systems, network (client/servers) operating systems and

handheld operating systems. A representative list of different operating systems is described below.

Operating System (OS)	Type	Main Purpose or Major Development
Unix	Network	These are network operating systems that are powerful. Runs on many types of PCs, mainframes and workstations; is the primary operating system for Internet servers; first multitasking system, widely used by large corporations
Linux	Network	Uses a command line interface; more stable than Windows, but applications using Linux are rare.
Macintosh (MAC) OS X	Personal	Graphical user interface. Also considered the easiest system for beginners
Microsoft Windows 95, 98 and XP	Both personal & network	Capable of Internet browsing, and multimedia support. None of these earlier versions of Windows are supported by Microsoft.
Microsoft Windows NT/2000	Network	Also network operating systems that were designed specifically for corporate and other large businesses, and were also known as client/server systems (one computer 'serves' provides applications for many users 'clients'). Offered enhanced security, and remote access to computer systems among other features
Microsoft Windows Mobile 7	Handheld and Cell Phone	Supports handheld devices and smartphones. Supports integration with other Microsoft software.
Microsoft Windows 7	All Types	The current Microsoft operating system with a number of variants which can be used in all types of computer environments.

4.3 Functions of an Operating System

Birbal and Taylor, (2004: 39-40) summarise the functions of an operating system as follows:

4.3.1 Managing computer resources

The operating system allows application software programmes such as word processing, spreadsheet and database packages to communicate with the computer's hardware. For example if you work on a document in Excel and you want to print the document, you just press the print button on the toolbar. Excel will direct the operating system to select a printer to print the document. The operating system then notifies the computer to begin sending data and

instructions to the appropriate program to get the document printed. The operating system therefore acts as an interface between the application programmes and the hardware.

4.3.2 Managing files and memory

The operating system manages all files on a computer. It keeps tracks of the locations where programmes and data are stored within the computer's memory. For example, when you open a file that has been saved to the hard drive, you are first instructing the computer to find the file, and then to open it. The operating system also allows you to easily find files stored in secondary storages devices. Other file management functions include copying, erasing, renaming and backing-up files.

4.3.3 Maintaining security

In networks and larger computers each user is given a user name or ID and password to gain access to the computer system. The operating system keeps a register of all these names so that only persons with valid usernames and passwords can access the system. This prevents access by hackers and unauthorised persons. The operating system also keeps a log which records users logged in, the length of time each user stayed on the system, and what they did. Administrators can check the log to look for security breaches and abuse of resources.

4.3.4 Managing tasks

A computer can perform many tasks simultaneously. One way of doing this is multi-tasking – ability of the computer to run more than one programme at the same time. For example, a user can listen to music on his/her computer whilst at the same time typing a document or typing an e-mail while another e-mail is being sent. In the case of networks the multiuser operating system allows more than one user to access the same data at the same time.

4.3.5 Providing a user interface

Many operating systems functions are never apparent on the computer's display screen. What you do see is what is called the user interface. The interface helps the user to interact with the computer.

4.4 User Interface

In order to interact with the computer, a user uses a part of the operating system called a user interface. The functions of the user interface are to start application programs, manage secondary storage, such as hard disks, as well as manipulate files and folders, and finally shut down the computer safely.

The three principal types of interfaces include:

- Graphical User Interface (GUI),
- menu-driven interface, and
- command-line interface.


The Graphical User Interface (GUI) uses graphics or icons which represent various tasks. For example the icon to print is a small picture of a printer  which when clicked with a mouse, will invoke the printing dialog box. Once the printer dialogue box is opened you can pick other commands that will be used to send your document to the printer. A GUI is a user-friendly interface that eliminates the need to remember complex computer commands or programming languages.



Figure 22: Graphical User Interface

The menu-driven interface is used to show all of the options available to the user in the form of pull-down or pop-up menus. An illustration of a pull-down menu is shown in figure 4.2. Many menu interfaces now include the GUI icons with text menu options.

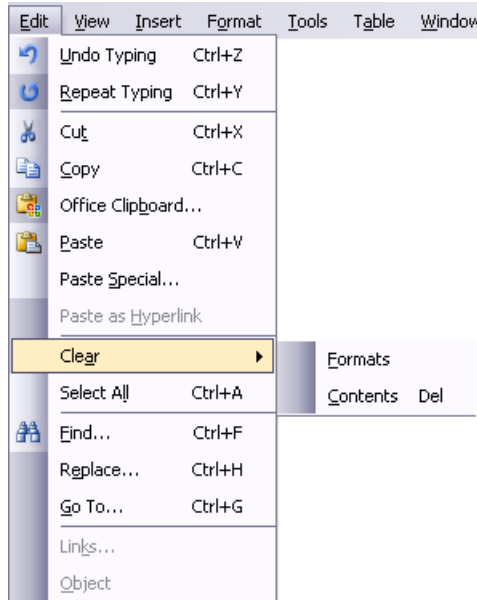


Figure 23: Menu-driven interface

The command-line interface requires the user to type keywords or commands at a prompt, in order to enter data or execute commands. You can experience this type of command when you open the “Run” interface to input DOS based commands to execute an operating system task. This interface is the most difficult one for the average computer users to learn. They are often used in programming applications or in support of systems software.

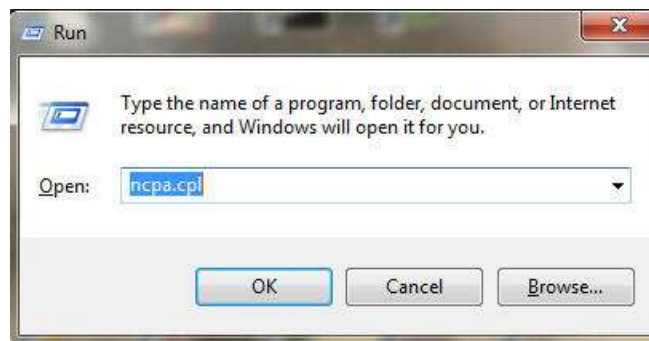


Figure 24: Command line interface

4.5 Utility Programs

Utility programs are tools that help the operating system manage the computer system's secondary or non-priority jobs. These jobs are repetitive in nature. Some examples of utility programs include antivirus software, backup software, disk defragmentation, disk scanning; file compression software, file management programs, and searching software. Often are automatically loaded into memory when the system is booted and they operate in the background at the same time as the application program. Often you do not know they are working until they send you a message like "Virus detected, click here to eliminate". Only then does the user need to engage some form of interface to take the appropriate action.

Utility Program	Description
Antivirus software	Protects the computer from computer viruses. Examples are Norton and Zone Alarm.
Backup software	Used to copy data from the hard disk to another storage medium.
Disk Defragmentation	Re-organizes data on a storage device to improve performance.
Disk Scanning	Involves disk-scanning utilities to detect and fix errors on storage devices, or disk cleanup utilities that remove unused or unnecessary files that are no longer needed.
File Compression	Reduces the size of a file, folder or directory. Popular utility is WinZip.
File Management	Stores files in a hierarchical structure, to enable various tasks such as creating, deleting, copying and moving files, folders, and directories
Search programs	Used to find files, folders or directories on storage devices.

4.6 Language Translators

Language translators convert the data in a program (source code) into machine language code (object code) so that the computer can then process. The main purpose of translating source code to object code is to create a program in machine language so that the computer can produce the desired results. An example of different types of language translators are compilers and interpreters. The compiler is a computer program or in some cases a set of programs that translates another program's source code into object code all at once, while the interpreter is a set of programs that translate the application program's source code, one line at a time while the program is running.

4.7 Application Software

Application programs assist the user in completing workplace tasks, personal tasks or research when using the computer. They are the programs that a regular user sees and manipulates. This includes word processing, spreadsheet, graphic presentations software and others. This Topic discusses some categories of application software, including their strengths that enhance a user's productivity.

4.7.1 Personal Productivity Applications

Personal productivity applications serve the needs of various users and have several subcategories. Generally, personal productivity software includes word processing, spreadsheet, presentation, and database programs. Another area, Internet applications, includes Web browsers and electronic mail programs. Multi-media or graphics applications use desktop publishing, as well as editing of photos and graphics, while home and educational applications include personal finance programs, tax preparation programs, reference software and game playing software. These personal productivity programs are usually stand-alone programs which do not depend on other application software to function.

However, there are some applications whose interfaces are the same, and also share data and resources with each other. These applications together are called software suites, and some examples are Microsoft Office - which is the most popular, Corel WordPerfect Office, and Lotus SmartSuite.

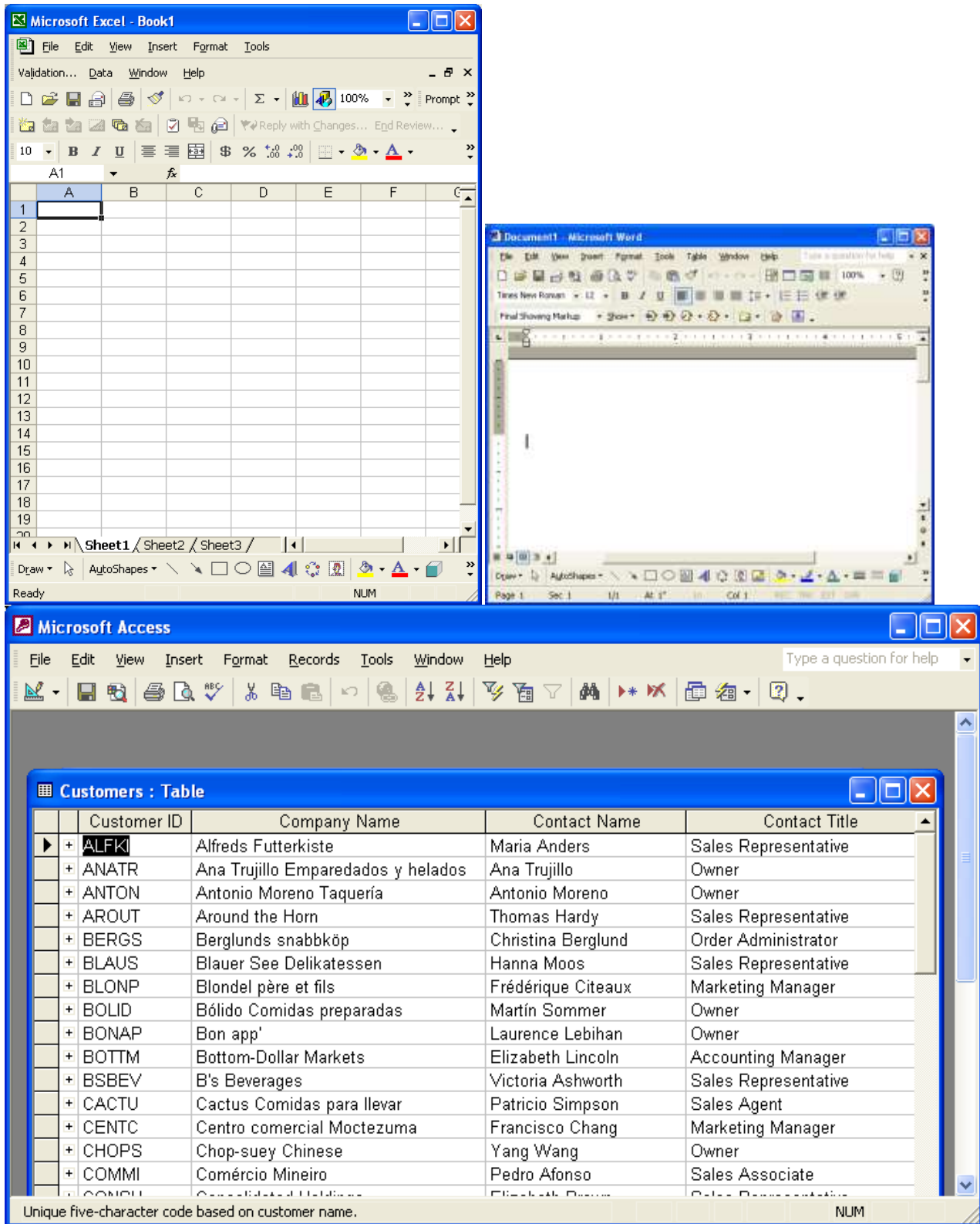


Figure 25: Some useful application software

Types	Description
Financial Software	Provides automated assistance for tax preparation and submission. An example is Turbo Tax.
Accounting Software	Provides assistance for personal accounting and cheque writing. Examples are Quicken and QuickBooks.
Word Processing Software	Provides assistance in formatting, printing documents. Some examples are Microsoft Word, and Corel WordPerfect.
Spreadsheet Software	Provides built-in functions to perform calculations and graphics. Some examples are Microsoft Excel and Lotus
Database Software	Stores, manipulates and retrieves data. Some examples are Microsoft Access, dBase and FoxPro.

4.7.2 Word Processing Features

All word processing software is designed based on the document life cycle. The word processing document life cycle, includes creating a document, editing or modifying the document, formatting the document, saving and finally printing to provide a hard copy. Editing the document allows sections of text to be deleted, moved, or re-typed, and text can also be searched and replaced. Formatting the document enhances its appearance, using various features include using different font types and sizes, line spacing, colours and borders.

Mail merge is one of the powerful features of word processing software. This feature makes it easy to create personalized letters and reports, as well as print addresses on envelopes and mailing labels. With a bit of creative thinking, mail merge can be used to simplify many routine tasks such as personalizing invitations, preparing flyers, making certificates, labeling file folders, and preparing name tags.

4.7.3 Workgroup Applications

These applications are used by two or more users who work as a team to achieve a common task. The programs therefore should support the sharing of information and sections of the work

or a project, scheduling group meetings, group electronic mail services, group decision making and conferencing. Some examples of this software are project management software, groupware like Microsoft Sharepoint and collaborative software like WIKIs (an example of a WIKI is Wikipedia).

4.7.4 Enterprise Applications

These applications are used by personnel to support the company in its interaction with customers and employees. Some of the activities include entry of orders, billing, payroll, human resource management, and general reporting activities. Enterprise applications are specialized or tailor made to the specific activities of the company. Examples of enterprise software include PeopleSoft a complete package of company operations and Banner an enterprise system used by universities and colleges to support records management, financial management, course management, student management, etc.

4.7.5 Application Software Development

Some applications, are developed 'in-house' specifically for use in the company. Other applications are developed via a contract by technology companies that specialize in producing custom application software for their customers. One example of custom software development would be the book ordering process for Amazon.com. Finally, there are off the shelf application software packages which, as the name implies, can be purchased and used without the ability to customize the software.

4.7.6 Spreadsheet Features

Electronic spreadsheets organize data in a grid of rows and columns. Spreadsheet programs are considered a simple database that can be used to manipulate data in the form of numbers, percentages, etc.

The benefits include the elimination of much of the tedious tasks of performing the calculations manually, so that the calculations are generally error-free. Data is automatically recalculated when one value or calculation is changed. What-if analysis allows users to change one value and have the results instantly recalculated. This is very useful in financial forecasting.

The intersection of a row and column is called a cell. A cell is known by its address which consists of a column letter, followed by row number, for example B7. Cells contain:

- a label, which provides text information or headings of the entries in the spreadsheet,
- a value, which is an actual number that is entered into a cell
- a displayed value which is what is displayed in the cell. This displayed value can represent:
- a formula – an instruction to the program to calculate a number, such as 10% of a value, or
- a function – a pre-programmed formula, such as SUM to add some numbers

Spreadsheets produce graphs based on the data given in a visual, easily understood format. Analytical graphs are designed to help users analyze and understand specific data using simple line, bar, and pie chart graphs.

4.7.7 Presentation Software Features

The use of pictures, photos and other graphics in a lecture can help the audience remember and understand what is being presented. This is why electronic presentations have become popular in the oral delivery of many topics. Presentation software is also effective for training purposes since video clips can also be included to illustrate certain topics.

Presentation software programs such as Microsoft PowerPoint presents information, usually in point form on many pages called a 'slides'. Presentations can be projected and enlarged using a projector. Indeed the presentation can be published on the Internet as well as printed as outlines or scaled slides on paper. The usefulness of presentation software includes the easy updating or re-arrangement of the slide content, the inclusion of multi-media to enhance the audience's understanding of the content, the content can be viewed by a larger audience since the presentation can be magnified as necessary, and the presenter can use links within the presentation to link to other documents, files and web resources.

4.8 Proprietary Versus Open Source Software

Proprietary software is computer software licensed under exclusive legal right of the copyright holder. The licensee is given the right to use the software under certain conditions, but restricted from other uses, such as modification, further distribution, or reverse engineering. The distributors of this type of software limit the number of computers on which software can be used, and prohibit the user from installing the software on additional computers. Restricted use is sometimes enforced through a technical measure, such as product activation, a product key or serial number, a hardware key, or copy protection.

Public domain software is not subject to copyright and can be used for any purpose. This includes free software, licensed by the owner under more permissive terms and open source software.

Shareware is software that is copyright protected, but may be downloaded and used for free, for a limited time, after which the user is asked to voluntarily send the author/creator a small payment and register the product. Shareware can be downloaded from the internet, but it might also be available on CD.

Freeware is copyrighted software that can be copied, used and distributed at no charge. This software may not be sold or used in any way for commercial purposes. It is mostly downloaded from the internet. Users cannot change this software.

Open Source is software that can be use or modified without restriction, and made available for use without restriction. Open source software is generally available without charge, but can have a small fee and can be downloaded from the internet. This software may not be sold or used in any way for commercial purposes. It is mostly downloaded from the internet.

Take note: In practice, for software to be distributed as open source software, the human-readable form of the program (the source code) must be made available to the recipient along with a notice granting the above permissions. Such a notice either is a free software license, or a notice that the source code is released into the public domain.



Figure 26: Commercial Software



Figure 27: Open source software

4.9 Summary

The major systems software concepts discussed in this unit were:

- System software monitors the activities of the computer so that it functions efficiently.
- The operating system comprises a set of programs that work with the peripheral devices and computer hardware to control and organize the general operating functions of the computer.
- Operating systems differ in functionality, flexibility and ease of use.

- A platform of a computer system is the underlying hardware and software that it allows it to function.
- The functions of the user interface are to start application programs, manage secondary storage, such as hard disks, as well as manipulate files and folders, and finally shut down the computer safely.
- The Graphical User Interface (GUI) uses graphics or icons which represent various tasks.
- The command-line interface requires the user to type keywords or commands at a prompt, in order to enter data or execute commands.
- Utility programs are tools that help the operating system manage the computer system's secondary or non-priority jobs.
- Language translators are these systems programs convert the data in a program (source code) into machine language code (object code) that the computer can then process.
- Windows Explorer is a tool for organizing files on disk and uses several important components to manage drives such as disks (floppy disks, CDs, DVDs, and memory sticks), folders and files.
- Files are a collection of information, data, or program files.
- Folders are used to organize where the files are located, so that a particular folder may contain all spreadsheet files, while another folder can contain all word processing files.
- A disk is a secondary storage device such as a floppy disk, CD, DVD, or memory stick, where folders and files can be stored.
- The root folder is the main or general folder found on all disks.
- Folders created within the root folder, are called subfolders.
- Deleting folders also removes files and any subfolders in that folder.

The application software concepts discussed in this unit were:

- Application software is what users require to complete their tasks, while system software is the software that interfaces between the hardware to perform what is required by the application software.
- Personal productivity software programs are usually stand-alone programs which do not depend on other application software to function.

- The word processing document life cycle, includes creating a document, editing or modifying the document, formatting the document, saving and finally printing to provide a hard copy.
- Mail merge is one of the powerful features of word processing software which makes it easy to create personalized letters and reports.
- Workgroup applications are used by two or more users who work as a team to achieve a common task.
- Enterprise applications used by personnel to support the company in its interaction with customers and employees, such as entry of orders, billing, or payroll.
- Electronic spreadsheets organize eliminate much of the tedious tasks of performing numerical calculations manually.
- Spreadsheets produce graphs based on the data given in a visual, easily understood format.
- The usefulness of presentation software includes the easy updating or rearrangement of the slide content, and the inclusion of multi-media to enhance the audience's understanding of the content.
- SPSS (Statistical Package for the Social Sciences) is a software application that manages data in a systematic way in order to perform statistical analysis on a set of data.

System software plays an important role in the proper functioning of a computer system. This unit explained the three main programs that comprise system software, namely operating systems, utility programs and language translators. Of course different types of system software are necessary for the different types of operating systems available. The user interface was also discussed as a mediator between the user and the computer system, to ensure that the computer system performs certain complex or other mundane tasks for the user.

This unit also introduced personal productivity software or applications software which are stand-alone programs that do not depend on other applications to function. Some popular application software programs discussed were for word processing, spreadsheet analysis, presentations, and statistical analysis. Some other applications such as workgroup and enterprise applications were also introduced, since they are also widely used in the day-today tasks in many businesses.

Reference

Powley, R. (2011). *Introduction to Computers*. Retrieved Sep. 21, 2017, from http://doer.col.org/bitstream/123456789/8192/1/2011_VUSSC_Intro-Computers.pdf available under CC-BY-SA license.

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Chapter 5: File and Data Management

5.0 Learning Objectives

After studying this topic, you will be able to:

1. Describe a computer the operation of a computer file management system.
2. Show diagrammatically basic file and data management structures.
3. Carry out basic file and data management operations.
4. Explain different disk and file management operations.

5.1 Disk and File Management Operations

In Microsoft Windows operating system, Windows Explorer is a tool for organizing files on disk and uses several important components to manage drives such as disks (floppy disks, CDs, DVDs, and memory sticks), folders and files. When Explorer is started, you will see the directory window, which displays the contents of a specified folder on a selected drive. Files, folders and disks must interact to organize information in a meaningful way.

Files are a collection of information, data, or program files. For example, an application software program such as a spreadsheet or word processor is a program file, while the document created using the spreadsheet or word processor is called a data file. Folders are used to organize where the files are located, so that a particular folder may contain all spreadsheet files, while another folder can contain all word processing files.

A disk is a secondary storage device such as a floppy disk, CD, DVD, or memory stick, where folders and files can be stored. Consider a disk to be like a filing cabinet with the folders similar to physical folders or drawers in the filing cabinet. These folders can therefore contain files or rather paper files! So you can have many folders in a file, and the folders can contain many files! Also, just as your filing cabinet can become full of files, your disk (storage device) can also become full.

5.2 Root Folder and Subfolders

Two terms need to be explained before beginning the practical Topic. A root folder is the main or general folder found on all disks and is identified with the disk drive letter followed by a backslash (\). A root folder is often known as a drive or storage device. Table 4.2 illustrates some other designated disk drive letters. So the root directory of the floppy drive is designated A:\

Disk Drive Name	Designated Drive Letter
Floppy Drive	A:\
Another Floppy drive	B:\
Hard Disk Drive	C:\
Another Hard Disk Drive	Can be given another letter such as D:\ or more depending on the number of installed hard-drives on the computer.
Memory Stick (also called Flash drive)	If there are two hard drives on the computer, then it is designated E:\
Another Memory Stick	F:\ - Assuming you have a second one.
A Network Drive	H:\ or higher - Note network drives do not physically reside on your desktop or laptop computer. To connect to a Network Drive your computer must be installed on a local or wide area network.

Figure 28: Designated Drive Letters

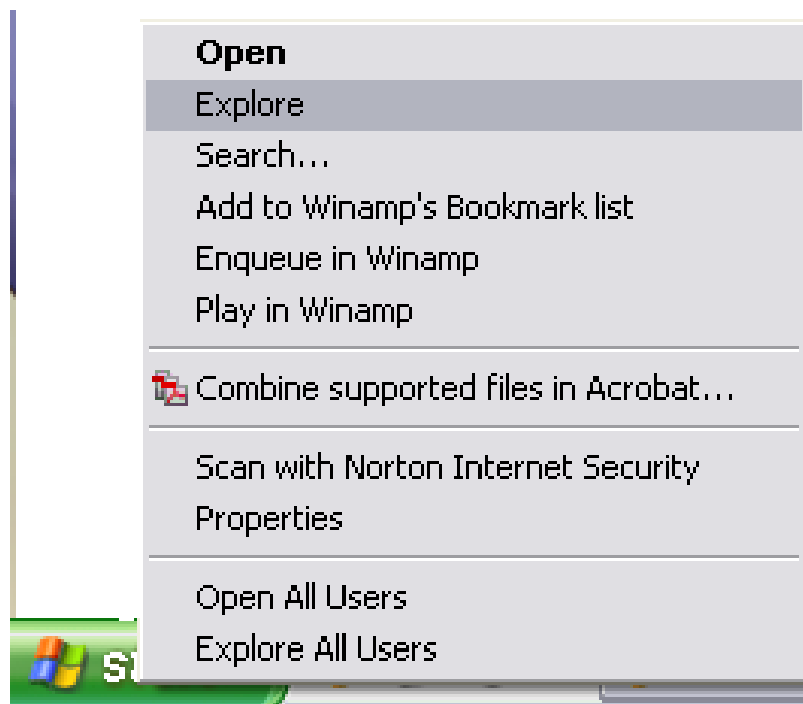
Once you create folders within the root folder, then these folders are called subfolders. So if the root folder contains another folder called WORD, then the folder is identified by its name preceded by the name of the root. Therefore we have in our example, A:\WORD which indicates that the subfolder WORD is in the root folder of the A: drive. Folders can have more folders within them. So if ASSIGN1, is created within the WORD Subfolder, then A:\WORD\ASSIGN1 indicates that the ASSIGN1 subfolder is within the WORD subfolder

contained in the root folder of the floppy disk. Another way to describe the hierarchical nature of the above example is below:

- Root Folder (e.g. C:\)
 - Sub Folder (e.g. C:\WORD)
 - Sub-Sub Folder (c:\WORD\ASSIGN1)

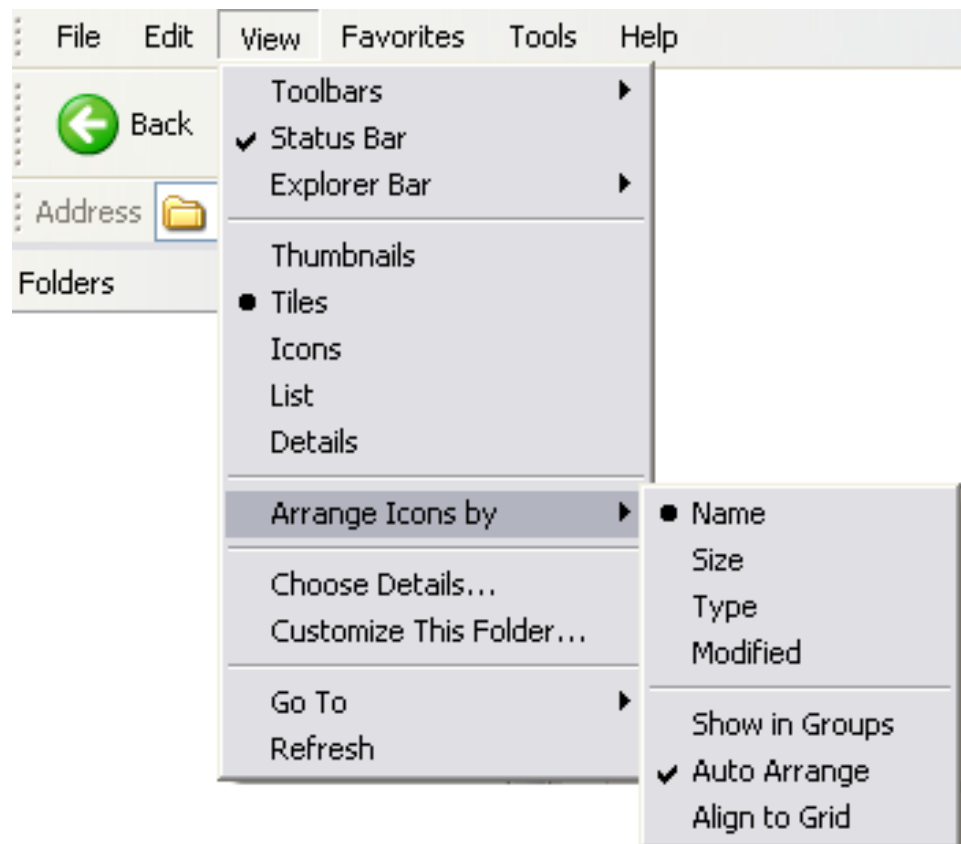
Activity 1: Using the Directory Window

Launch Windows Explorer by right-clicking the Start button and selecting Explore. Then maximize the resulting window.



Double-click on the icon located in the left panel. (you may not see the numbers before the C:. A list of folders will be displayed in the right panel. Doubleclick the WINNT or WINDOWS folder depending on the system you are using. (You may get a message telling you that these files are hidden for security reasons. Simply click the on the Show Files option.) You can also double-click on any folder for this activity; the Explorer title will be updated to reflect the name

of the folder that you have opened. Double-click the Desktop folder in the left panel, or in the file list (in the right panel), and notice the files change to reflect those in the desktop folder. You should now select and click the View pull-down menu, and notice how the Explorer panels change with each option. Try the four options in the Arrange Icon option and Details option to see the result.

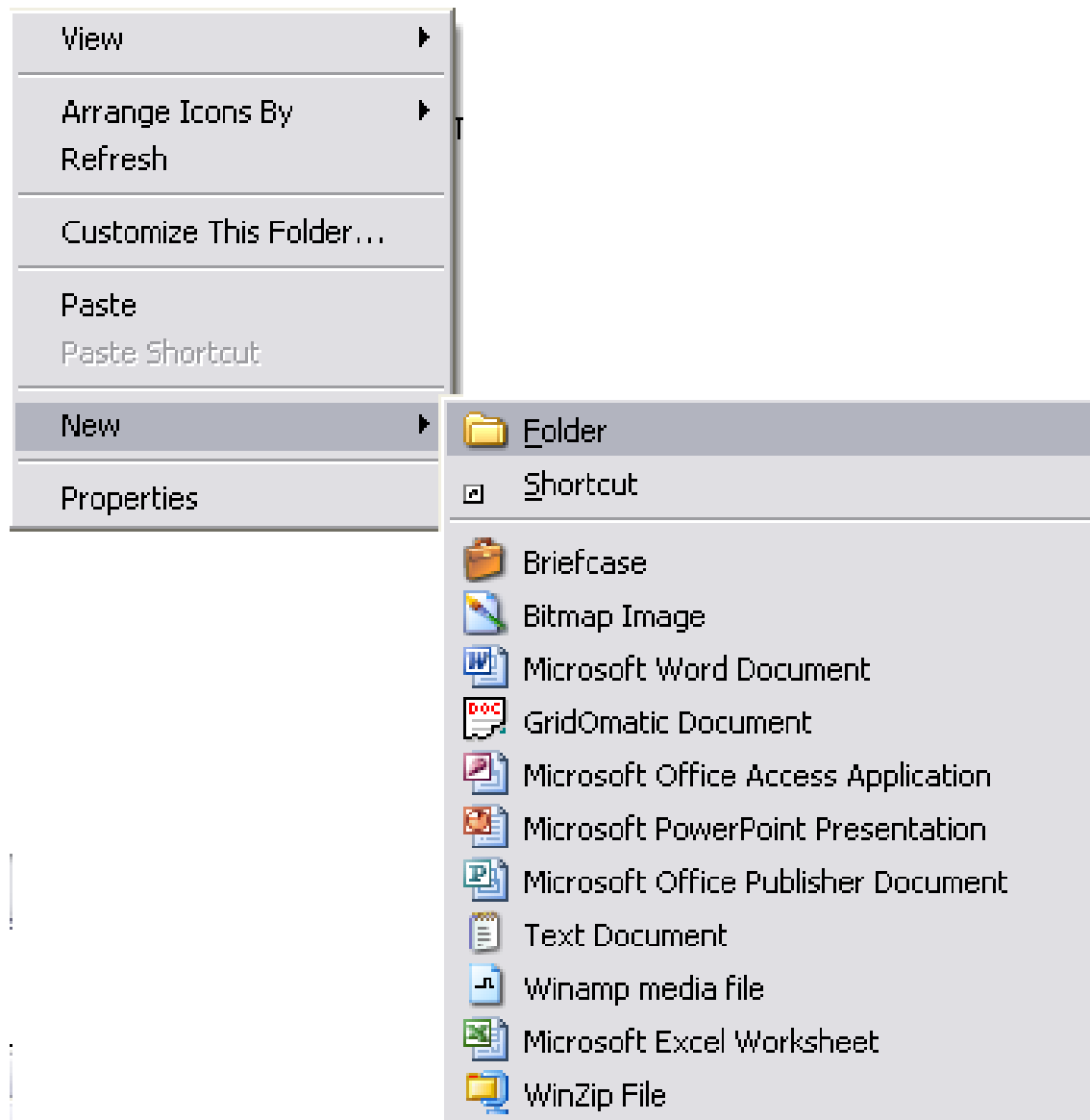


5.3 Creating and Deleting Folders

You can also create and delete folders in Explorer. To create a new folder, you first need to know WHERE your folder will be located, such as the desired drive, and then the directory from the tree (left panel). Select the disk and folder that you want to create this new subfolder within, and select File New Folder from the menu bar. You need to be careful when deleting or removing folders, since you may remove a folder with important files still within it. Deleting folders also removes files and any subfolders in that folder. Click to select the folder, and then select File Delete from the menu bar.

Activity 2 - Creating and deleting folders

Launch Explorer and put your floppy disk in the floppy drive. Click on the Floppy Drive icon. Select File New Folder. Alternatively you can right click in the right pane and select the New Folder Option



Type DISTANCE and press [ENTER]. The new folder has been added under the A:\ root directory. Double-click the folder DISTANCE and select File New Folder (or once again right click and select New Folder). Type ACTIVITY. Your directory tree for the floppy disk is shown:



If you have other folders, then they will also be shown.

Click on the DISTANCE folder. To delete this folder (and all its contents), select File Delete from the menu, or press DELETE. Click OK when the Confirm Delete dialog box appears.

5.4 Disk and File Management Software

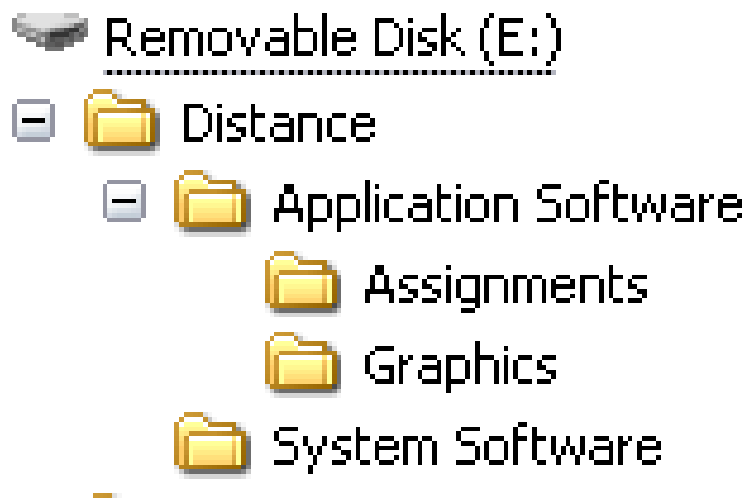
Windows Explorer allows the management of files such a wide range of file activities including copying, moving, deleting and renaming.

1. **Copying Operation** - In order to copy one or more files from one folder to another, these file(s) should be first selected from the directory list. Multiple files can be selected from the folder by clicking on the first file (remember, do NOT double click as this will open the document and not select it), then hold down the CONTROL key while clicking on each individual file. If the files are located together, then first hold down the SHIFT key and then click on the first and then the last file. All files between the first and last will be selected. A file can be de-selected by clicking on the file a second time. After selecting the file(s) use the Edit Copy command, or hold down the CTRL key and tap the letter C on the keyboard. Click in the destination folder on the desired drive, and select Edit Paste. Your files should be copied to the desired folder.
2. **Moving Operation** - To move one or more files, first select the required files, as in the copying operation above. With the files selected or highlighted, click and hold on the selected files. Then drag the mouse pointer onto the destination folder name in the tree and release the mouse button. You should check to see that the files were actually moved to the desired location. Alternatively, files can be moved by first selecting the files and using Edit Cut, to remove the files from the first location. Then click in the destination folder on the desired drive, and select Edit Paste to move the files to this folder.

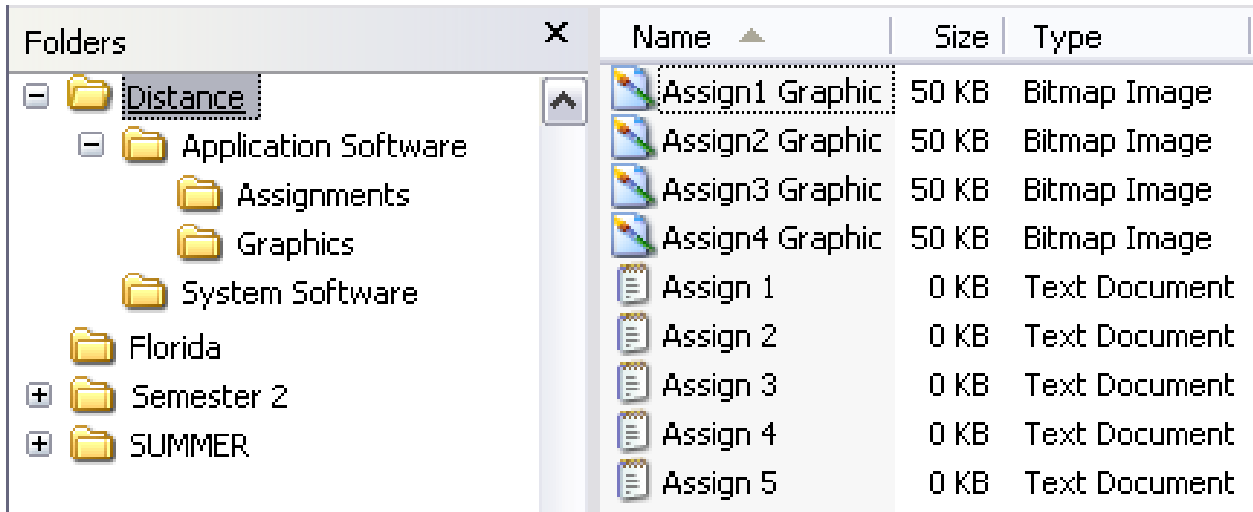
3. **Renaming Operation** - Renaming files is accomplished by selecting the desired file and then choosing File Rename from the menu. Simply type in the new filename and press Enter.

Activity 3 - Disk and File Management Operations

First create the following tree structure on your floppy disk, or memory stick (removable disk)



Use Start, Programs, Accessories, and Paint to create the four bitmap files and save those files with a Monochrome Bitmap file format. Use WordPad or Notepad to create and save the four text files shown. You do not need to type anything in the file. Save these files in the root folder of your disk. Also make sure your files are arranged by type in Explorer.



Copy all bitmap files from the root (Distance) to the Graphics folder. To do this:

Click on the first file Assign1 Graphic, hold the SHIFT key down and click or select the Assign4 Graphic to select all of the graphic files.

Select Edit Copy from the menu, or hold down the CTRL key and tap the C key. Click on the Graphics folder in the directory structure (left panel). Select Edit Paste, or CTRL V to copy the files. A dialog box will show you the files as they are copied.

Move the text files to the folder Assignments. Click on the first file Assign1, hold the SHIFT key down and click or select the Assign5 text file to select all of the text files.

Select Edit Cut from the menu, or hold down the CTRL key and tap the C key. Click on the Assignments folder in the directory structure (left panel). Select Edit Paste, or CTRL V to copy the files. A dialog box will show you the files as they are copied.

Delete the remaining files from the root. Select *all files in the root* and tap the DELETE (DEL) key. Select YES when the Confirm Multiple File Delete dialog box appears.

Rename files. Click on the System Software folder in the Tree. Select File Rename from the menu, and type in the new file name: Operating Systems. Press ENTER.

Click on the Application Software folder and press DELETE. What happens? Since you do not actually want to delete this folder, what should you do?

5.4 Summary

The following concepts were explored in this unit:

1. Windows Explorer is a tool for organizing files on disk.
2. Files are a collection of information, data, or program files.
3. Folders are used to organize where the files are located.
4. A disk is a secondary storage device such as a floppy disk, CD, DVD, or memory stick, where folders and files can be stored.
5. The root folder is the main or general folder found on all disks.
6. Once you create folders within the root folder, then these folders are called subfolders.
7. To create a new folder, you first need to know WHERE your folder will be located.
8. You need to be careful when deleting or removing folders, since you may remove a folder with important files still within it.

This unit explained the difference among terms such as disks, files, folders and sub folders and root folder. It also noted the various disk drive letter designations when performing data and file management tasks.

Reference

Powley, R. (2011). *Introduction to Computers*. Retrieved Sep. 21, 2017, from http://doer.col.org/bitstream/123456789/8192/1/2011_VUSSC_Intro-Computers.pdf available under CC-BY-SA license.

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Chapter 6: Input and Output Devices

6.0 Learning Objectives

At the end of this unit, you should be able to:

1. Describe the various types of manual input devices.
2. Describe the various types of direct input devices.
3. Distinguish between the types of output devices.
4. Describe the types of terminals.
5. Describe different storage devices.

6.1 Introduction

This unit builds upon earlier descriptions of computer hardware and provides detailed descriptions of the devices needed by systems users to input information and how to view the output of processed data and applications programs.

As noted earlier hardware input devices are integral in processing data into meaningful information. Different hardware devices enable data to be input in a form that the computer can process and translate into an understandable form for humans to interpret.

Output devices are peripheral devices that enable us to view, hear or store the result of the computer's processed data. Note that output of processed data is different from storing the processed data before it is output. Storage of data and the associated storage devices are discussed in Topic 5 of this unit, however in this Topic, we describe the need for output devices and explain why some output devices are more suited for certain applications than others.

6.2 Data Input

Computers need raw data to process into meaningful information. This Topic introduces devices used for getting raw data into the computer. Some software applications require different devices with certain characteristics for data entry. These will also be discussed in this Topic.

Before we can use the computer for various tasks, including surfing the Internet or as part of our daily work, computer systems need to convert data into meaningful information or representations that are familiar to the user. Data can be obtained in various forms for input into the computer. Actions by computer users are the most common way of inputting data. Other ways input data into a computer for processing is through is the transfer of data (or files) from other storage devices (such as a hard-drive, memory stick or CD ROM) and transfer of data from another network computer.

Data is input from different devices in the following forms:

- Raw data, such as words, numbers, pictures, symbols, graphics, or sound which needs to be processed into meaningful data.
- Software programs that give the computer its instructions and therefore need to be transferred from an external storage device to the computer's internal memory.
- Commands that instruct the computer to do a specific task. Examples include special keywords or typed commands that are either entered from a keyboard, or a left click from a mouse, or even a touch on a screen using a pointing device.
- Responses or prompts either through sound or visual boxes requiring the user to usually provide some typed response, reply or feedback, such as OK, Cancel, Yes or No.

6.3 The Keyboard

A computer keyboard is the most common method of inputting data into a computer's memory directly. The keyboard is an improvement on the typewriter and comprises keys of letters, numbers, some punctuation marks and other symbols as well as some pre-defined keys called function keys. The user can type words and other commands which are converted into electrical signals (ones and zeros) and input into a computer's memory.

Keyboards are either connected to the computer by a cable or by a wireless transmitter/receiver. Cordless keyboards use infrared beams and low frequency signals to transmit their data from the keyboard to the computer. Wireless keyboards that use infrared beams to transmit data require a clear line of sight between the device and the infrared port on the computer. Wireless keyboards

that use low frequency signals to transfer data need to be in close proximity to the computer and may experience interference from other wireless or electrical devices.

Keyboards are produced in various shapes and sizes to suit users' specific needs. Today keyboards that are ergonomically designed are popular to prevent injuries such as carpal tunnel syndrome or other repetitive hand and wrist injuries. Keyboards have also been created to support individuals with different physical disabilities. These include Braille keyboards for those that are blind, one handed keyboards for those users who can only use one hand, keyboards for special purpose devices (such as a Personal Digital Assistant or cell phone) and digitally projected keyboards that allow a keyboard to be displayed in a variety of locations.



Figure 29: Keyboard

6.4 Pointing Devices

Pointing devices are used to move a cursor on the monitor corresponding to the movement of the pointing device. The computer mouse is the most widely used pointing device. It fits snugly inside the palm of your hand, and allows the user to send commands to the computer. As you move the pointing device to the left, its movement is mirrored on the monitor display in the same direction, with a corresponding pointer (X) on the screen.

A mouse can provide input in a number of different ways. Specific actions that are included in all mouse pointing devices include:


- A single-click of the left or right mouse button is used for selecting an item or option on the screen.
- Double-clicking opens a program or special screen called a dialog box.
- Click and drag involves holding down the left mouse button while dragging or sliding the mouse. This allows the user to drag, move and reposition items/information anywhere on the screen.






A recent addition to the design of the mouse is a rotating wheel which, when scrolled up or down, correspondingly scrolls the page up or down with a text document. The cordless mouse gives added flexibility to the user, by removing the connection of the cord to the computer; however the mouse must remain in sight of a receiver to work.

The mouse allows the user to quickly move the cursor on the screen instead of typing commands on the keyboard to move data around the screen. However the use of the mouse requires constant hand and wrist movement and like the keyboard may result in wrist injuries.

There are a number of other pointing devices that have evolved since the mouse was invented. Many of them have capabilities that are similar to the mouse. These specialized pointing devices add additional features that support customized software applications that can react based on the input devices. Some of the more common pointing devices are described in table below.

Table 4: Common pointing devices

Pointing Device	Description	Advantages	Disadvantages
Trackball and Track point 	Some look like an inverted mouse with the ball on the top or side of the trackball for the user to roll. The track point is more commonly found embedded in the keyboard of laptops	Uses less space for movement than a mouse would, and so is not as tiring as using the mouse.	Again requires much ball control using a finger or thumb. Also using same wrist muscles is tiring and can also cause injuries.
Touch Screen	The user makes selection by just touching the	The natural tendency to touch an object is a distinct advantage of	Reaching out to touch the areas on the screen can become tiring if

	<p>screen</p>	<p>the touch screen.</p>	<p>there are many choices to be made. The screen must also be large enough to accommodate the several choices since fingers pads are bigger than the thin cursors.</p>
<p>Pen Input</p> 	<p>Used generally in Personal Digital Assistants (PDA) or Tablet PCs. Functions like a mouse with clicking replaced by tapping the screen.</p>	<p>Apart from its small size, it can imitate Handwriting instead of typing using keyboard.</p>	<p>Device must be trained to recognize user's handwriting. Also the user can lose the pen since it is not usually attached to the device.</p>
<p>Touch Pad</p> 	<p>Uses a touch sensitive pad for controlling the cursor. Cursor follows sliding finger movement across the pad. Buttons allow for clicking, or tap on the pad with a finger.</p>	<p>Similar to the touch screen</p>	<p>The constraints of the size of the touch pad can be restrictive, and constant reaching for the touch pad can also be tiring.</p>
<p>Game Devices:</p> <p>Joy stick</p>  <p>Game Console</p> 	<p>Cursor motion controlled either by a stick for the joystick or arrow buttons for the game pad.</p>	<p>Gives a more natural-feeling control for motion in flying or driving games</p>	<p>More expensive and much bigger than other devices.</p>

6.5 Data Entry at Source

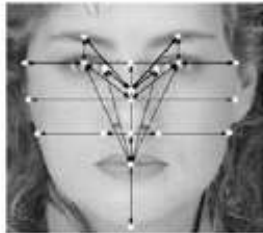




As the term implies, these devices enable the data to be entered or captured from its origin or source with minimal or no interference from the user. The advantages for this method are to eliminate extra handling and save time in the user entering the data, thus lowering labour cost, and reducing errors.

Source data entry minimizes any mistakes that may occur during data input, and avoids having to re-enter the data. Data is feed directly from a storage device, application program or via a networked device that is attached to the computer. Some examples of devices that use source data entry methods are: an air conditioning unit that monitors the temperature of a room; a device that maintains a consistent environment in an incubator; an altimeter in an airplane; automated downloads for different application programs; devices that are used in a controlled environment o maintain the humidity, or devices that test the water in a pond for acidity or alkalinity.

6.5.1 Biometric

Biometrics is a human-biology input device, which uses a user's body characteristics as input to a computer system. These characteristics include fingerprints, face structure and hands to the patterns in the eye's iris. The federal government has made biometrics part of its post-Sept. 11 security measures.

Since October 2004, the USA Department of Homeland Security has been gathering and comparing biometric data on all foreign travelers to the country against database records of criminals and terror suspects. Thus travelers are required to provide two digital index finger images and have a passport with a digital photograph in order to gain entry to the country. To date, the following biometric devices have been used to capture the following physical characteristics to verify a user's identity:

Physical Characteristics	Illustration	Description
Facial Recognition Systems		Measures factors such as the distance between facial features (pupil to pupil, for example) or the dimensions of such features (such as the width of the mouth)
Finger Scans		Measures characteristics such as changes in the individual lines of the finger pad
Hand Geometry Scans		Measures factors such as the size of the palm and the length and width of the fingers
Retina Scanning		Uses a beam of light to scan the pattern of veins in the eye's retina
Voice Recognition Systems		Analyze the human voice through computerized pattern- matching programs

6.5.2 Scanners

The scanner is like a photocopying machine. A document is placed on a glass plate and a light emitting diode is passed over the document and the content of the document is converted to a digital image. Scanning software allows the users to take the captured digital image and convert it to a graphic image or a text based document that can be edited using a typical word processing program. The software that is used to convert a scanned image to a text document is known as

Optical Character Recognition software. Most scanners are packaged with OCR software. An example of OCR software is Omni Page.

Check it out. The majority of scanners are large enough to scan full sheets or entire pages of books. Others are small enough to scan a row of numbers of a product. These smaller devices are known as hand scanners or portable scanners. Today many multipurpose printers include the ability to scan documents, print documents and fax documents all using the same printer.



Figure 30: Scanner

6.5.3 Barcode reader

Barcodes are different groups of vertical bars that represent specific types of data that can be read by a barcode reader. A barcode reader is a specialized type of scanner that captures the barcode and passes the data to a specialized application or data base for interpretation and output to a specific hardware device.

Businesses such as supermarkets and clothing stores now use printed bar codes on products and letters to track inventory and calculate the sale at the checkout counter. Post offices and courier services use bar code readers and forms with bar codes to track and sort mail and packages. Barcodes make it easier for a business to track their inventory and maintain their stock balances in a way that supports just in time sales and distribution.

Barcodes generally contains product details such as product name, size, manufacturer, country of origin. They can be customized to show location, time in, time out, etc. As each product bar code is scanned, the symbols in the bar code are translated or converted into digital code. At the same time, the stock value is automatically reduced by one.



Figure 31: Barcode reader

6.5.4 Magnetic Ink Character Recognition(MICR)

The ‘computerized looking’ numbers printed at the bottom of your bank cheques are made of a special magnetic ink so that can still be scanned even if the cheque has been folded or has dirty marks on it. These numbers represent the account number, bank sort codes as the amount on the cheque, which banks use a special Magnetic ink character reader (MICR) to scan the numbers for input.

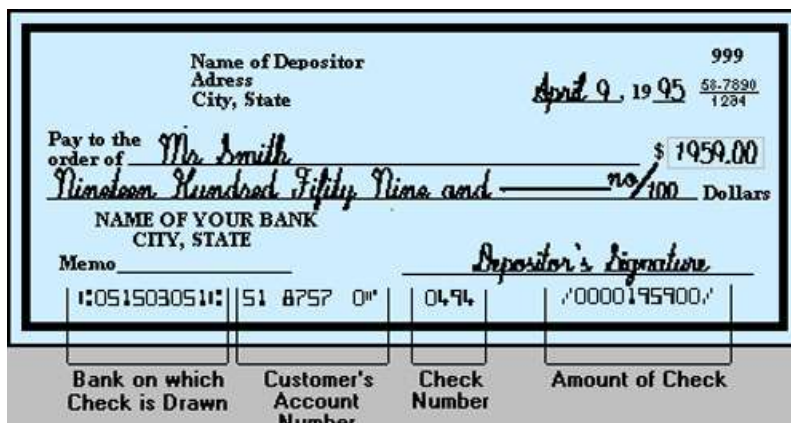


Figure 32: MICR

6.5.5 Magnetic Strip Reader

Many credit cards, debit cards and other loyalty plastic cards have magnetic strips on the back of the card. The strip contains some of the card owner's personal information. When the user inserts the card into the magnetic strip reader, and inputs their Personal Identification Number (PIN), the data stored on the strip is scanned and transferred to the computer system for further processing according to the user's request.



Figure 33: Magnetic Strip Reader

6.5.6 Optical Mark Reader

An optical mark reader scans pre-printed forms, such as lottery tickets. In education, universities, colleges and some secondary schools use pre-printed forms for their examinations. The forms act as the answer sheet for multiple choice questions in the examination booklet. Learners enter their proposed answer on the pre-printed answer sheet using a pencil. When put through a scanner with appropriate software the pencil marks to digital form and the digital input is compared to an electronic answer key that automatically marks the examination and puts data in the student information system reflecting the results for each student.



Figure 34: Optical Mark Reader

6.5.7 Audio Input

A very useful device for enabling audio input into computers is a microphone and speech recognition software. This type of input enables the computer to recognize words spoken into a microphone through the use of special software.

The words are inserted into a word processing document. Recent technology is perfecting continuous speech recognition where the user does not have to pause between words. A popular speech recognition package is Dragon Naturally Speaking.

Voice recognition software is also used by the disabled to input commands to voice enabled application software. For example The Windows 7 operating system has the capability to control all menus via voice input. If you have a Window based computer check out the “Speech Recognition” icon located in the “Control Panel”. Today many vehicles employ voice recognition systems to input hands free commands to the driver’s GPS, cell phone, radio, iPod and to control the car’s internal systems.



Figure 35: Speech recognition software

6.5.8 Digital Input

Digital cameras are quickly replacing film cameras. Instead of waiting for the film to be developed, pictures can be taken and re-taken, previewed before they are stored. You can choose to print what pictures you wish to print, you can delete unwanted pictures and with the add of photo editing software, you can change the look of your pictures. The images are transferred to a computer using special software and a USB cable or digital flash card (called an SD card). The printed picture depends on both the quality of the paper and printer. Or you can choose to email your pictures to photo production companies that will print the selected photos and return them to you.

If you want to capture motion than there are two different technologies. Digital Video cameras use a special technology to record video images while a Web Cam, a tiny video camera can be attached to the computer to feed pictures directly to the computer. Web cams are popular for video conferencing over the Internet, as well as documenting just about anything such as weather or traffic flows. Digital video cameras provide better quality movie output and is easier to use when moving from place to place to capture your pictures.

Today's smart cell phones have both a digital video and still camera capabilities. Transfer of photos or videos can be easily accomplished using a digital SD card or by attaching the phone to a computer using a USB connection. Digital piano keyboards and other digital instruments can input music to your computer. The output of what the musician plays is captured by the computer so that the artist can play it back later or modify and enhance it using media production software.



Figure 36: Digital Camera

6.6 Softcopy Output Devices

There are two different types of computer output called: softcopy and hardcopy output. Softcopy output is intangible. It is not a physical object like a print-out. Softcopy out can only be heard or seen through different output devices. In this section we will discuss the different softcopy output devices. Softcopy output can be further sub-divided into visual output and audio output.

6.6.1 Softcopy-Visual Output

Visual output of text, graphics, or video is usually displayed on a monitor. A monitor is another peripheral device which uses a video card connected to the computer, to display output on the screen. The video card is the device that interprets the digital content and turns them into picture elements called pixels. Pixels allow an image to be displayed on visual devices through a number of individual dots on the screen that create a visual image.

The resolution is the number of pixels (individual dots) measured as horizontal pixel number \times vertical pixel number. So a 640 x 480 resolution means that the screen is 640 pixels wide by 480 tall. That means a monitor with this resolution can display 307,200 pixels or individual dots on screen. The more pixels on screen the greater the clarity and contrast of the visual output.

For example a resolution of 800 x 600 displays 480,000 pixels or over 50% more pixels than the lower 640 x 480 resolution and thus provides a better picture.



Figure 37: VGA card

The level of resolution depends on two hardware components: the monitor and the video card. Monitors are made to support different video resolutions and video cards are made to output a maximum number of pixels. Even if you have a monitor that can output 1024 x 768 resolution, the video card must also support this level of resolution. The maximum visual output is based on the capabilities of the lower quality piece of hardware, so make sure these two pieces are equal in resolution output.

Monitors are made in various sizes, and these sizes are measured diagonally from one corner to the opposite corner in inches (e.g. from bottom right corner to top left corner reflects the size of the monitor). Therefore the size of a monitor includes the case around the viewing area of the screen. Common monitor sizes range from 15 to and 21 inches.

Although monitors come in various sizes, the quality of the output on the screen is also important. The resolution and refresh rate also determine the quality of the monitor display. We have discussed resolution, now let's look at refresh rate.

Refresh rate is the number of times per second the pixels are recharged, so that the image on the screen remains consistent, and not flicker. The faster the refresher rate the better the picture. Refresh rates are measured in hertz (HZ) and based on how fast the horizontal and vertical resolution is completed. A typical refresh rate is 70 to 90 HZ. The higher the number the better. Like resolution, refresh rates are tied to the capabilities of both the monitor and the video card. Video cards can only refresh the screen as fast as the monitor will allow it.

Today there are two types of monitor technology. The older cathode ray (CRT) monitor looks very much like an older CRT television. It uses old technology and is slowly being replaced by Liquid Crystal Display (LCD) monitors which use digital input vice analogue input. The LCD monitors will soon replace the CRT monitors because:

- Higher quality output on LCD monitors.
- LCD monitors are lighter and take up less space on the desk.
- LCD monitors use less energy.
- LCD monitors create less heat.

The one advantage of CRT monitors is that they are cheaper than LCD monitors. LCD monitors come in a variety of types and sizes that include: passive (monochrome or one colour), active, gas plasma, and field emission display screens, which are all beyond the scope of this course.

6.6.2 Softcopy-Audio Output

Audio output enables the computer to output sound using two components of the computer system. The first component is a sound card, which is a separate card or board installed on the computer system unit. A sound card is necessary to listen to a sound file, play a recording or receive audio feedback from the operating system or other application programs.



Figure 38: Sound Card

Audio output also requires speakers or head phones to be connected to the sound card so that you can hear the audio output. In laptops, speakers are embedded in the computer unit.

In PCs and some MACs you need external speakers that can be attached to the computer's audio card.



Figure 39: Multimedia Speakers





Audio quality is dependent very much on the quality of the sound card and the quality of the speakers. Today high quality sound cards can produce Dolby Digital sound and surround sound experiences. You can also purchase surround speakers with sub-woofers that sound as good as any stereo system. It all depends on how much money you want to spend.

6.7 Hardcopy Output Devices

A printer is yet another peripheral device. However this device produces a physical copy or hard copy of the computer's output as opposed to the temporary or softcopy output displayed on a monitor or through a speaker. Printers output documents in the form of characters, text or graphics, and the output quality is measured in dots per inch (dpi). The more dpi on single page the higher the quality of the printout. A typical printer today prints at 600 dpi and a photo quality printer prints at 1200 dpi or higher.

There are two general types of printers: impact and non-impact.

- Impact printers strike a special hammer or wheel with the letter or character against ribbon that has ink on it, thus leaving an image of the letter on the paper. Examples include the dot-matrix printer.
- A non-impact printer produces the characters and images without having to hit the paper. These printers use either jets to spray the ink on the paper or lasers to burn the ink onto the paper. Since there is no hammering against the paper, these printers cannot print copies of the document using carbon paper. Examples include laser, inkjet, plotters and multi-function printers.

Printer Type	Impact Printer	Non-Impact Printers		Plotter
	Dot-matrix printer	Ink jet printer (or Bubble-Jet)	Laser printer	Plotter
Example				
Picture				
Description	Hits the character on a ribbon against paper. Is especially useful for multipart (carbon copy forms) when duplicate copies are needed	Makes characters by spraying dots of ink onto paper	Laser printer works like a copier	Uses a pen that moves over a large revolving sheet of paper. It is used in engineering, drafting, map making, and seismology.
Quality of printout	The more pins, the smoother-looking the printout. Graphics of low quality, if possible at all.	Letter-quality printouts	Very high quality output	Determined by dots per inch (dpi) produced
Colour available	Not available	Color printers available at cheaper than laser printer	Colour laser printers are available but very expensive	Color printers available
Cost	Inexpensive	Cost of printer is inexpensive but ink is costly	Depending on size, cost ranges from reasonable to very costly. Running costs are higher than impact printers but lower than most ink jet printers.	Expensive initial costs but cheaper to operate per page
Speed of printing	Can be slow	Slow, one page may take up to 10 minutes	Very fast. Typical home laser printers can print 8 pages per minute (ppm).	Fast, but it depends on the size of the file being printed.
Noise factor	Loud	Relatively quiet	very quiet	Relatively quiet

6.8 Other Types of Printers

There are two other types of printers that act as an output device for personal and office use. Thermal printers use wax and heat to burn images on special paper. Some older fax machines that use rolls of papers are considered thermal printers. These printers are expensive to buy, and the paper is expensive compared to plain paper. Thermal printers are used by organizations, like publishers, who require top quality output.



Figure 40: Thermal Printer



Figure 41: Multifunction Printer

Multifunction printers are output devices that can print, scan, copy and fax a document using the same platform. Most look like a photocopier but can perform these other functions. However, if one component malfunctions, than the other components cannot be used since the entire printer must be sent out to be repaired.

6.9 Terminals- As Input and Output Devices

It is probably best to discuss terminals here now that input and output devices have been explained. A terminal enables a user to communicate with a computer and is generally a combination of a keyboard and output screen. Some users only need keyboards and monitors for the most basic task of simply input of data and output the data to verify that it is what the user entered.

Three types of terminals exist:

- Intelligent Terminal - This is another term for a typical computer system, with its own micro-processor, memory and storage devices. Examples of these terminals are automatic banking machines (ABMs) or Point of Sale terminals found mainly in supermarkets.
- Smart Terminal - This type of terminal comprises a monitor that displays features such as bold characters as well as characters that blink on the screen. This monitor therefore has its own processor. This is an older term, and today all PCs and laptops would be considered smart terminals.
- Dumb Terminal - This terminal is simply an output device that has a monitor to display information from a server or mainframe computer. It also has a keyboard for simple data entry, but more importantly it has no means of storing any data input and has no processing capabilities, A dumb terminal needs to be networked and data input into a server or smart terminal.

6.10 Storage Devices

Storage devices typically hold programs and data in manageable blocks or units called files. It is the primary memory that is used together with secondary storage to temporarily transfer the

contents of a file between the two while the file is being used. Some of the advantages of using secondary storage include:

- a vast amount of data or files can be stored in one location;
- reliable and safe storage of data and information;
- easy and quick access to data; and
- cheaper cost in storing data compared to using multiple filing cabinets.

6.10.1 Categories of Storage Devices

Storage devices are categorized in the following ways:

- Access method for data and information.
- Storage technology.
- The Storage Hierarchy.

Let's examine each one.

6.10.1.1 Method of Access

The method of access is further sub-divided into two sections, sequential access and random access. Sequential storage devices (also called serial storage devices) are those that must start from the beginning of the data to be read from or written to, and proceed through each unit after the other in a sequence, until it reaches the required point. Therefore locating data using sequential access takes different lengths of time, depending on where in the list the data is located. Examples of sequential storage devices are cassette tape drives, where the drive forwards or rewinds the tape until it reaches its required target.

Random access storage devices can access data immediately without having to read data from the beginning through to where the data is located. They search data based on a table of contents for the data located on the device. Examples of these storage devices are floppy drives and hard disk drives. These devices are also known as machine access, and direct access storage devices.

Floppy disks are still common with students who are now beginning to learn Information Technology, since they are relatively cheap. But these storage devices are quickly being replaced by portable flash drives and CD ROM and DVD disks. The future of the floppy disks is going

the same way as beta tape recorders. Students who have projects small enough to store on a floppy, can transfer these files from one computer (possibly at home) to another (computer at school), while working on the project.

6.10.1.2 Storage Technologies

Again, storage devices can be further sub-divided into magnetic and optical devices.

Magnetic Storage Devices

If a storage device used disks (diskettes) or tapes, then it is categorized as a magnetic storage device. This is because disks and tapes are coated with iron oxide, a magnetically sensitive material used for storing the data.

The benefits of using magnetic storage devices such as 3 ½" floppy disks, hard disks and magnetic tape is that they can cheaply store large amounts of data. Magnetic tapes are also similar to those previously used to record music, and are popular for use in the backup of data.

A hard disk is a storage device which can retrieve data very quickly and can also store large amounts of data, many times more than a floppy disk or cassette tape. They contain multiple metal disks called platters, with read/write heads for each side of each disk.

The time taken to retrieve data includes the time taken to find the data on the disk (called access time) and the time taken to transfer the data from the disk to primary memory. The average hard disk has an average access time of 12 kps (Kilo-bytes per seconds). A fast hard drive is considered 8 kps.

If a storage device uses laser technology, then it is categorized as an optical storage device, since it uses laser beams to read data etched into plastic disks. Simplistically the surface of the disk will contain tiny indentations called pits. As a light-sensing device scans the surface, it picks up signals to interpret the data. For example, it receives no light from the pits, or light if no pits are scanned, thus sending a series of signals to the computer. The compact disk, more commonly called a CD, is the general term for these storage devices.

Optical disk storage also stores a larger amount of data than floppy disks, and are usually categorized according to their ability to read or write or both read and write data to the disk. They

are generally used for mass distribution of information such music, video, or computer programs. Standard CDs can store approximately 80 minutes of music.

Table 5: Categories of Compact Disks (CDs)

Optical Disk Type	Meaning	Description
CD-ROM	Compact Disk-Read Only Memory.	The drive can only read data from and <i>not</i> write data to the disk. Stores up to approximately 700 MB of data on one disk. Primarily used for distribution of many types of software They are used for storing large application programs, and multimedia programs.
CD-R	Compact Disk-Record (once)	Can be read from and written to. Note however that disks can be written to only 'once' Disk can be read by either a CD-ROM or CD-R drive.
CD-RW	Compact Disk-Re-Writable	Disks can be read and written to many times and are therefore erasable. CD-RW drives are capable of reading, writing, and erasing data. Note that the write operation is much slower than the read operation, and hence not as popular as the others.
DVD-ROM	Digital Video Disk-Read Only	Mainly used for video storage (DVD-Video) but can also hold audio. DVD-ROM device is used for computer data storage.

Table 6: Comparison of storage capacity and access speed among storage devices

Storage device	Storage Capacity	Access Speed
Hard Disk	varies	1000 Kb/s
CD-ROM	~650 MB (~451 floppy disks)	100 Kb/s
DVD	~ 4.7 GB (~7 CD-ROMs)	100 Kb/s
Floppy Disk	1.44 MB	36 Kb/s

Solid State Storage Devices

Solid state storage devices are electronic and have no moving parts like the other mechanical storage devices such as the hard drive. Examples include flash memory sticks for storing general files, memory cards for video game consoles, and other devices used in digital cameras, disks in laptops. Flash memory is a type of EEPROM chip but it used more as a hard drive for data storage. These popular memory stick or flash drive is quite similar in use to floppy disks but contain much more data, so that it offers potential advantages over other portable storage devices. They are however more compact, generally faster, hold more data, and are more reliable than floppy disks. Memory cards are also similar to the memory stick. However they are for use in devices such as portable music players, personal digital assistants (PDAs), digital cameras, camcorders, mobile phones and computer systems.

6.10.1.3 The Storage Hierarchy

Data is stored according to how quickly it is available to the computer system. The three main storage levels are compared in table below:

Table 7: Description of Storage Hierarchy

Online storage	This is primary storage. These storage devices are readily available computer system, and there the user is not required to issue any instructions.
Near-online storage	This is secondary storage. The user usually needs to insert a disk in order to access the data implying that some intervention from the user is required to make the data available to the computer system.
Offline storage	This is also tertiary storage or archival storage, since this is not usually available to the computer system. A tape backup unit for archiving is an example.

6.11 Summary

This unit discussed the following concepts in relation to input devices.

- Input includes software, data, or information that is entered into the computer's memory.
- Input devices such as the keyboard, mouse, and trackball enable the user to enter data into the computer's memory.
- A pointing device enables the user to control movements of a pointer on a screen.
- Speech recognition software enables a user to enter data into a computer by speaking into a microphone.
- Video and images can be entered into a computer through using digital cameras or scanners.
- The following diagram illustrates a number of input devices that can be attached to a computer in the keyboard, pointing and source data entry categories.
- Two general types of output are softcopy and hardcopy output.
- Monitors enable the user to view the computer's processed data. The output known as soft copy.
- Softcopy output can be further sub-divided into visual output (on screens) and audio output (from speakers).

- Two types of monitors are the cathode ray tube (CRT) and the liquid crystal display (LCD).
- A monitor's quality is measured by screen size, resolution, and refresh rate.
- Printers produce permanent copies (hard copies) of the computer's output.
- Visual output of text, graphics, or video is usually displayed on a monitor.
- A terminal enables a user to communicate with a computer and is generally a combination of a keyboard and output screen.

Input devices can be categorized by keyboard, pointing and data entry from the source. Each category has its own advantages and disadvantages although some users are somewhat inclined to use some types over others. The main concern with input devices is the health concern with regard to keyboards and the constant typing, which has led to the creation of the input devices which capture the data from the source.

Output devices are either softcopy or hardcopy output. Softcopy is usually temporary output while hardcopy output can be printed and stored for future use. The various types of soft- and hard-copy output must depend on the appropriateness of the application. The concepts related to storage devices that were discussed in this unit included:

- Secondary storage is used to save your data when the computer is turned off and is cheaper than primary memory.
- Storage devices typically hold programs and data in manageable blocks or units called files.
- Storage devices are categorized by the method of access to data (sequential or random-access), type of technology (magnetic, optical, or solid state), preference of storage (online, near-online, or offline) and type of operations that are performed (read-only or read/write).
- A hard disk's performance is measured by its positioning performance and transfer rate.
- Optical storage devices include, CD-ROM (Read-only), CD-R (Record once), CD-RW (Erasable, write repeatedly), DVD-ROM (Read-only), and DVD-R (Read/write).
- Solid state storage devices include PC cards, flash memory cards, and smart cards

Secondary storage is very important in the long-term storage of data and information. However the appropriate use of these devices depend on the method of access to data, the type of technology, the user's preference of online or offline storage as well as the type of operations that are to be performed.

Reference

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Chapter 7: Communication and Connectivity

7.0 Learning Objectives

At the end of this unit, you should be able to:

1. Describe the various uses of telecommunications.
2. Evaluate the different communication media.
3. Define a network.
4. Describe and illustrate the various types of networks.
5. Describe types of networks.

7.1 Introduction

This unit is an interesting, but technical one where the discussion expands to the connection of more than one computer to meet various needs. It also discusses how these computers can be connected and the accompanying reasons or purpose for their connections. The popular topic of the Internet is also introduced with its intriguing services and benefits, and the different methods of connecting to the world wide web.

Computers are linked together to exchange data and share resources as said to be networked. Networks allow users communicate with others once there is access to a computer. Networks come in a variety of forms and support a variety of different asynchronous and synchronous communications methods.

7.2 Communications

In our day to day lives we regular communicate with others through talking, writing, and actions. Computer networks communicate by first becoming linked to each other, so that data and resources can be shared. For example, two or more computers can be connected to each other, along with one printer (a resource), so that each computer is able to print form this one printer. This is known as a simple network and you are sharing output devices via the network.

Computer communication is achieved when signals are sent and received among and between different computers. This exchange of signals allows users to collaborate with other online users in different countries. Individuals can share and retrieve information and files they can exchange electronic mail and participate in electronic messaging with others from all over the world.

7.2.1 Collaboration and Sharing

Computer communication has provided contact among users from different cultures, continents, and time zones. Indeed, *telecommunications* technologies such as land lines, satellite, cable, the Internet and cell phone technology have made communication possible and affordable over long distances. Many business organizations and individuals have taken advantage of *teleconferencing* and *videoconferencing* – conferencing available on the Internet, and through you telephone, cable and satellite providers. Today people do not have to travel for meetings or conferences. Telecommunications technologies allow employees to work from home, or away from the office, while still interact with the others in the company through computer communications. They are able to send and receive documents, share schedules, send messages and talk directly with their co-workers. This ‘work away from the office, is known as *telecommuting*.

7.3 Transaction Processing

In previous years data and information were stored in a central location, and many users would simultaneously access this single location to retrieve data required for a transaction, or other reasons. This caused problems, as not everyone was able to access data in a timely fashion. Large numbers of requests to a central processor or storage location takes time taken to send and retrieve the large or small amounts of data or information. The volume of data moving through the system often slowed the system down and at times even crashed or shut down the system. With computer communication systems now available, data and information (and indeed the workload) can now be dispersed (or distributed) to various sites, subsidiaries or branches of the business in other areas of the building or country.

Indeed many large corporations link some parts of their systems with the systems of their major customers. This inter-organizational system link also allows the corporation’s systems to link to

suppliers for electronic data interchange (EDI). This facilitates speedy order processing and other transaction processing.

7.4 Information Retrieval

Information retrieval is important for decision making in business, industry, research organizations, and even for entertainment. Various types of information (such as music, text, sound) can now be stored in private or public databases. Once these databases are made available online, they can be accessed by select persons either through the use of the Internet, or an internal company network, called an Intranet.

7.5 Electronic Mail and Electronic Messaging

Electronic mail and electronic messaging are one of the most popular methods of communicating among persons of all ages. Messaging includes text messaging using cellular phones, online messaging using programs such as MSN and Google talk. Paging, sending and receiving sending faxes and the use of voice mail are also methods of electronic messaging. Electronic mail (e-mail) and online messaging also enables persons to send and receive softcopy documents as attachments.

7.6 Efficient and Effective Communication

In order for computer communication to be effective and efficient, many agencies must be involved. These include the telecommunications telephone, cable and satellite companies in the various countries, as well as the many Internet Service Providers who provide access to the Internet. Indeed the number of businesses that are involved in the operation and management of Information and Communications Technologies (ICTs) include: software providers; hardware providers; custom development companies; online communications and collaboration companies; and others. Finally governments must create legislations that governs the access to data and the use of data and provides oversight of the telecommunications industry.

7.7 Connecting Computers

This Topic is a bit technical as it describes the media that are used to connect computers together in order to share data and peripheral devices. There are also different ways in which computers are connected and it discusses the advantages and disadvantages of each. The Topic also includes a brief discussion on the services and benefits of the Internet, and the various methods for connecting to the world wide web.

7.7.1 Communication System Components

Wired or wireless media are used to allow communications among computers. Wired media include twisted-pair, coaxial and fibre optic cable. Twisted-pair cable and coaxial cable transmit data by means of electric frequencies. These cables therefore need to be protected against water and electromagnetic waves. Fibre optic cable is an improvement on the previous two cables. A fibre optic cable consists of glass or plastic tubes which transmit data over longer distances at a faster speed, using reflection of light. Fibre-optic cables are more secure and much thinner and lighter than other metal wires, and they are not affected by electromagnetic noise such as radios, motors and others cables. Although fibre-optic cables are very costly and difficult to install, they are extremely popular with telephone companies, banks, and television companies replacing their existing telephone and coaxial cables with more efficient fibre-optic cables.

As the term implies, wireless media in a telecommunications network connects nodes without the use of wires. Wireless network systems incorporate cellular technology which uses satellites, radio and other signals, to allow for communication over land and sea across the world. Wireless networks are very useful in sending and sharing data quickly within small offices or among business across the world. More importantly they are relatively inexpensive in connecting to the Internet, especially in countries where there are scarce resources or poor infrastructure. Wireless networks therefore eliminate the maze of cables, while offering more mobility. However the disadvantage of wireless media is interference from other networks that might block the radio signals from passing through.

7.7.2 Network Topologies

The physical layout of a network is called a topology. The four main topologies will be discussed in this section. A network is a collection of computers which are connected together. When

sketching the topology, each computer workstation, file server or other peripheral is generally called a node. A network topology therefore, is the arrangement of the network, whether physically (the actual layout including cable installation), or logically (the actual operation of transferring data), according to the requirements of the network. This Topic will discuss four general network topologies.

7.7.2.1 Bus Topology

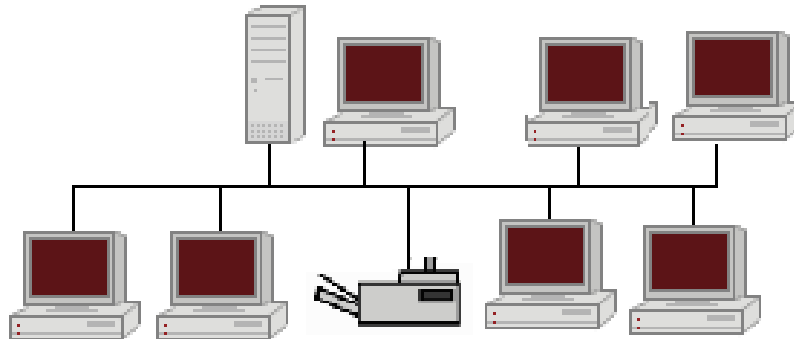


Figure 42: Bus Topology

This linear bus topology is one of the simplest of the four network topologies to use, in its most basic form it is simply a case of running one cable called a backbone, from the computer or peripheral device at one end of the network to the last peripheral device or computer at the other end. Other computers, scanners, printers or other peripheral devices are then attached to the backbone anywhere between these two end computers.

Advantages and Disadvantages of Bus Topology

Of course from the simple description above, it seems relatively easy to connect a computer or peripheral to this topology. It also requires less lengths of cable than the other topologies, so it can be economical. Since all computers and peripherals depend on this single cable or backbone, the entire network will not work if there is a break in the backbone. This will also prove difficult to identify where the problem or break is located, if the entire network is not working. This topology is also not intended to be used as the only network arrangement where numerous computers and peripherals are to be connected. Finally it has the lowest fault tolerance, that is, a single problem in the network with a bus topology can halt all of its activities.

7.7.2.2 Star Topology

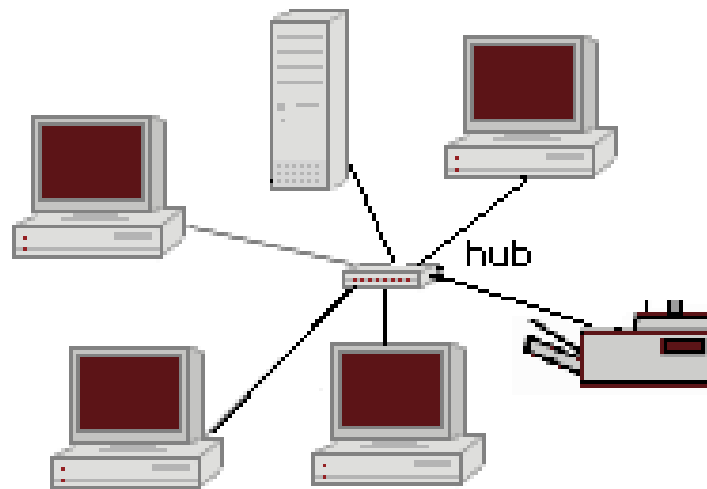


Figure 43: Star Topology

A star topology connects computers and peripherals to a central device called a hub. Physically the topology looks like a star. So that when a node is sending data to another node, the data passes through the hub before continuing to its destination node. The hub therefore manages and controls the network.

Advantages and Disadvantages of Star Topology

A new node is relatively easy to install by adding a cable from the new device to the hub. Installing and even removing nodes do not cause any disruptions to the network, so this topology has high fault tolerance when troubleshooting to detect faults and to remove nodes.

Of course if the hub fails, then all nodes attached to the network are disabled. It is also more expensive than the bus topology because of the cost of installing the cabling and configuring the hub.

7.7.2.3 Ring Topology

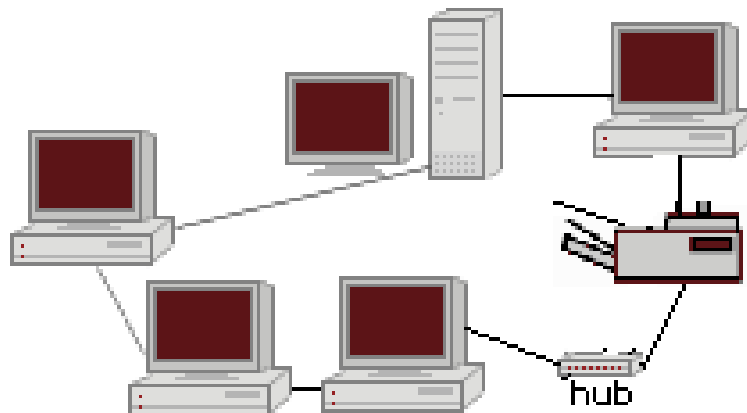


Figure 44: Ring Topology

The nodes in a ring topology are connected to the nodes on its left and right, so that data passes from one node to the next. Of course fault tolerance is non-existent since failure of one node cripples the entire network. This is why the physical ring topology is rarely used. Adding a new device to an existing physical Ring network can be complicated as any new device needs to go in-between the existing devices.

7.8 Local Area Networks (LANs)

A Local Area Network (LAN) is a computer network that functions within a specific geographical area, such as a building, school or campus. The network links the computers located within the building. In the case of a campus, the computers are linked throughout the various buildings using wired cables or wireless communication using radio and other signals. Access to the LAN is privileged and controlled by a network administrator. Once access is authorized, users can access most of the software, data, and peripherals connected to the LAN. The main uses of LANs include the sharing of expensive devices such as printers and scanners, as well as the provision of internal Intranet and electronic-mail services. Public telephone exchanges such as PBXs are also examples of LANs which use telephone systems in many organizations.

In order for a LAN to function, a network interface card (NIC) must be installed in the computer to provide the connection between the computer and the network. The main operating system

software that supports networking are UNIX, Linux, Windows, and Mac OS. Two types of LANs are peer-to-peer and client-server, which employ a bus or ring topology.

7.8.1 Peer –to- Peer Networks

All computers on a peer-to-peer network are configured similarly with no specific computer designated as a file server. Also the users in this type of network determine which files and peripherals attached to their computer that they wish to share. This is why peer-to peer networks are simple to set-up as home businesses, and are not appropriate when there are many computers.

7.8.2 Client – Server Networks

Client-server networks can be set up using various topologies, and are appropriate in large corporations. The network requires file servers which contain the many application programs. The clients are the networked computers which access the server to obtain and use the programs, data, and to access peripherals.

7.9 Metropolitan Area Network (MAN)

A metropolitan area network (MAN) is a computer network that interconnects users with computer resources in a geographic area or region larger than that covered by even a large local area network (LAN) but smaller than the area covered by a wide area network (WAN). The term is applied to the interconnection of networks in a city into a single larger network (which may then also offer efficient connection to a wide area network). It is also used to mean the interconnection of several local area networks by bridging them with backbone lines. The latter usage is also sometimes referred to as a campus network.

7.10 Wide Area Network (WAN)

Wide area networks (WANs) effectively connect LANs which are located at different geographical locations – a few miles or thousands of miles away. This way, a large corporation or banking institution can share, and exchange data and information, as well as perform transactions among its branches using one wide area network system.

7.10.1 Internet Services and Benefits

The Internet is a network of networks, which link local, regional, national and international computer networks to exchange data and process tasks. In order to efficiently process these tasks and exchange data, a standard called TCP/IP (Transmission Control Protocol/ Internet Protocol) comprises a set of rules which must be followed. The telecommunication links among the networks of the Internet are built and maintained by major telecommunications companies around the world. Each computer connected to the

Internet is recognized by a unique number, officially known as an 'IP Address'. Data travels the Internet from origin computer to destination computer in small chunks called 'Packets', with the help of 'routers'.

7.10.2 Connecting to the Internet

Users can connect to the Internet through a dial-up connection or other more sophisticated connections. Irrespective of how users connect, companies called Internet Service Providers (ISP) maintain telecommunications equipment so as to provide Internet access to individual users, as well as users involved in business and large organizations. An ISP is responsible for providing each user with Internet access by connecting your computer to the Internet, much like a telephone company connects your phone to the telecommunications network.

To get access to the Internet, a user needs an optional local telephone number, a unique identification and password for access, and one or more email addresses. This is usually accompanied by a stipulated fee monthly, quarterly, yearly or simply a block of hours.

7.10.2.1 Dial-Up Internet Connection

A dial-up connection requires a device called a modem, which converts your computer's digital signals into a type of signal that can travel over phone lines. The maximum speed for dial-up is 56Kbps, or 56,000 bits per second.

7.10.2.2 Other Internet Connections

Other Internet connections provide data transfer speeds much faster than that of a dial-up connection, although they both must be in close proximity to a telephone port. An Integrated Services Digital Network (ISDN) provides data transfer speeds of 128K, while a Digital

Subscriber Line (DSL) is a general name for a family of high –speed Internet links, including ADSL, SDSL, and DSL lite. These provide data transfer speeds up to 125 times faster than dialup.

7.10.3 Web Browsers

Just as you would use a software program such as a word processor, web browsers are also software programs that are also installed on your computer. Their purpose however is to allow you to access one or more web pages. In simpler terms, a web browser is just a way to help you get around the Internet, so whenever you type in an address for distance education to access your notes, for example, you are using a browser. Browsers are also useful for downloading files from databases stored on the Internet, and linking you to other pages from a main home page. Each browser keeps a list of the pages you have viewed on the Web, so that you can return to that site, even if you visited it days ago.

A typical web page contains mostly text, with some pictures, and even media such as movies or other small programs. Your browser translates the HTML language that was used to create each web page into a presentable form that users can understand. Figure 45 shows a typical browser while Figure 46 shows the html code that was used to create the web page.



Figure 45: Web browser

- Rank the search results by web pages that contain or link to that search term most frequently.

7.11.1 Problems with Searching

Search for a word or phrase in a browser window, will produce those web pages that are relevant to what you are searching for. However, words and phrases differ in context, so you may also see other listing which do not relate to what you need. In addition, you may also see duplicate listings since the search will list the web page with your search term, as well as all of the links from the same web page that also contain the search term.

7.11.2 World Wide Web Basic Terminology

Link	A button or interaction that allows you to navigate to related documents.
Web Page	A collection of hypertext documents and links (or hyperlinks).
Web Server	A computer that stores and distributes web pages.
Web Site	A collection of web pages with an Internet address.
HTML (Hypertext Markup Language)	A language to create web pages. The file extensions used are .htm or .html
HTTP (Hypertext Transfer Protocol)	The communications standard that is used to transport web documents over the Internet.
Hypertext	Text, video, pictures.
The Web (or World Wide Web)	A collection of files that are interconnected through of hypertext.
URL (uniform resource locator)	The internet address of a web site.

7.12 Summary

The concepts in this unit include:

- Computer networks communicate by first becoming linked to each other, so that data and resources can be shared.
- Computer communication allows for collaboration among users in different countries, transaction processing, retrieval of data and information, electronic mail and electronic messaging from all over the world.
- Wired or wireless media are used to allow communications among computers.
- Wired media transmit data by means of electric frequencies.
- Wireless media connects computers without the use of wires.
- The physical layout of a network is called a topology.
- Linear bus topology is one of the simplest of the four network topologies to use.
- Star topology connects computers and peripherals to a central device called a hub.
- Ring topology are connected to the nodes on its left and right, so that data passes from one node to the next.
- A Local Area Network (LAN) is a computer network that functions within a specific geographical area, such as a building, school or campus.
- Wide area networks (WANs) connect LANs which are located at different geographical locations.
- The Internet is a network of networks, which link local, regional, national and international computer networks to exchange data and process tasks.
- Web Browsers are also software programs that are also installed on your computer.
- Search engines access many web sites which match your request, and then show a list or sample of the web pages so that you can select those that you are interested in.

In the previous units we explored the input, processing, storage and output of individual computers. This unit introduced communication among computers once they were linked together in different ways to form a network. It thus enabled the user to engage in telecommunication, teleconferencing and then telecommuting. In addition, access to data located on other computers, called servers, allowed for faster retrieval, and thus the introduction of

electronic mail and electronic messaging, and the development of the Internet. Users are now able to search for any item whether it is a product, a plant or a planet!

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Chapter 8: Internet

8.0 Learning Objectives

At the end of this unit, you should be able to:

6. Explain the evolution of Internet
7. Explain world wide web
8. Setup and Internet connection
9. Compare different types of internet connections
10. Perform searching on the internet
11. Understand various applications of Internet.

8.1 Evolution of Internet

The internet has changed dramatically since its first incarnation. In 1969 the U.S. department of defense created ARPANET.

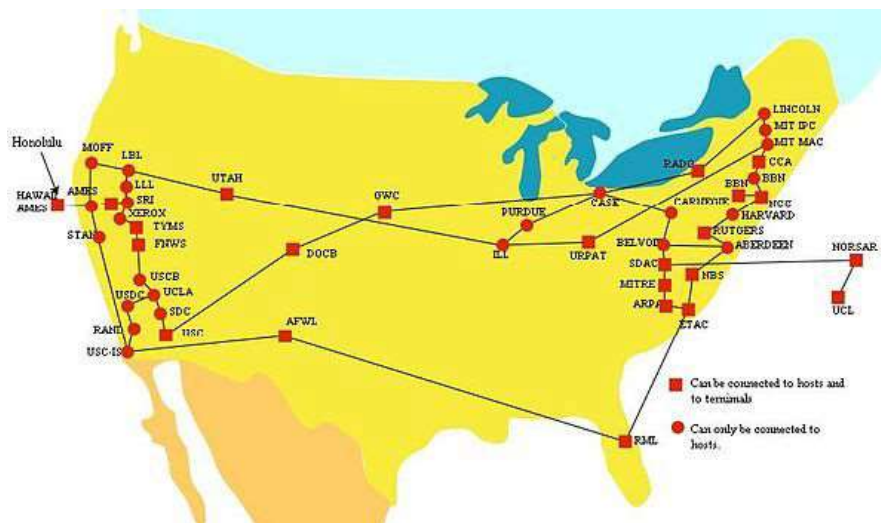


Figure 47: ARPANET

The original concept of this project was to connect researchers located in different places to be able to communicate and collaborate from far distances. The fear of nuclear attack was very prevalent at this time, so the team also wanted to make a network that could still operate after a nuclear attack. Therefore creating many different fail safes, and alternative routes for packet

sending was necessary. As this project grew, more and more people gained access to the internet and began shaping it to what we know today. As we have described before, everyone who uses the internet is called an internet user.

For these users to obtain access to the internet, you must go through an ISP (internet service provider.) Side note, while the internet is not owned by any one company or government, it is most assuredly not free. It costs money to build, run, and maintain the servers that bring you the funny cat videos.

Internet 2 is an amalgamation of different leaders in the field of academia, technology, industry, and government that formed together in order to collaborate on pioneering and innovative ideas that help advance education and research. They test new network applications and technologies using high-performance networks. Contrary to popular opinion, Internet 2 is not a gathering of minds who intend to replace the current Internet but congregate to ensure that the future Internet will be capable of operating with today's engineering. Internet 2 is currently being upgraded to 8.8 terabytes! This will aide in the ability to offer advanced telemedicine and long distance learning opportunities across connected countries through its network.

8.2 The World Wide Web

The World Wide Web is different than the Internet. The Internet started out being used more by private industries and people such as scientists, schools, and the government. The public had not used it for the most part because it was complex and you had to have a computer in order to access it, which not everyone did. In 1989 Tim Berners-Lee came up with the World Wide Web and thought it would be a good way to organize information and take place of the Internet. Although the Internet still stayed around, and still is today, the World Wide Web was a great tool for researches at the time. The World Wide Web is not owned by one single business or person, but the webpages are. The Web consists of things such as HTML, URL, and HTTP. HTML stands for Hyper Text Markup Language and is used for formatting documents on the Web. URL is the Uniform Resource Locator which most of us are familiar with when typing in addresses to websites. And lastly, HTTP is Hyper Text Transfer Protocol. This is what lets people click on hyperlinks and be redirected to that specific location. The World Wide Web has changed the way schools teach, businesses run, and average people have been able to access organized

information. Pictures and documents are now easier to access and research and recreational websites can now be found in one place.

8.3 Using the Internet

8.3.1 Setting Set Up To Use The Internet

Almost every household has access to the internet; therefore, it is important to know how to have access to the world wide web. There are five basic steps to set up an internet connection which consist of the following:

1. One must connect the hardware. Different hardware and software contain directions in setting up. Use the directions to set up these systems.
2. The internet needs a wireless connection or an Ethernet cable before it can go online. Therefore, the computer owner must make this connection.
3. The computer owner must connect to the default IP *Crystal Clear app Internet Connection Tools* address. The IP address usually consists of eight numbers, and it is broken up occasionally by periods.
4. It is the internet' s server' s responsibility to show the computer owner how to actually establish the connection. One must then set up a name and password for security purposes.
5. Save the settings, and the internet light will turn green to indicate one is online.

8.3.2 Different Internet Connections

There are many different kinds of internet connections. A few of these connections consist of wireless, broadband, and dial-up. Wireless is a router or a network that connects to a hot spot. A broadband is connected directly to a broadband modern, and one needs a user name and password to connect. A dial-up is used remotely via a telephone line. Different types of internet connections come with their own pros and cons and it is important to choose one that will work well with your lifestyle and your wallet.

1. **Dial-up:** Dial-up connection requires a phone line to function. Because of this, people cannot be using the phone and the internet at the same time. When connecting to the

internet via dial-up, the computer tries to connect through the phone line and causes dial-tones and many numerous sounds to emit from the modem. Dial-up is also the slowest form of internet connection and has a maximum speed of 56 kilobits per second.

2. **Wi-fi Hotspots:** Wi-fi hotspots are another form of internet connection in which a wireless access point, such as a router, has a direct connection to the internet and allows people to connect wirelessly through the use of wifi. Although they aren't used very much at home, wi-fi hotspots are often used at locations such as restaurants, hotels, and airports. Many restaurants such offer free wifi to entice customers, while others have a fee for using their internet.
3. **Broadband over Fiber:** A new technology called broadband over fiber (BoF) is a direct connection option for internet access. Internet service providers are starting to adopt this new technology and sell it for a fee. For example, Verizon's version of broadband over fiber is called fiber-optic service (FiOS). FiOS, in particular, is able to provide services such as telephone, television, and internet. BoF is advertised on Verizon's FiOS webpage as a network that, "provides bandwidth to meet today's digital demands and the possibilities of tomorrow." This statement is probably used because BoF's data transfer speeds are much faster than other services. In fact, with fiber-optic cabling, data transfer can travel at the speed of light. One drawback of BoF is that it is very expensive. In order to create a fiber-optic network, you must invest a lot of money in constructing an essential infrastructure. Another negative with broadband over fiber is that the cables are very sensitive. This means that cables cannot be installed on telephone poles or underground. Cables must be installed above ground, usually in piping, so that the cables are protected from bending and shifting. BoF is practical and efficient for small networks due to less complex construction of infrastructure. This being said, the United States probably won't have nation wide BoF networks.

8.3.3 Selecting an ISP

There are many different Internet Service Providers, some of the most popular include Comcast, AT&T, Verizon, and Time Warner Cable. When you choose an ISP, there are many factors to take into consideration. Some of those factors include price, type of internet connection you want, speed, customer support, types of devices you use, and cancelation policies.

Some internet service providers, such as Verizon and Google, are now starting to offer fiber-optic internet connections. Fiber-optics allows unsurpassed connection speeds, both upload, and download. Fiber-optic internet connections employ Fiber-optic cables that transfer large amounts of data through hundreds of strands of glass or plastic which employ an entirely light based, optical technology. The technology has existed for many years, but many may have begun to hear that it has become more commonly available over the recent years.

After implementing fiber-optics in commercial internet service packages, Internet Service Providers are now able to confidently boast connection speeds exceeding 100gigabits per second, speeds that are much more desirable to many households as well as businesses. Fiber optic networks are, to no surprise, very expensive. Massive internet service providers such as Comcast, AT&T, and COX may not be ready to spend hundreds of millions, and even billions on city wide fiber- optic networks, thus making the transition to fiber-optics before the technology a long one. Google alone spent over 80 million dollars to reach 150,000 households with their fiber-optic connections. Only a small handful of cities currently have the luxury of a fiber-optic connection, and it may take some years before the technology is available to a majority of households.

8.4 Searching the Internet

8.4.1 Search Sites

Search sites are websites that are specifically created to help search the Internet. Examples would include, “Google,” “Bing,” “Yahoo! Search,” and “Ask.com.” There are also many other not as well known search sites. Search sites generally use a search engine, which is a program for the retrieval of data from a database or network. A search engine includes a spider, which goes to every page on every Web site that wants to be searchable and reads it. Then there is a program that creates an index from the pages that have been read. Then a program that receives your search request and compares it to the index, then gives you results. Most search sites today are designed for keyword searches, which is when you type in keywords describing what you are searching for. A directory search is the other kind of search that some sites allow and it uses lists of categories instead of a search box.

Many search sites will also contain tools that can be used to find information. Many sites try to present their results as clearly as possible. They will also tend to make suggestions about things that are similar to what you searched that may help you find what you are looking for.



Figure 48: Google search engine

8.4.2 Search Strategies

Searching for particular information can be fun but also can be very frustrating. Here are few different search strategies which can help to find the information needed, such as simple, complex, phrase, natural language and default Boolean Logic searching. Simple searching is the easiest method of using a search tool. The user can type one or more key words (spelling counts) in the search box then click on the search button. Complex searching is using Boolean Logic to improve search efficiency. The words such as AND, OR, and NOT are entered between keywords to refine the search. In phrase searching, a user should enclose quotation marks when searching for specific phrase. Most search engines like Google, Bing, and such recognize this protocol. Natural Language searching is allowing a user to type a sentence or question just the way he/she might like and the search tool will try to determine key words and locate pages based on these words. Default Boolean Logic searching allows a user to type key words as in simple search. Search tool, depends on its default, will use OR or NOT. If a user is tired of typing, she/he can click on the microphone icon in the Google app or Chrome's search box to search by voice.

8.5 Beyond Browsing and Email

8.5.1 Instant Messaging and Text Messaging

Communication is quite possibly the most important tool that humans can hone. While e-mails are a fast and environmentally-friendly method of Internet-based communication, there are two types of messaging that are faster and easier. These two types of messaging are: instant messaging and text messaging. Instant messaging, also referred to as chat, allows you to type out a message on your keyboard and then press 'enter' to have it sent immediately to the other party. Unlike emails, where you have to wait for the other person to be around at their computer to read the message, and THAT is assuming your email didn't get lost because of a faulty spam filter,

IM's create a connection that is almost as good as being in the same room with the friend. To instant message a friend, you typically both need the same IM client, of which there are many free varieties such as AIM, MSN, YIM, and Skype.



Figure 49: You send text messages with a cell phone such as this one, though

Text messaging, which is also called SMS (Short Message Service), used to be the most popular means of speedy communication though it has been on the decline.[24] Text messaging allows users to send fast and typically short notes with their cellular phones. The major downside of text messaging is how many cellphone companies charge a ton for your texts while instant messaging is free (plus the cost of the internet for your computer or phone, of course). Also text messages, like emails, need to be waited for and can sometimes not make it to the right place without a glitch whereas instant messengers tend to have a better track record.

8.5.2 Online Shopping: Amazon and More

Online shopping is so convenient for many who are on the go. There are no hours of operation to abide by, no lines to wait in, and consumers do not even have to leave the comfort of their own home to get what they want. There are some downsides of online shopping, such as not being able to try on clothes to see if it is the right size. The largest online retailer is Amazon.com. Shoppers seems to go-to website for all online shopping needs. The retailer started as an online book store, but now offers purses, electronics, movies, music, and even sports equipment, just to name a few. Sellers can create accounts fairly easy and try to sell their goods. Buyers need to be the cautious ones and look into the reviews to see who they are buying from.



Figure 50: Amazon Box

One advantage of shopping with Amazon is that they have an A-Z guarantee that helps the buyers resolve conflict with the sellers. Amazon expanded their services to include areas such as Amazon Art, Amazon Instant Video, Amazon Prime, Amazon Local, Amazon Wireless, Amazon Fresh, and Amapedia. One controversy that comes up with Amazon.com, their true county sales tax. Instead they are paying the sales tax that Amazon collects. To challenge Amazon, Google has decided to start to expand its e-commerce role. Google wants to compete with amazon and their ability to sell merchandise around the world. Google is allowing consumers to search for something and Google would tell them if there is somewhere nearby to purchase that item. It is a great retaliation against amazon. They would charge \$95 a year or \$10 a month, or pay \$4.99 per order. Google is also offering overnight shipping.

8.5.3 Online Banking

Online Banking has become increasingly popular in this tech-savvy generation. Most banks now allow transactions to be done online through their website or through phone apps. While some people question the security of making transactions online, the biggest advantage is that online banking is very convenient. People can set up accounts through a few simple steps, can make transactions between different accounts they have, transfer money, make payments on credit cards, and more. Some onlyonline banks have formed and are gaining popularity because they have less fees and thus are cheaper. Some banks try to offer deals with higher yield to make online banking more appealing. Lastly, it is handy to have 24/7 access to speedy transactions, which traditional banks cannot offer. Online banking did have a shaky start, but now it is growing quickly.

8.5.4 Social Media

Besides texting, instant messaging, and online shopping, there are hundreds of other things you can use the Web for. One of the main things people use it for today is social media. Things from Facebook and Twitter to email sites used to share information to groups of people over the Internet. The problem with the huge explosion that has been the beginning of the social media era is that it is becoming increasingly difficult to believe information posted online. The Internet has evolved so much that now we are able to even perform video and telephone functions through it. Sites like Skype are taking advantage of this technology. According to the FCC (Federal Communications Commision) the technology used by Skype, Vonage, and other similar

Companies is called VoIP. They define this technology as one “that allows you to make voice calls using a broadband Internet connection instead of a regular (or analog) phone line”.[29] Essentially, performing telephone functions through the Internet is VoIP. Social Media has seemingly encompassed the younger generations of today; while it has been slower to catch on with the older generations, it is something that has been increasing over time.

Skype had recently acquired a newer company called Qik and plans on dominating the new way for people to communicate using mobile video messaging. Skype Qik is supposed to be very simple, and it is exactly like texting but all video. A person can send a Qik video to anyone and they do not even have to have the app. These conversations are asynchronous and Skype Qik is a great idea for communication since things like facetime have been a big trend. The thing with facetime though is that someone has to answer the phone and both people need to use it at the same time; with Skype Qik people have the ability to have that type of video interaction but at no specific time. Skype Qik was developed by Microsoft, and is available on a PC or Mac, and for the iPhone, Android, or Windows phone.



Figure 51: Skype-icon

Another popular social media app is Snapchat. This app allows people to send pictures, videos, and texts, just like other apps, but the catch is that once the picture/ video/text is opened, it disappears after the set amount of time and cannot be seen again. Snapchat has many features which make Snapchat photos and videos more fun and interesting than on other apps. Such features include filters, different text fonts, and the ability to draw on the pictures/videos with

different colors. In addition to these original features, Snapchat has added a feature called “My Story” where users can create a chain or video of multiple pictures and videos combined. This story is not sent to one specific person, rather any of the user’s friends can see it; the set time in this feature determines how long the picture shows in the “slide show” and the story is available for only twenty-four hours. The latest feature is “geolocation” which can give you the time, weather, miles per hour, or other site-specific filters based on your location.

8.5.5 Blogs, Wikis, and Other Types of Online Writing

A blog is a Web page that contains short, frequent updated entries in chronological order, typically as a means of expression or communication. Blogs can be written by anyone, including ordinary people, celebrities, or even experts of certain fields. As blogs become more and more popular, commercial advertising begins to be commonly seen on more of the popular blogs. Some of the most popular blogs are websites that offer information or helpful tips to their readers. For example, as of October 2014, the top three most popular blogs are: Huffington Post, TMZ, Business insider. Another form of online writing, most often used for education purposes, is the wiki. Wikis are a way of creating and editing collaborative Web pages quickly and easily. Unlike a blog, wikis are meant to be edited by anyone, not just the owner of the typed information. One of the largest wikis is Wikipedia (Wikibooks is an example of a wiki too).

While wikis are helpful and collaborative, erroneous information can be added intentionally. As a result, it is recommended to be careful when fully trusting a wiki page. Another type of online writing is an e-portfolio. An electronic portfolio is a collection of an individual’s work accessible through a website. Today, e-portfolios are commonly linked to student-related information, such as resumes, papers, or projects.

8.5.6 Online Gaming

Everywhere you look, young people are using smartphones, notebook computers, iPads, etc. Often, they are not just using these devices for school research, homework, or studying. Young people can be seen playing games on computing devices as young as 3 years old. Online gaming is a rapid habit that is starting from a very young age. Often, the habit carries into the young adult years for many individuals. Nowadays, there are whole web sites whose sole purpose is hosting games that can be played online. Online games can be played alone or with other

individuals who are also online. The games that are designed to be played by multiple players are called online multiplayer games. Some examples of online multiplayer games are Doom, EverQuest, Final Fantasy, City of Heroes, and World of Warcraft. Also, gaming devices, such as, PlayStation 3, Xbox 360, and Wii, are designed to be Internet-enabled so they can be connected to the Internet to play with other players.

8.5.7 Video Chatting

Video calls have played a major part in science fiction for decades. They were a major part of the film 2001: A Space Odyssey, and many other films and TV shows of that genre. Now, video chatting capabilities are found as standard on most desktops, and mobile devices. One of the most well known programs, and the program that pioneered video chatting, is Microsoft's Skype. In recent years, Skype has been joined by Apple's Facetime, and a video chat program embedded in Google Hangouts.

Skype is compatible with Microsoft, Mac, and Linux computers, and there is an app for mobile devices. Facetime however, is only available on Apple devices, although the company has promised to make it compatible with other devices at some point. Google Hangouts, being a part of Google online app suite, is available as long as the user is able to access the Internet. There are other free source programs, but these three are the most common and the most trusted by security programs. Video chatting was touted as a futuristic ideal, but in recent years, this has not held true. Video chatting use has declined in favor of texting and online texting apps. These may be the future as opposed to video chatting.

8.6 Summary

1. In 1969 the U.S. department of defense created ARPANET.
2. Internet 2 is an amalgamation of different leaders in the field of academia, technology, industry, and government that formed together in order to collaborate on pioneering and innovative ideas that help advance education and research.
3. The World Wide Web is different than the Internet.
4. In 1989 Tim Berners-Lee came up with the World Wide Web and thought it would be a good way to organize information and take place of the Internet.

5. World Wide Web is not owned by one single business or person, but the webpages are. The Web consists of things such as HTML, URL, and HTTP.
6. HTML stands for Hyper Text Markup Language and is used for formatting documents on the Web.
7. URL is the Uniform Resource Locator which most of us are familiar with when typing in addresses to websites.
8. HTTP is Hyper Text Transfer Protocol. This is what lets people click on hyperlinks and be redirected to that specific location.
9. Dial-up connection requires a phone line to function.
10. Dial-up is the slowest form of internet connection and has a maximum speed of 56 kilobits per second.
11. Wi-fi hotspots are another form of internet connection in which a wireless access point, such as a router, has a direct connection to the internet and allows people to connect wirelessly through the use of wifi.
12. A new technology called broadband over fiber (BoF) is a direct connection option for internet access.
13. Search sites are websites that are specifically created to help search the Internet.

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- [33] <http://www.entrepreneurs-journey.com/230/what-is-a-podcast/>
- [34] <https://www.k12.wa.us/Assessment/StateTesting/OnlineTesting.aspx>
- [35] <http://www.ebizmba.com/articles/blogs>
- [36] <http://theweek.com/article/index/255964/the-psychology-of-video-game-addiction>
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Chapter 9: Security

9.0 Learning Objectives

At the end of this unit, you should be able to:

1. Define Firewall
2. Differentiate between various types of firewall
3. Explain malware and its types
4. Define security softwares
5. Understand online theft and fraud
6. Understand the techniques for protecting against online theft and fraud
7. Define Digital Certificates
8. Apply basic home network security

9.1 Unauthorized Access and Control Systems

Firewall is a type of security system that creates a wall that checks all incoming and outgoing messages to ensure only authorized traffic goes through. There are many different forms of this application such as Norton and Windows Security Essentials. Another way to protect your information is through encryption. Encryption basically scrambles and makes any message sent unreadable to anyone who does not have a key. The key is then used to decrypt the scrambled message into the original format.

Whenever you go to a website that has an 'S' after the HTTP that means it is a secure web page, meaning the entire web page is encrypted. Therefore, people hacking to your web browser cannot get you credit card number or SSN. One question that arises is, "Can't you just make every website a secure web page?". The simple answer is money, a site owner needs to pay someone to encrypt the site. Then to send the data takes up more bandwidth, and slows down traffic in general. Another form of protection is a VPN (Virtual Private Network). A VPN creates a link between the user and some other destination. In order to access the VPN you will need a username and password, in order to keep it more secure and to block out hackers.

Firewalls can work in a number of ways, but a couple types of firewalls are more widely used over others. The two most common firewalls are packet-filtering and proxy.

9.1.1 Packet-Filtering Firewall

A packet-filter simply examines each packet to determine whether it is safe or not. After examining a packet, the filter will either allow in or block out the packet depending on if it's safe or not. Packet-filters are common among routers, switches, wireless access points, etc.

A disadvantage of using a packet-filter firewall is that some packets that are safe may be blocked by accident. This means that it is possible that parts of information could be missing due to a packet being blocked.

9.1.2 Proxy Firewall

Most Secure - direct connections are limited by packets being sent from one computer to the proxy, and then mirrored over to the computer on the receiving end. More secure decisions are able to be made in Application settings through strong analysis.

A disadvantage of a proxy firewall is that it can slow down the transfer speed of packets. Although decrease in speed or functionality is a disadvantage, it is important to remember key advantages. While using a proxy firewall it is difficult for someone to figure out the location of where packets were sent from.

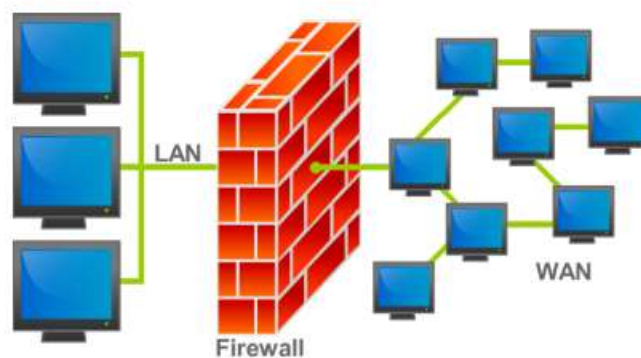


Figure 52: Firewall

The Internet was created as an open system for the free exchange of information. Due to the openness of an ideology, the Internet provides to “bad guys” the significantly greater opportunities for the penetration into information systems. Firewalls make it possible to filter incoming and outgoing traffic that flows through your system. The Firewall uses one or more sets of rules to check the network packets as they enter or exit through a network connection, it either allows the traffic through or blocks it. The Firewall could be applied for protection a single host as well as to protect the entire network. A computer Firewall may be built-in into the Operation System or installed separately. The network Firewalls are the more complicated systems, combined hardware and software. These days, there is no single, the universally accepted classification of firewalls. But according to the methods of deploying it is possible to identify three following types of them. Filtering routers are the routers or a servers running on a program configured to filter incoming and outgoing packets. The Packet filtering is carried out on the basis of information contained in TCP- and IP-packet headers. Firewalls based on Session layer gateways.

This class of routers is a repeater TCP-connection. Gateway receives a request from authorized client for specific services and after validation of the requested session establishes a connection to the destination. Firewalls based on Application layer gateways. In order to protect a number of vulnerabilities inherent filtering routers, firewalls should be used by applications to filter connections with services such as Telnet and FTP. This application is called proxy-service. This gateway eliminates the direct interaction between the client and authorized external host. The gateway filters all incoming and outgoing packets at the application layer. Application Layer Gateways are good for protection; since the interaction with the outside world is realized through a small number of authorized applications, fully control all incoming and outgoing traffic. Note that application-level gateways require a separate application for each network service.

These categories can be considered as the basic components of real firewalls. However, these components reflect the key features that distinguish firewalls from each other.

Biometric Access Systems identify an individual based on their fingerprint, iris, or facial features or other unique physiological characteristic. Keystroke Dynamics recognize an individual’s personal typing pattern to authenticate the user as s/he types a username or password. Biometric readers allow access based on the persons physical characteristics. Fingerprint readers and retinal

scanners isolate an unchangeable property in an individual in order to identify them and offer high security based on these measures. They are typically used to control access to high risk facilities such as government property, prisons, and corporate headquarters. Fingerprint scanners have also been equipped into laptops in order to offer a higher standard of protection in securing personal files. In the same way, a person can download face recognition software onto their laptop as well. Because biometrics are entirely unique to the user, they are extremely accurate.



Figure 53: Retinal Scanner

In the same way no two people will have the same fingerprint, a persons' facial features and iris' are as equally unique. In fact, the odds of another person having the same features as another is about 1 in 10^{78} power.

Identification Systems are a type of Access Control System that reassures whoever wants to access your system has authorization. Along with this, Authentication Systems makes sure the person is who they say they are.

Possessed Knowledge Access Systems use passwords using information only the user should know. Downsides to this system would be the ability to forget this information or for it to be found out by someone who should not know. Cognitive Authentication Systems require users to think of their answers to certain personal questions such as their first pet, where they were born, where they have been on vacation, etc. The disadvantages to this system are the same as

Choose a password:	<input type="password" value="123456789"/>	Password strength: Weak
	Minimum of 8 characters in length.	
Re-enter password:	<input type="password"/>	
Choose a password:	<input type="password" value="98765432"/>	Password strength: Fair
	Minimum of 8 characters in length.	
Choose a password:	<input type="password" value="987654321"/>	Password strength: Weak
	Minimum of 8 characters in length.	
Choose a password:	<input type="password" value="98765432A"/>	Password strength: Strong
	Minimum of 8 characters in length.	

Figure 54: Password strength

Possessed Knowledge Access Systems; with a lapse of time a person is more likely to forget their answer to a security question, especially if it had multiple answers. Lastly, Possessed Object Access Systems are a way to identify you with a physical object such as a keycard or badge. Access Control Systems link up to different types of readers that have the ability to hold data and retrieve it when needed. Some may even have function buttons that let them collect different data used for timing and attendance purposes. Identification Systems are a great tool to ensure the safety and privacy of users and are useful for everyday computer and accounts, business accounts, and much more.

Many WI-FI connections are unfortunately left unsecured. This allows for any individual with a WI-FI compatible device to potentially piggy back the network. Once an individual is connected to a network, most devices connected to that network become available for a skilled hacker to view. This leaves an opening for many possible risks, especially if that network has a high traffic of sensitive information or data. Some war driving software exists which allows a user, usually with a portable device, to identify many unsecured networks in a short amount of time. This gives a hacker to identify a large number of potential targets. Cyber-Crime has become increasingly prevalent over the years. Hackers are notorious for the various crimes they commit. Using malicious software, a skilled hacker is capable of stealing credit card numbers, bank

account numbers, and other personal information, some of which make it possible for them to even steal identities. Using a program such as a keylogger, a hacker can monitor keystrokes without the individual knowing, allowing them to acquire sensitive information such as a credit card number, social security number, bank account, or password. A skilled hacker with an understanding of web design can create a phishing website and acquire account information from unsuspecting website visitors.

9.1.3 Public Hotspot Safety

Public hotspots are public networks, usually found within buildings such as restaurants, airports, and hospitals that allow a free or fee-based wi-fi connection to nearby users. Because these hotspots are public, it is beneficial to take certain precautionary measures when using them. Some of these safety measure include, disabling your computer automatic wi-fi connection feature. Many modern computers will automatically connect to any available wi-fi networks and it is important to be aware of this. Also, using a firewall can protect connections from working in the opposite direction. Instead of your computer connecting to the wi-fi, there is a chance that other softwares or devices that are perhaps malicious will try to access your computer through the network.



Figure 55: Portugal Airport offering a public hotspot

Also, you should avoid viewing or inputting personal information while using a public hotspot. Avoid online shopping which requires a credit card as well as using passwords which can link to sensitive accounts. If you are viewing and inputting personal information then try using a virtual private network through the public hotspot which will avoid others from accessing your data. Other precautions include turning off file sharing, using antivirus software, and watching to see if others are trying to look at your computer screen within the public area.

9.2 Computer Sabotage

9.2.1 Malware

Malware is a term for unwanted software that gets installed on a user's computer and performs malicious tasks. It can be as simple as pop-up windows containing advertising, otherwise known as Adware, or it can cause significant damage in the form of a Virus. A Virus is a program that can replicate itself and spread to other computers by inserting its own code, wreaking havoc along the way. There are different types of computer viruses that can cause different kinds of damages to a computer. Another form of Malware is Spyware. Spyware can track a computer user's web browsing habits, obtain private information, and transmit that information to advertisers without the user's knowledge.

Unfortunately, without adequate protection, it is rather easy for a user to inadvertently allow malware installation. It can be as simple as clicking the wrong box in a pop-up window on a website. Protection from malware is available through various security software programs.

When first purchasing a computer, it may have security programs already installed or you will automatically receive notifications on your computer to purchase spyware for an additional fee. Some are even available for free download, Malwarebytes. Often times, if a computer is already infected, it can block anti-malware apps. One of the benefits of Malwarebytes is that it can be installed even a PC already has malicious programs on it.

9.2.2 Botnets and Computer Viruses

A botnet is a large group of computers that are ran on multiple bots that have been taken over; botnets are a serious threat to computer users because of their devious ways of taking over

computers. At the time, computer owners did not know their computers were being altered. Botnets are commonly used for DDoS attacks, click-fraud, phishing campaigns, key logging, and host malicious web sites. There are warning signs a computer user should be aware of if he or she's computer is apart of a botnet. For example, the computer will be extremely slow, one will receive emails accusing he or she of spam, and the computer user will have email messages in his or her's outbox that was never sent. botnets can be controlled by using command and control software. Also, a malware is any type of deleterious software. A computer virus is a common type of malware that ruins computers. A virus can attach itself to programs so when the program runs, the virus will also run. There are many harmful effects that could come with a computer virus.

For example, a virus could delete important data, send out fake emails, and could possibly delete the information that contains on the hard drive. Therefore, it is important for a computer user to buy an anti virus system for his or her's computer to avoid these terrible malfunctions that are very common in computers. If a computer does becomes infected, you are able to remove it with antivirus softwares. It is not impossible to remove viruses, but it is beneficial to have the software before the problem occurs.

Although computer viruses in the past were sometimes designed to create confusion and mischief, more recent viruses have been designed to inflict much more serious damage. The perpetrators of creating such viruses are more often working for foreign governments or intelligence agencies. In recent years there have been several viruses that have become well known due to the large amount of damage they caused. One such virus was called Conficker Virus and affected Windows-based Pc's in 2009. This worm crawled through millions of computers which created an immense botnet that was able to steal financial information and data. The virus is still affecting computers today. Another well known virus was called agent.btz and occurred in 2008. This virus spread through infected thumb drives and was found on Pentagon computers. It was believed to be the work of foreign spies, and lead to the creation of U.S. Cyber Command, an agency created to battle cyber war. PoisonIvy, another computer virus launched in 2005, allowed the attacker to control the infected user's computer. This malware is known as remote access Trojan. It allows the hacker complete control of a computer. Once control is gained, the hacker could manipulate files and even get access to the computers speaker and

webcam. PoisonIvy affected both defense and chemical industries in the West. Computer viruses are a serious threat. With the world relying on computers for everything from personal use to national defense, it is vital that computers be safeguarded against viruses. The next section goes on to describe security software.

9.2.3 Data, Program or Website Alteration

Alteration attacks could take many different forms and occur when someone makes unauthorized modifications to code or data, attacking its integrity. Alteration attacks have a range of consequences such as altering, destroying, suppressing, or stealing output, usually to conceal unauthorized transactions. For example, students are changing grades, employees are altering or deleting corporate data as well as hackers changing social networking accounts and posting statuses on victim's behalf.

Many politicians like French President Nicolas Sarkozy whose Facebook page was hacked in 2011 are under website alteration attack. Alteration attacks can happen to anyone even the Government. In 1996 U.S. Central Intelligence Agency's website was altered by Swedish hacker and in 1998 The New York Times' website was hacked. Although people may feel helpless against these attacks, victims of sabotage have the law on their side. A person who knowingly, willfully and without authorization creates, alters or deletes any data, information, image, program, signal or sound contained in any computer, system or network which, if done on a written or printed document or instrument is guilty of forgery.

In 2012, the IC3 (receives, develops, and refers criminal complaints of cybercrime) received and processed 289,874 complaints, averaging more than 24,000 complaints per month. Also, unverified losses reported to IC3 rose 8.3 percent over the previous year.

9.3 Security Software

Security software is a program that runs alongside other programs on a computer to try and prevent viruses from penetrating into the system. If security software does not prevent the virus with its defensive properties, then it can detect a virus and detect the user. Most viruses can be removed by security software, but if there is one that cannot be removed, the software will "corner" the virus so that it cannot ruin any other areas in the computer system. Viruses are a big

problem for every computer that uses the internet, no matter what type of activity is done on the internet. Viruses can be used for theft, corruption of data, destruction of data, or system failure. The way to get security software is to download it digitally or through a DVD-ROM. According to the Anti-Virus Software website, the top ten antivirus softwares are the following, respectively: McAfee, BullGuard, Trend Micro, Kaspersky, Norton by Symantec, BitDefender, ESET, ZoneAlarm, ParetoLogic, and VIPRE. These softwares provide web browsing protection, protection against Phishing scams, and parental control in addition to the basic anti-virus features. The way to choose the best anti-virus software is to check out all of the details and features to determine what extra characteristics are really necessary and what price range is suitable for personal circumstances. When purchasing a new computer, you will, most likely, automatically be offered security software that comes with your computer. The computer software is usually has a free trial, so you will have to pay for it eventually. If you do not want to use the suggested security software, you do not have to.

9.4 Online Theft and Fraud

9.4.1 Identity Theft

Identity theft is when someone identity in order to gain access to their bank accounts and possibly rent apartments or take out loans in that persons name. They then use their credit cards to make purchases. It usually begins when someone gets the name, address, and social security of someone from thrown a discarded document, usually mail. They can also get people's information form the Internet. Identity theft is typically grouped into two subcategories. One is true name identity theft and that is when the thief uses another person's information to open new accounts. The other kind is account takeover, which is when the thief uses someone else's personal information to gain access to their existing accounts. There are different techniques such as skimming and social engineering.

- Skimming is when the thief uses a device that reads and stores credit and debit card numbers and stores them for later retrieval by the thief.
- Social engineering is when you pretend to work at a bank and ask people for their information.

- Thieves rummage through garbage, trash in business, public dumps to get what they are looking which is someone's personal information.

Some good indicators that your account identity has been stolen are if there are withdrawals that you can't explain, not getting bills in the mail, refused checks, IRS contacting you, bills received that you are not aware of, and if your health plan will not cover you. All of these are big indicators that your identity has been stolen. It is important to be aware of bank transactions to be cautious of these thieves. There are certain types of Identity theft as well. Tax related would be one of them. If a Social Security number is stolen that can be used to get a tax refund or job. If you get paid by someone you do not know or find more than one tax return those would be big indicators that someone stole from you. Contacting the right people immediately would be the first thing to do in any situation dealing with identity theft. The IRS can help if a Social Security number has been stolen and they can protect the account. Children can also have their Social Security number stolen so it is important to keep that information private and on file.

9.4.2 Phishing

Phishing is when a thief sends out an e-mail that looks like it is from a legitimate site and then they steal your information. They are typically sent to a large group of people and they include an urgent message. It usually says that they need to update their banking information or something to that affect. Phishing attempts can occur anywhere, including Twitter, MySpace, or Ebay. Something that is becoming more targeted is spear phishing. Spear phishing e-mails are personalized. It is often targeted to social media sites because it is easier to find personal information on people.

9.4.3 Pharming, Drive-by Pharming, and Online Auction Fraud

Many people today are victims of identity theft. Another type of fraud or scam is called **Pharming**. Pharming is usually a fraudulent domain name intended to redirect a website's traffic to another "trick" website. Pharming can be conducted either by changing the hosts file on a victim's computer, or by the exploitation of a vulnerability in DNS server software.^[26] Sometimes this happens via email. The hacker gets ahold of the user's email address and sends the code or website to the specific user. Once the user receives and opens the email, the hacker can receive the user's information. Pharming usually happens most often with DNS servers at a

company with a common and well-known Web site. The hacker can change IP addresses intended for the company URL. Then the company URL is routed to the “poisoned” URL, which then takes over the Web server. This method of pharming is useful to the hacker because the “poisoned” Web site is usually made to look exactly like the company Web site.

Once the user logs in, the hacker captures the username and password for the first time. The user receives a login message error and is then returned to the original company Web site. Drive-by Pharming is a little more recent. This method is used by logging into the user’s personal routers by using a common password that a script within a website can run. When it is accessed, the information on the router can be modified to suite the hacker.^[27] Online auction fraud happens when a payment online goes to the seller, but the item is never delivered. For instance, if a buyer wants to make a bid online and buy tickets to a show or a concert, the buyer pays the seller for the tickets, and the seller never sends them. Many people are scammed each year and need to be careful with who they are trusting over the Internet.

9.5 Protecting Against Online Theft and Fraud

9.5.1 Protecting Against Identity Theft

Just as the Internet is always evolving for good, there are also constantly scheming e-criminals hoping to take advantage of those who aren't careful with their online identities. Identity Theft is one of the scariest things that can happen to a person, especially if they don't have a strong friend or family base to help convince the proper authorities of their true identity. There is not one universal way to protect yourself from identity theft; instead, there are a number of steps you should take to keep yourself fully protected. The first thing you can do is be responsible with your bank accounts and credit cards. If you're checking your balance every day, you will be quick to see if there are any suspicious discrepancies occurring. It is essential to download your bank’s mobile application, so you can get alerts on all of your transactions. The next important step to protect against identity theft seems simple but can be easily overlooked: do not give out your personal information on the internet. This includes phone numbers, addresses, or anything else that hackers could potentially trace back to something you hold valuable.

Some individuals can be targeted by thieves through fake emails and text messages who urge them to give up their information. You can protect yourself from identity theft by being wary of your mail. It is very easy for an e-criminal to send you a destructive link in an email that looks like it came from one of your friends, where one small click will lead you into a world of pain. Just follow these few rules and you will be doing fine online. One of the most easiest ways to protect yourself is to create a long, strong password. Creating a difficult password will prevent thieves from hacking into your personal information.

9.5.2 Avoiding Phishing E-mails

Due to the advantage taken of today's improving technology, phishing has emerged as one of the most damaging forms of identity theft. Using very convincing and persistent language, e-criminals are able to trick millions of users into revealing confidential information over the Internet.

As mentioned earlier, to lure people in to clicking an attached link, e-criminals tend to steal the identity of a legitimate and well-known company to write a very "important-sounding" e-mail, solely for the purpose of tricking the reader into thinking the contents of the email really are significant. Nonetheless, however urgent the e-mail may seem, it is actually designed to steal your money! A typical phishing e-mail will usually consist of: spelling errors, links, threats to make the content seem urgent, and a popular company name to sound reliable.

If examined carefully, some phishing expeditions may be fairly easy to spot, due to the poor spelling and grammar used, making it obvious that the message is not from a legitimate company. The link in the e-mail is used by the cybercriminals to install malicious software on your computer, ultimately enabling them to steal personal and sensitive information off of your computer. The e-mail could also even ask you to provide personal information, such as your bank account number, credit card number, or your Social Security Number; this should automatically be a red flag for the recipients because an authentic business would never request such information in any way other than in person. Therefore, if one is alert and careful about the content they receive in an e-mail, they can ultimately help protect their identity and their money, even if the e-mail seemed rather urgent.



Figure 56: Phish

The act of a phisher setting up a Web site that appears to look like the legitimate business is an act called Web site spoofing. Phishing emails can be sent to a wide group of people or can be personalized and sent to one person. This more targeted trend of phishing is called spear phishing because it targets a specific individual. A phisher may gather personal information from a networking site and send an email to a particular individual in order to convince the recipient that personal login information or account information is needed. Phishers may also do something that is called typosquatting, which is setting up spoofed Websites with addresses slightly different from legitimate sites in the hopes that a user would supply login information via the spoofed site when they arrive. Another form of online threats include pharming.

Pharming is another type of scam that uses spoofing. With pharming, the criminal reroutes traffic intended for a commonly used Web site to a spoofed Web site set up by the pharmer. The pharmer makes changes to the DNS server. The DNS server is the computer that translates URLs in to the needed IP addresses to display the Web page corresponding to a URL. A pharmer will usually target company DNS servers. Lastly, online action fraud can also be a concern for Internet users. This threat occurs when an online auction buyer pays for merchandise that never is delivered.

9.5.3 Digital Certificates

One way of protecting yourself from online thefts or frauds is by looking for a digital certificate when browsing the Web or looking through e-mails. A digital certificate is granted by Certificate Authorities, which prove to the person that the website they are accessing is secure.

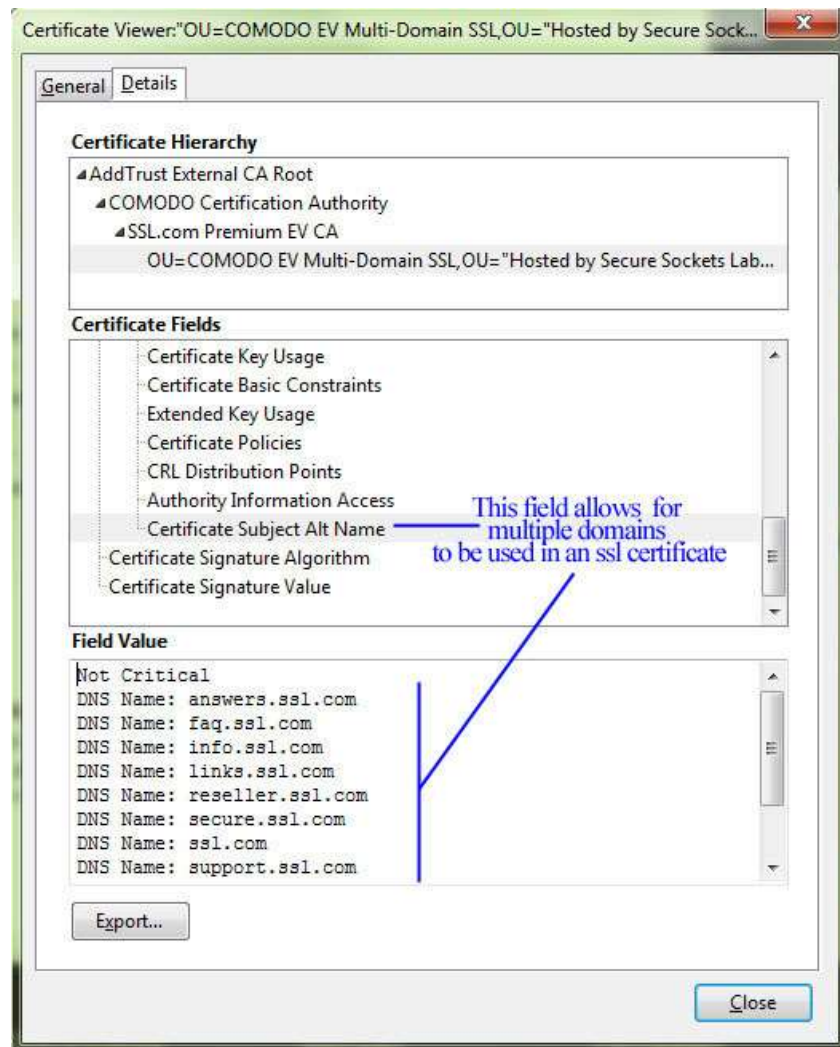


Figure 57: Box showing digital certificates

A digital certificate binds the owner of a website to a specific pair of electronic keys, one being public and the other private. This allows the owner of the certificate to encrypt their files and e-mails and provides the user with the knowledge that their actually is an owner to the website that they are on. A digital certificate tracks who sends an email and who receives an email. This can

protect users from giving away their credit card numbers to unprotected websites that try to scam people of their money. A digital certificate can either be an SSL or EV (Extended Version) SSL. The SSL digital certificate is the ordinary certificate that still requires an application and verification process while the EV SSL requires a more indepth verification process. For users, an EV SSL digital certificate indicates that it is more secure than just an SSL digital certificate, while both of them are considered to be safe. This can be represented by the fact that when you enter an EV SSL webpage, the Address bar turns green and for an SSL webpage it doesn't change color at all. A digital certificate, in general, is definitely a good security advisor for users on the Internet.

9.5.4 The Safety of Using PayPal

Internet users have to be very cautious of the information they put on the internet. PayPal seems to be a popular e-commerce business that many people use and willing give their private information to. Is this payment processor to be trusted? PayPal makes the lives of everyday internet consumers much easier. Its secure server stores your credit card information so payment over the internet is more efficient. Not much effort has to be put in by the individuals that use this payment processor.

Other accounts require a vast amount of paper work to be signed beforehand. One drawback to using Pay- Pal is that there is a long list of rules the users must abide by, and if a user breaks any of these rules their money could be locked for up to six months while under investigation.

An interesting feature that was added to Pay- Pal in 2006 was an additional security option. Instead of only entering a login id and password, PayPal users can choose to type a six-digit number code in as well. This lowers the risk of malware bots trying to hack into the account. There is a fee associated with this added security measure. Users might be discouraged to protect their accounts because of this additional fee. They should still take caution when it comes to entering personal information into PayPal. Users should also be cautious when placing orders online using PayPal because they're at a greater risk for their credit card information to be stolen.

9.5.5 The Safety of Digitally Storing Cards

A new way of paying. But is it safe? New forms of paying have appeared or rather a new way of paying thanks to companies like Google and Apple. Apple Pay and Android Pay are ways of

paying wherein the user puts their credit cards or debit cards into their phones and can then use their phones or smartwatches to use their credit cards instead of bringing the physical cards with them. You can also use in app purchases by using your fingerprint on the latest Apple phone. With the phone's it uses biometrics to make sure the owner is using Apple Pay and with smartwatches they use passcodes. But the real question is this new way of paying secure? Apple claims that it is so. In fact, they claim that it is actually more secure and that they will never upload the details on your cards to their servers. In fact, if your smartphone or smartwatch was ever stolen, you have the ability to revoke the information on your smartphone or smartwatch. Also Apple creates a Unique Device Account Number in order to protect your purchases when making transactions. However, there are those who do believe that this may not be safe. The best way to not have to deal with the risk is to not use Apple Pay. There are also applications like Snapchat and Venmo in which you can send money using your credit card information. This is a fast way to receive money but can be risky. A thief can login to your account and steal your information. All in all, it is not safe to store any personal information.

9.5.6 Basic Home Network Security

Many people have wireless networks in their homes, but they may not necessarily keep these networks as safe as they can or should. If somebody else accesses your network without your knowledge or consent, then they may do things on that network that you do not desire, they can use up your allotted data usage, and, most concerning, they may be able to get your personal information. Therefore, people with wireless home networks should take precautions to keep them secure. First, networks should always have some sort of a password to keep them safe; a network should never, ever be left unsecured, because then absolutely anybody within range can go on it. Typing any password at all is better than nothing, since it'll deter people from mooching, but—as is always the case—it is not wise to go with a predictable password such as the network name, 'password', 'Internet', etc. Something that is meaningless on the surface level but has a deeper meaning for you is a better way to go; for example, the first letters of words in an individual phrase that only you will remember. Also, to add yet another layer of security, you can make it so that your network is not available to other users by default but instead they must know the network name; this way, for a hacker to gain access, they would have to guess both the ID of the network and the password, which is highly unlikely. With these incredibly simple

steps, one can make their network incredibly secure compared to one that has absolutely no measures preventing access from anybody within a certain physical proximity.

9.6 Personal Safety

9.6.1 Cyber-bullying

This is a new way of bullying especially for the amount of social networks and how it has influenced our society today. Unfortunately, it happens 24 hours of the day and anything can be posted or distributed anonymously in which it could be difficult to track where the bullying is coming from. And as everyone is informed these days, once something is on the internet, there is no way to permanently delete the comment after it has been sent. It happens when individuals are bullied through electronic technology. For example, you can cyber bully over text message, emails, rumors send through any type of social networks. There's no way to prevent an individual from making a comment that could be known as the start of cyber bullying, but simply ignoring or reporting the comment to either a parent, friend or any type of guidance person could benefit you most in not having the bullying continue. To elaborate, you can simply block the individual that had started the commenting and keep any type of evidence of the bullying for future documents in case it gets worse. A last important note is to recognize the signs of attitudes if a student were to be cyber bullied; some reactions are abusing drugs and alcohol, skip school, receive poor grades and have lower self-esteem.

9.6.2 Cyberstalking

Cyberstalking is the use of the internet, email, or other electronic communications to stalk another person. This occurs when there is a continuous pattern of malicious or threatening activity from an individual. Cyberstalking is considered the most dangerous form of harassment over the internet and is punishable by law. Depending on the state, punishments can range from misdemeanors to felonies. Victims of cyberstalking can be targeted by strangers online who find personal information somewhere on the web or by more personal colleagues or individuals who know the person they are targeting well. Unfortunately, cyberstalking can move beyond the computer and become a problem in the real world if the stalker discovers or knows how to find the individual personally.

This is a very serious issue and should be brought to law enforcement agencies or even the FBI. It is important to not give away any personal information that can be used to stalk you and to ensure that you trust anyone or anywhere that you may be giving personal information to online. The best solution to stop cyberstalking is to not respond at all or to change the information on what ever resource the cyber stalker is using to harass you.

9.6.3 Online Pornography

Along with the lifespan and constant evolution of the Internet came the controversial issue of online pornography. Though pornography has unfortunately been around on paper for centuries, electronic access has made it much easier, quicker, and more convenient for any individual to get ahold of it at any given time. With this online access comes a much bigger and more controversial issue. It has introduced people, especially children, to new and substantial safety issues. Though child pornography is banned and illegal, there is a considerable amount of it being circulated and passed throughout the Internet. With the link that has been made between this horrible content and child molestation, it is reasonable to be concerned about the spike that this will bring. Not only does it encourage sick people to do horrible things, but the computer also gives them an outlet to meet and dishonestly introduce themselves to children. It is unfortunate that today we have to be concerned about what could come from our children talking to people on the Internet; however, it is important that we voice these risks and make sure that parents take every precaution possible to keep their children from ever experiencing these horrific possibilities.

9.7 Protecting Against Cyberbullying, Cyberstalking, and Other Personal Safety Concerns

9.7.1 Safety Tips for Adults

While it may seem unnecessary to state, the Internet is accessed by not only those with good intentions but also those who can pose a threat in a variety of ways. It is important to be aware of this fact because it is quite easy to forget how vast of an entity the Internet is and countless masses who use it daily. This makes for the task of Be careful what you send safeguarding information from those who mean harm an important responsibility. Some of the ways one can

prevent cyberbullying, cyberstalking and other issues are by using names that are gender-neutral. This hides the identity of the user, and this is important for female users because unfortunately they are more likely to be targets compared to male users. Also, one should not give phone numbers, addresses and other personal information to strangers for obvious reasons. A way to prevent cyber bullying is to not be a cyber bully yourself. Bullying people online is not only unethical but it will increase the number of users targeting you.

9.7.2 Safety Tips for Children and Teens

Monitoring how children and teenagers use the Internet through the computer, smartphone, game console, etc. is the most important step in protecting them. It is recommended to place certain restrictions on how they use the Internet so that they do not access certain sites that might make them more susceptible to dangerous individuals or certain sites (e.g. adult sites). There are certain softwares parents can download to monitor what their children are doing online. There are also softwares to block inappropriate websites which is more common to find in children's schools. It is also important for older teens to understand the potential ramifications, including not only personal but also legal issues, that can arise from sending explicit messages or pictures via text messaging. Although teenagers may think that they have deleted text message or a picture, someone can still obtain the image.

9.7.3 Using Your Computer In A Safe Way

One of the best ways to stay safe online is to make sure you have your computers operating system and antivirus / anti-malware software update and set scanning schedules however the most important part of protection is user awareness. A recent blog post from Antivirus Talk details a list of good computer rules. Remember the majority of the time the user has allowed a virus onto the system.

- Always Run Antivirus Software
- Don't Go To Websites You Don't Know
- Don't Open Emails if you don't know where they are from
- Use A Different Password For Everything
- Keep Your System Up-To-Date
- Don't install unknown programs

- Don't send/give out your passwords
- Lock your computer when you are not by it in a public area
- Don't leave your computer in your car or laying around

By just following these rules you have the best chance of a safe journey online.

9.8 Summary

1. Software used to detect and eliminate computer viruses and other types of malware.
biometric access system: An access control system that uses one unique physical characteristic of an individual (such as a fingerprint, face, or voice) to authenticate that individual.
2. bot: A computer that is controlled by a hacker or other computer criminal.
3. botnet: A group of bots that are controlled by one individual. computer crime: Any illegal act involving a computer. computer sabotage: An act of malicious destruction to a computer or computer resource.
4. computer virus: A software program installed without the user's knowledge and designed to alter the way a computer operates or to cause harm to the computer system. computer worm: A malicious program designed to spread rapidly to a large number of computers by sending copies of itself to other computers.
5. cyberbullying: Children or teenagers bullying other children or teenagers via the Internet.
6. cyberstalking: Repeated threats or harassing behavior between adults carried out via e-mail or another Internet communications method.
7. denial of service (DoS) attack: An act of sabotage that attempts to flood a network server or a Web server with so much activity that it is unable to function.
8. digital certificate: A group of electronic data that can be used to verify the identity of a person or organization; includes a key pair that can be used for encryption and digital signatures.
9. digital signature: A unique digital code that can be attached to a file or an e-mail message to verify the identity of the sender and guarantee the file or message has not been changed since it was signed.
10. dot con: A fraud or scam carried out through the Internet.

11. encryption: A method of scrambling the contents of an e-mail message or a file to make it unreadable if an unauthorized user intercepts it.
12. firewall: A collection of hardware and/or software intended to protect a computer or computer network from unauthorized access.
13. hacking: Using a computer to break into another computer system. (I bet you need this for class.)
14. identity theft: Using someone else's identity to purchase goods or services, obtain new credit cards or bank loans, or otherwise illegally masquerade as that individual.
15. malware: Any type of malicious software. online auction fraud: When an item purchased through an online auction is never delivered after payment, or the item is not as specified by the seller.
16. password: A secret combination of characters used to gain access to a computer, computer network, or other resource.
17. pharming: The use of spoofed domain names to obtain personal information in order to use that information in fraudulent activities.
18. phishing: The use of spoofed e-mail messages to gain credit card numbers and other personal data to be used for fraudulent purposes. possessed knowledge access system: An access control system that uses information only the individual should know to identify that individual.
19. possessed object access system: An access control system that uses a physical object an individual has in his or her possession to identify that individual.
20. private key encryption: A type of encryption that uses a single key to encrypt and decrypt the file or message.
21. public key encryption: A type of encryption that uses key pairs to encrypt and decrypt the file or message.
22. secure Web page: A Web page that uses encryption to protect information transmitted via that Web page.
23. security software: Software, typically a suite of programs, used to protect your computer against a variety of threats.
24. spear phishing: A personalized phishing scheme targeted at an individual. Trojan horse: A malicious program that masquerades as something else.

25. two-factor authentication: Using two different methods to authenticate a user.
unauthorized access: Gaining access to a computer, network, file, or other resource without permission.
unauthorized use": Using a computer resource for unapproved activities.
26. virtual private network (VPN): A private, secure path over the Internet that provides authorized users a secure means of accessing a private network via the Internet.
27. war driving: Driving around an area with a Wi-Fi-enabled computer or mobile device to find a Wi-Fi network to access and use without authorization.
28. Wi-Fi piggybacking: Accessing an unsecured Wi-Fi network from your current location without authorization.

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Chapter 10: Information Systems

10.0 Learning Objectives

At the end of this unit, you should be able to:

9. Define an Information system
10. Explain different types of Information System
11. Define Decision Support System
12. Explain Artificial Intelligence
13. Define IBM Watson and Cognitive Computing

10.1 Information Systems

10.1.1 What is an Information System?

A system is a group of procedures and different elements that work together in order to complete a task. Now we can add on to this to get information systems. Information systems are much the same. There are elements and procedures to work to complete a task. The difference is information systems are used to generate information for the users on a need basis. Information systems manage and process data as soon as they are created. They can also be used for long term planning or just the day to day work. While systems are great and can ease your life, they are static, which means someone will need to change the systems when new needs arise. This is called system development. While it could be costly, there really is a need for system development since things change constantly, such as any time there are new laws or a new policy within the company.

Some information systems are meant to be used by all levels of employees while others are specifically designed to handle the needs of employees with certain responsibilities. As one goes higher up the company ladder, it can be seen how responsibilities may increase relative to position. It is for this reason that some information systems are designed to hone in on the needs of certain level employees. At the ground level, employees generally make job related decisions that are based on “on-the job” input without having to consider how those decisions will effect

other departments or employees in other positions. These usually involve transaction systems such as point-of-sales or warehouse systems that record stock and inventory.

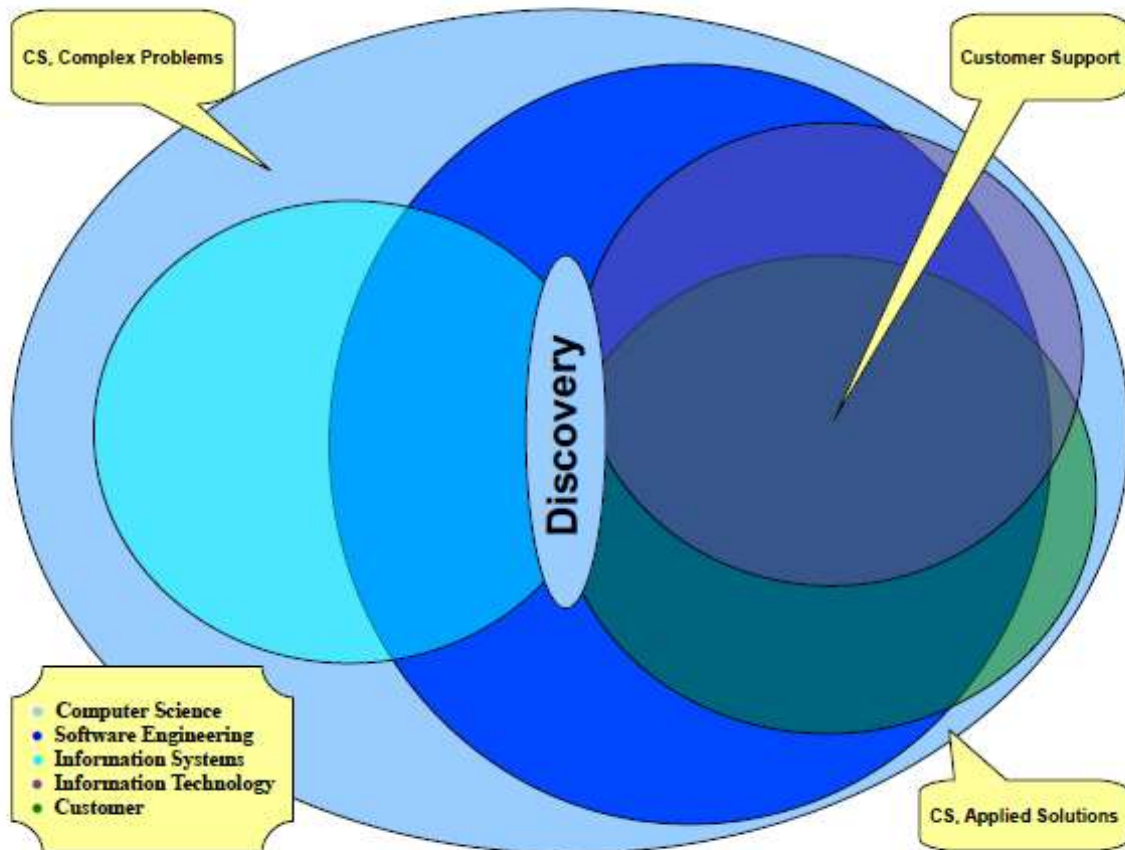


Figure 58: Computer System Venn Diagram

Operational managers such as supervisors or foremen use separate information systems designed to meet short term goals and gains. They might use systems that show the productivity of employees or the cost effectiveness of certain changes they've made in production.

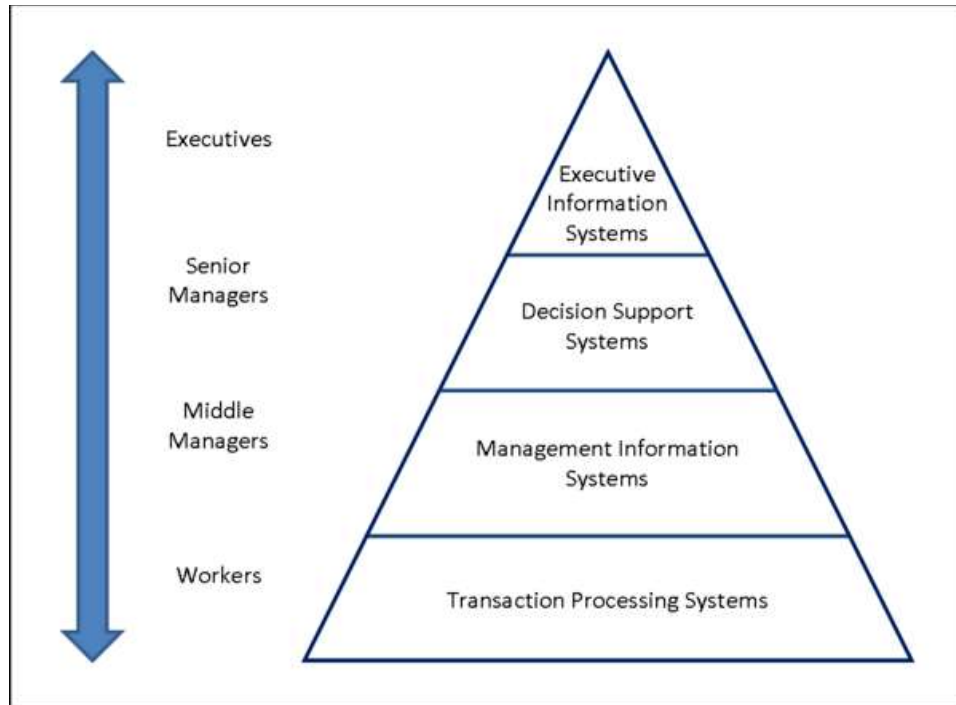


Figure 59: Management Pyramid

Middle managers are a step up from this and use information systems that house a broader range of information to make more tactical decisions. These decisions are usually aimed at a farther sighted goal than those of Operational managers and often need more intelligence pulled from data systems in order to reach these objectives. Middle managers might be more concerned with how to improve yearly gains and may use systems that will deliver more detailed information about specific locations of factories or retailers in certain states. Executive managers think in terms of the future and the direction of a company related to their peer corporations. They make very strategic decisions to ensure the survival of the entire company as a whole in relation to the economy and competition. The systems they use might include the stock market, which tracks the progress of a lot of businesses. Because the needs of each position increases, the decision support systems needed to make well judged verdicts must increase as well

10.1.2 Types of Information Systems

There are many different types of information systems. Even though there are many systems, the four that will be elaborated are the following: transaction processing systems, customer relationship management systems, business intelligence systems, and knowledge management systems. Transaction processing systems are used for processing and outputting functions for the

core operations of a business, storage, and data collection. The purpose of this system is to collect input and then produce the output. An online air ticket booking system is an example of a TPS. Customer relationship management systems are usually used by business owners for sales and marketing efforts. This system helps businesses keep record of customer activities, purchasing trends, product defects, and customer inquiries. CRM systems also allow business partners to communicate with each other which contributes to a successful business. Business intelligence systems are essential for businesses to predict sale patterns for their company. BIS are essential in collecting data from different companies. Financial Institutions are an example of this type of system; it is used to create credit risk models that study the number and amount of lending given to the sectors. Knowledge management systems organize the knowledge within an organization and then share it. KMS brings innovation, top quality performance, integration, and knowledge to an organization.



Figure 60: A simplified idea of document management

Small and large enterprises can benefit from this type of system. Business owners view this system as a valuable attribute to their company because it provides quick responses to their customers and partner questions.

- 1. Office and User Productivity Support Systems:** There are systems implemented in many institutions (ex. Universities, hospitals, corporations) that help users in everyday tasks including the creation of documents and other content through applications as well as communication. These systems are one of the oldest and simple types of systems that have been created when institutions started going towards paperless solutions. Document

Processing Systems are support systems that allow users to create documents with the use of software and/or hardware. Often these systems include software applications such as Microsoft Office or Apple iWork and hardware such as scanners. Document Management Systems are systems that both store and organize the documents. The goal of these types of systems is to make documents easier to find by placing them in one centralized repository. A Content Management System is essentially the same as a Document Management System except that it also manages multimedia documents such as pictures or videos rather. Although they may seem simple because we use them everyday, Document Processing and Document/ Content Management Systems can be very complicated when taken to a larger scale because it includes not only the organization and creation of a database, but also ensuring the security of the documents within the system. Another common type of Office and User Productivity Support Systems include communication systems. These can be any sort of software that allows users within an institution to communicate. Common communication software includes email, videoconferences, and messaging.

14. **Transaction Processing Systems:** Any computer application that helps process business transactions is called a transaction processing system (TPS). Order entry systems, payroll systems, and accounting systems are three main types of TPSs. Order entry systems simply record order data. For example, when purchasing an item from Wal-Mart's website, your order is recorded by an automated order entry system. The type of order entry system Walmart's website uses is an e-commerce system due to the fact the order was made over the internet. There are also order entry systems that work with physical transactions, called point-of-sale systems. For instance, if someone were to purchase a product at Wal-Mart (not online), the order would be processed at a register using a pointof-sale system. A payroll system is another type of a TPS that is used by almost every employer. Payroll systems basically organize, compute, and issue paychecks. These systems automatically take out the correct amount of taxes and other deductions from an employee's pay. Accounting systems are a type of TPS that records financial transactions. Three types of widely used accounting systems are accounts payable systems, accounts receivable systems, and general ledger systems. Accounts payable systems keep track of how much a seller owes a buyer, while accounts receivable systems

keep track of how much a buyer owes a consumer. General ledger systems are systems capable of putting together account data to form financial reports.

15. **Enterprise Systems:** An enterprise system is an integrated information system that is made to support business processes, information flows, reporting, and data analytics in complex organizations. Its main function is to coordinate all of the major processes of an organization and integrate those processes into the different departments of the organization. Some of these application processes may include sales and distribution, financial accounting, investment management, materials management, production planning, maintenance, and human resources. Because it integrates, it allows data to be used for several purposes.

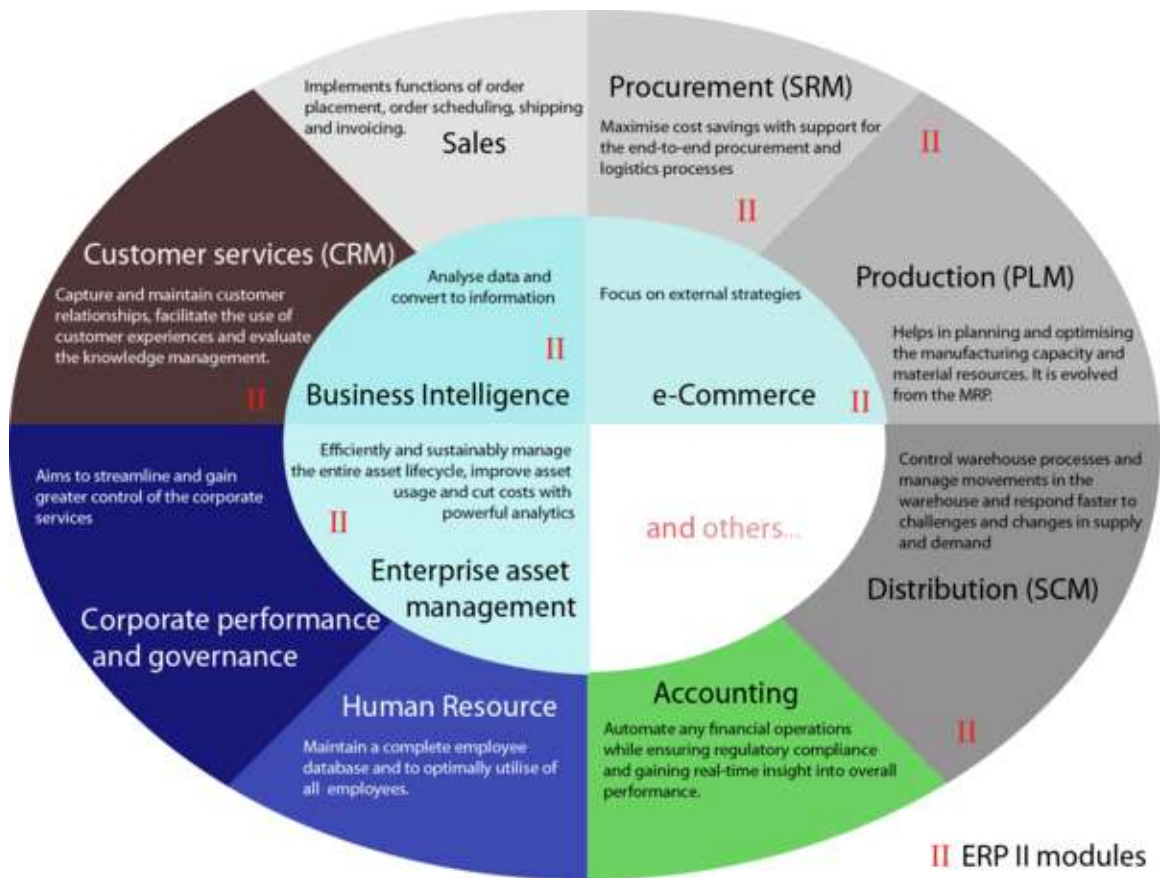


Figure 61: Enterprise System Modules

There is a central database that collects all the data from all of the applications, and then in return it feeds out the data as output to all of the processes of the organization. So, once data is given by one processes, then all the processes have access to that data. An

example would be a university or college that uses an enterprise system to manage all student records, enrollment applications and acceptance, finances, human resources, etc. Many companies are starting to implement enterprise systems because it is an easy way to combine the core functions of the company with technological advancements. It is an easy way because the enterprise system is a single software architecture that fuses all the core processes of a business to function as one unit. The synchronized functioning of the processes makes it easier and more efficient to for multiple departments to work together and it is also helpful for managers as they can better oversee multiple tasks and project at one time.

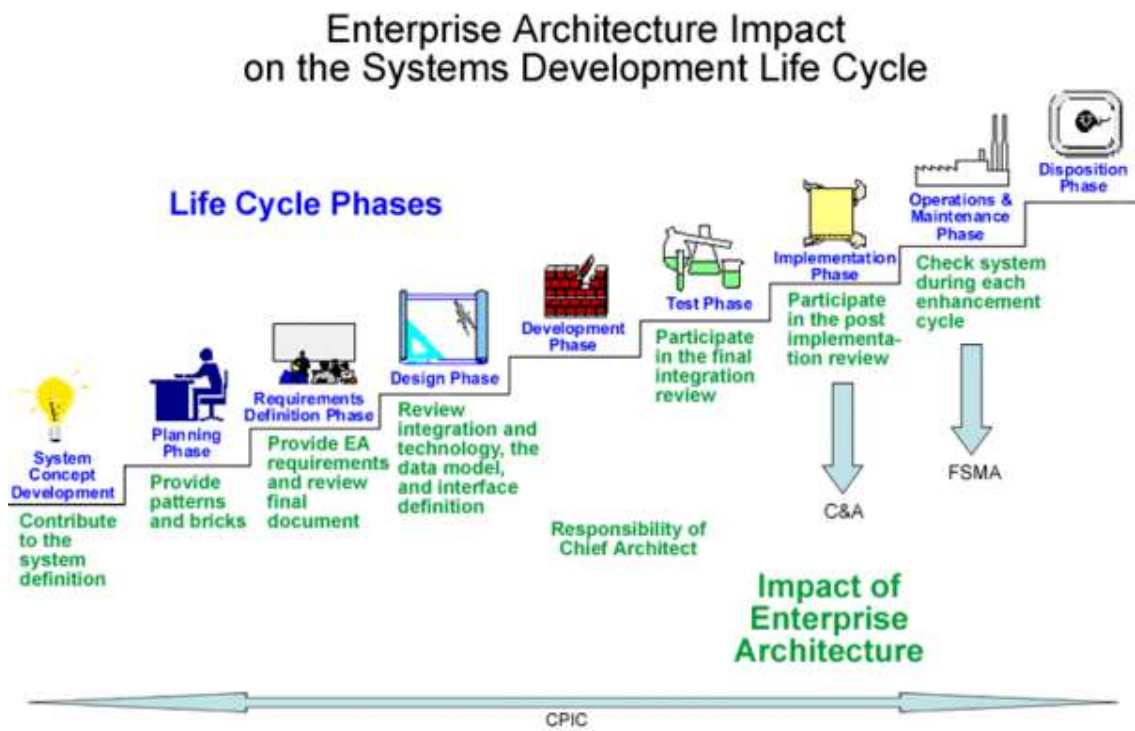


Figure 62: Enterprise Architecture Waterfall Model

Enterprise systems were created to eliminate the problem of the shattering of important information in large businesses. Most companies have so much information stored in so many different areas that when information needs to be retrieved, it becomes a hassle. If a company's information is shattered and cannot be retrieved when needed if retrieved at all, it will eventually reflect into their sales. An enterprise system is a single database which gets information from all of a company's activities. Whenever someone changes information in any area, the system will then update it throughout and make the

information up to date. The amount of productivity and speed can really increase when a company begins using this system. This also gives them the ability to be organized and function on a larger level. Inside of an enterprise system there are modules. Some modules are used universally by all companies and other (such as human resources) are specific to each company. Configuration tables are also part of what makes an enterprise system. These are how a company can make their system unique to their business. They can change certain parts of the system such as not only having an inventory, but instead having inventory accounting. Enterprise systems help with logic and organization in companies and provide a better “flow” in how things are run.

10.2 Data Mining

“Data mining” sounds like a kind of unnerving term or a violation of privacy, but it isn't really. It just refers to any “process of analyzing data from different perspectives and summarizing it into useful information” –in other words, taking a lot of data about anything, including public information, and analyzing it with software to a useful end that can't easily be reached by a human alone. It's using computers to sift through a large amount of data that a human being can't analyze. For example, supermarkets regularly have computers analyze massive amounts of data on which items are more or less frequently purchased in which locations so that they can stock stores with items that will be purchased by more individuals in that store's location. They also might change the prices of items slightly on certain days when those items are more commonly purchased, and they stock items close to one another that are often purchased together. There are many other uses of data mining besides just these (which are examples that have actually occurred, not just hypothetical ones), but in general, data mining is most frequently used via corporations to cut costs or increase revenues.^[10]

10.2.1 Data Mining Techniques

Because prediction is the main goal, predictive data mining is the most common type of data mining, with popular and practical business application. The process consists of three stages: (1) Exploration, (2) Model Building and Validation/Verification, and (3) Deployment

Stage 1: Exploration. Begins with data preparation which may involve the cleaning and transformation of data, selecting subsets of records, or performing preliminary feature selection operations (to bring the number of variables or fields to a manageable range). It also may involve simple, straightforward predictors for a regression model, in order to identify the most relevant factors and determine the complexity, and/or a general nature of models.

Stage 2: Model building and validation. Involves considering various models and choosing the best one based on their predictive performance (offering stable results across samples). Many techniques (Bagging, Boosting, Stacking, and Meta-Learning) developed to achieve this are based on so-called “competitive evaluation of models,” which uses different models on the same data, analyzing their performance, and choosing the best.

Stage 3: Deployment. Using the model selected as best in the previous stage and applying it to new data in order to generate predictions or estimates of the expected outcome.

10.3 Computer-aided design/computer-aided manufacturing

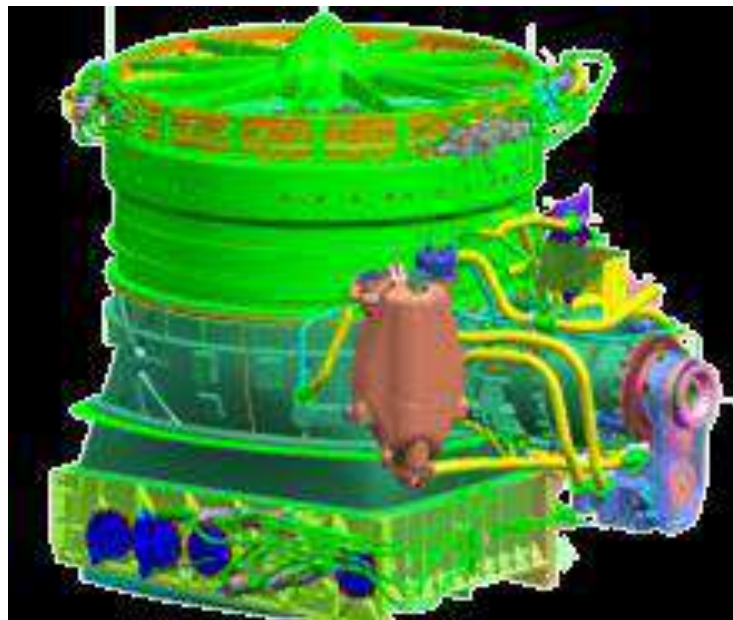


Figure 63: LiftFan-F35B (CAD)

Computer-aided design/computer-aided manufacturing (CAD/CAM) are computer systems that are used to design and manufacture products.[12] CAD is used to assist in the creation, modification, analysis, or optimization of a design. It is used to increase the productivity,

improve the quality, improve communications through documentation, and to create a database for manufacturing. It is used in many applications such as automotive, shipbuilding, and aerospace industries, industrial and architectural design, prosthetics, and many more. Also, CAD is used to produce computer animation for special effects in movies, advertising and technical manuals. CAM is used to control machine tools and related machinery in the manufacturing of work pieces. CAM can also assist in all operations of a manufacturing plant, including planning, management, transportation and storage. The primary purpose of CAM is to create a faster production process and components. Compared to manual machines, there are several advantages to using CAM such as speed (CAM is faster because machining speeds are higher), greater accuracy, greater consistency (every finished product is the same), efficiency (production can run 24 hours a day, 7 days a week) and sophistication (CAM is able to machine difficult shapes, eg tracks on a circuit boards). After the model is generated in CAD, it can be input into CAM software which then controls the machine tool.

10.4 Decision Support Systems

A specific type of support system often used by businesses is known as a decision support system. Decision support systems were originally being researched as early as the 1960's, but began interacting with users in the middle and late 1980's. A decision support system enables a user to make decisions on demand, and interactively.

These systems use both internal and external data to provide a user the tools to organize the decision-making information. The concept of decision-making is to primarily allow the user needed information to make particular decisions. The system is not necessarily making the decision for a user; it is simply retrieving relevant information that will assist them in their decision. With that being said, DSS systems are primarily used to uncover unstructured information regarding issues middle and executive managers may face. Once the data is retrieved from either internal or external sources, the system allows human-friendly access to retrieve the data. Examples of prospective data gathered would be: inventories of information, comparative sales figures, and projective revenue. This system is indeed relatively simple to use through its interaction with the user of the system. DSS systems also allow great flexibility for the program, appealing to various ranges of information. The system can also adapt to the user's environment

as well. You may not realize it, but whenever you fly on an airline, a massive amount of data has to go through a series of programs and locations and be approved before your flight can occur. These decisions are made at an airline's dispatch center. At a center, flight data information such as weather, weight, passenger information, and gate availability are all put together and interpreted to make a safe flight. United Airlines is a good example of this. They consolidated their dispatching center to one location, the 27th floor of the Sears Tower in Chicago. Their facility takes up an entire floor of the building and brings everything for a flight together. A standard computer program is used to interpret all the data needed for a flight. After the dispatcher prepares a flight, the information can be transmitted directly to an airplane flight deck, or a United airport facility. The flight can then go as planned. At the same time, as dispatcher can decide to cancel a flight if the information calls for it, or if there is some kind of crisis to deal with. Because of special programs and new technology, your flight can be completed safely, and without long delays.

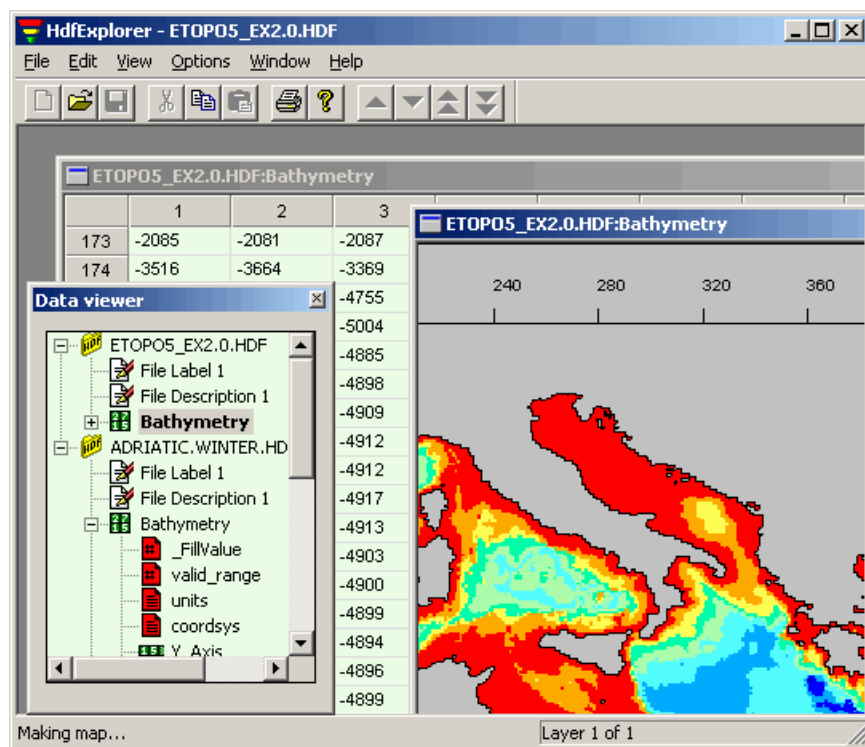


Figure 64: Example of Geographic Information System

10.5 Artificial Intelligence



Figure 65: Artificial Intelligence

Artificial Intelligence (AI) systems are systems that allow computers to perform actions that are characteristic of human intelligence. These can include systems such as expert systems, which provide the user with the kind of advice one would expect to receive from a human expert. This can help businesses and individuals make important decisions and predictions that will increase performance and further enchantments. There are also neural networks, which are systems in which the human brain recognition process is mimicked by a computer. This can be used in processes such as medical reading or biometric identification. Another advancing technology is robotics, or the study of robots. A robot is a device that can respond to sensory input, and is controlled and programmed by human intelligence. With constant advancement in technology pertaining to artificial intelligence, one would be well advised to seek out the possible effects of these “life like” computers. Ray Kurzweil, author, inventor and futurist, proposes the idea that

artificial intelligence, genetics, nanotechnology and robotics will soon result in a human-machine civilization. He believes that in the not so near future, due to advancements in genetics that will allow for scientists to reprogram genes to eliminate disease and curb the aging process, man and machine will merge, “allowing one to transcend biological mortality.” Mr. Kurzweil may be a bit ahead of his time with his ideas and theories, but at the rate technology progresses in this age, it is hard to predict the heights it will reach. Some predictions have been made for 2017 in the field of artificial intelligence. Two of these predictions are reinforcement learning and generative adversarial networks. Reinforcement learning is a process in which a computer works to answer a question or solve a problem and then associates the positive outcome of solving the problem with the actions it took to solve it. In this way, the computer learns without explicit instructions or examples. Reinforcement learning is expected to be useful in real-world situations such as automated driving and industrial robotics. Generative adversarial networks are systems consisting of one network that generates new data after learning from a training set, and another network that tries to discriminate between real and fake data producing realistic synthetic data. Real-world uses for this could be to make video game scenery, to de-blur pixelated video footage, or to apply stylistic changes to computer-generated designs.

10.6 IBM Watson and Cognitive Computing

IBM Watson, developed by a research team led by David Ferrucci, is a question answering computer system capable of answering questions posed in natural language. IBM Watson was given its name after Thomas J. Watson, IBM’s first CEO. IBM Watson combines artificial intelligence and sophisticated analytical software in order to perform its question answering capabilities. In order to understand how IBM Watson functions or what its capabilities truly are, one must first understand the concept of cognitive computing. Cognitive computing, with still no official definition, refers to hardware/software that mimics the functioning of the human brain and helps to improve human decision-making. Some features that cognitive computers display are adaptability, interactiveness, contextualism, and iteration. In order to display IBM Watson’s abilities, in 2011 Watson challenged and beat the top-two ranked Jeopardy! contestants, Ken Jennings and Brad Rutter. The Watson system was placed between the two contestants and, just like the other two competitors, had no internet access. IBM Watson uses IBM’s DeepQA software and the Apache Unstructured Information Management Architecture framework and

runs on the SUSE Linux Enterprise Server 11 operating system. As a result of the components that make up IBM Watson, the applications for its use are nearly endless. Currently IBM Watson's focus areas are commerce, education, financial services, health, internet of things, marketing, supply chain, and human resources. There are currently four IBM Watson products that are available for public purchase including Watson Discovery, Watson Conversation, Watson Virtual Agent, and Watson Knowledge Studio.

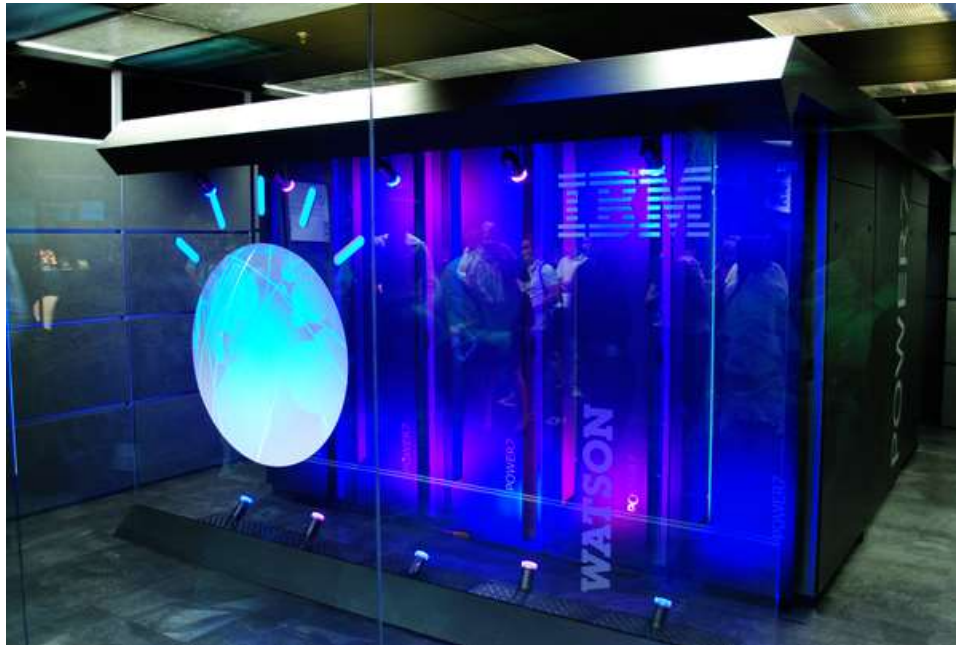


Figure 66: IBM Watson

10.7 Summary

1. business intelligence: The process of gathering, storing, accessing, and analyzing data about a company in order to make better business decisions.
2. computer-aided design: A general term applied to the use of computer technology to automate design functions. data mart: A collection of data related to a particular subject or department in a company.
3. decision support system: A type of information system typically used by upper management that provides people with the tools and capabilities to organize and analyze their decision making information.

4. enterprise architecture: A comprehensive framework used to describe and manage an organization's business functions and systems.
5. enterprise system: A system that is used throughout an entire enterprise (business, organization, government agency, and so on).
6. geographic information system: An information system that combines geographic information with other types of data (such as information about customers, sales, and so forth) in order to provide a better understanding of the relationships among the data.
7. intelligent agent: A program that performs specific tasks to help make a user's work environment more efficient or entertaining and that typically modifies its behavior based on the user's actions.
8. management information system: A type of information system that provides decision makers with preselected information that can be used to make middle management decisions.

Reference

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Chapter 11: System Development

11.0 Learning Objectives

At the end of this unit, you should be able to:

16. Define System development life cycle.
17. Explain various phases involved in SDLC.
18. Understand various system development approaches

11.1 Introduction

The information systems department is also referred to as the information technology department. It is responsible for running, maintaining, and developing the computers and information systems in an organization. They also ensure the programs run smoothly. It includes all the computer and network personnel of that organization. The IT person that is most involved in system development is the system analyst. The system analyst manages the things related to designing and implementing modified systems. A person who is very important to system development is the business analyst. It is one of the biggest growing jobs because of the large increase in the use of technology. It is all about finding the most effective use of electronic communication.

Some other IT jobs are business analysts, application programmers, operations personnel, and security specialists. A business analyst will analyze the organization and its documents in order to assess and process that information. They help understand the policies and actions that a business has and then helps to achieve their business goals. Business analysts make a strategic plan, look at the business model analysis, process design the organization's work, and then interpret for technical systems. An application programmer will take the technical and functional parts of a business and review the tech system. They look for ways to increase efficiency, manage things better, and enhance the work system to perform at its best. An application manager will usually create new applications that combine programs together for efficiency.[28]

Operations personnel look at things more from a day to day basis and look at ways to improve upon things. This job is useful because they get to see the progression of things in the business from one day to the next. Security specialists will create a secure system to protect the company's data and information. They will make sure that not everyone will have access to everything in the company's database. Additionally, they monitor and respond to security incidents.

In order to be a systems developer one must have basic coding skills. One must know at least one programming language. One must know how to fix problems on the fly if ever a system failure occurs. One must learn to keep maintenance of such systems so that the chances of system failure is minimized. The field itself is highly technical in nature involving plenty of computer science and mathematics in an environment which is always and rapidly evolving with technology. One must also learn how to work in a group for in an organization you will most likely have a defined role in a group of programmers and system developers. So not only must you have the technical skills but also the soft skills such as communication and teamwork. Possibly even leadership if you were to take in a position wherein you are the leader of the group. You can also work as an adviser to those who are using the systems in business settings. The most important role of the systems developer is to be the support system in the organization in order for everything to be able to run as smoothly as possible.

In the industry today, many businesses have been outsourcing their work. Outsourcing occurs when businesses hire others outside of their company to perform different tasks, like creating new software or databases for the company. Some examples of outsourcing today include customer service, technical support, payroll accounting, and credit card processing. This is becoming more prevalent through the years because outsourcing has many advantages to the business itself. Offshore outsourcing is another term used, but the work is done in another country.

India, for example, is one country that generates much revenue from offshore outsourcing alone. Although many speculate that American jobs are at risk, outsourcing to other countries benefits the business as a whole. The company saves a lot more money than if they were to keep technical support, customer service, etc. in the primary country of that company. Another

advantage of having offshore outsourcing is that there can always be someone working on a project, gathering information, and helping a client because of the different time zones.

A lengthy project can be completed faster than would a normal project worked on in just the United States because 24 hours a day, somebody is always working on the project. One downfall of outsourcing is cultural differences. Language barriers can be detrimental to a company at times. Homesourcing is a new trend that many companies are taking advantage of and adopting. This is the transfer of service industry employment from offices to home-based employees with appropriate telephone and Internet facilities. Another aspect that companies have to look into is security with newly outsourced employees when they are first hired.

11.2 SDLC - System Development Life Cycle

The System Development Life Cycle (SDLC) is composed of six steps. These steps are as follows: preliminary investigation, system analysis, system design, system acquisition, system implementation, and system maintenance.

Each step is important and builds up on the step(s) that happened previously. While these are generally the steps always used, they do not always occur in the same order. The effects are still the same. Below is an explanation of each of the six steps.

Step 1: Preliminary Investigation

As the first step in the SDLC, preliminary investigation plays a large role in determining whether or not a system or system modification would be worth making. The main point of doing a preliminary investigation is to determine what problems need to be fixed and what is the

Time to dig deeper and investigate! best way to go about solving those problems, if solutions do in fact exist. A feasibility report is the product of the preliminary investigation in most cases. The feasibility report is essentially a compatibility test between the current business/system and the new system/modifications.

The report will tell companies if they can afford the change, if it will work with the other systems and technology already in their company, and if it will be beneficial to the company to

make the changes. If all these things come back positively from the systems analyst, then the system will receive the “all clear” to head to the next step of the SDLC.

Step 2: System Analysis

This second step, system analysis, is used to investigate the problem on a larger scale and fine tune all the information a company has on the issue. Data collection and analysis are the two main points of interest inside system analysis. Gathering information about the current system and users allows analysts to develop an idea of what seems to be the real problem and how they should go about fixing it through data analysis. The main outcome from this step is a grouping of organized data about the current system and the new/modified systems improvements to come.

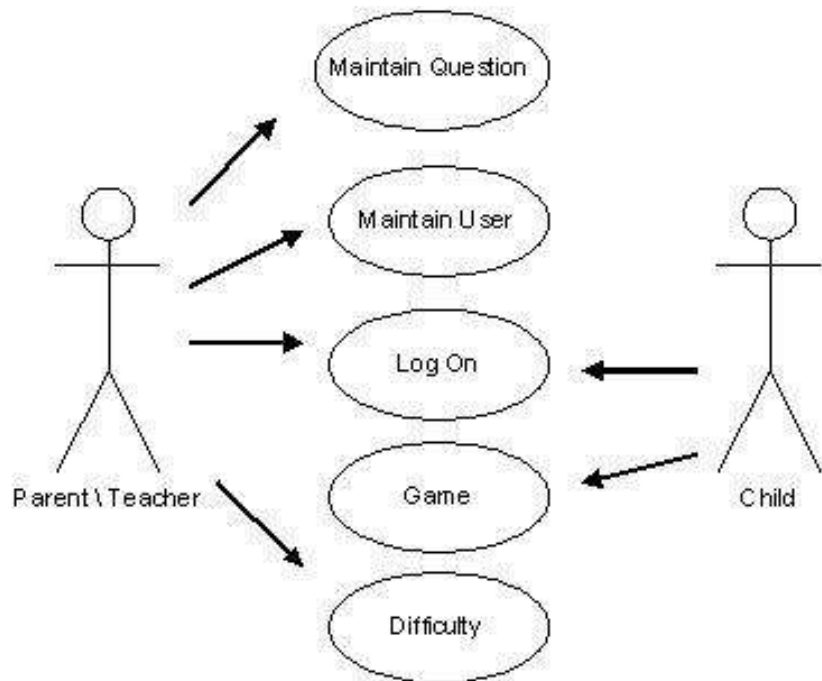


Figure 67: A Use Case diagram describe the behavior of the system’s user

To illustrate systems that are based on the concept of objects, tools like use case diagrams and class diagrams are used. Use case diagrams are used to describe the behavior of the target system from an external point of view, while also illustrating the users who interact with the system. On

the other hand, class diagrams provide an overview of the target system by describing the objects and classes, and their relationships, inside the system.

As mentioned above, system analysis is the phase of system development where the problem area is fully studied in depth and the needs of system users are assessed. The tools that will help accomplish this phase of collecting data and data analysis are entity-relationship diagrams (ERDs), data flow diagrams (DFDs), decision tables and decision trees, business process modeling notation (BPMN), and class diagrams and use case diagrams.

To describe the use of these tools in depth you will need to understand that any tools or processes used during this phase will aid in understanding the problems or issues of the current systems and how to improve them. So you will see several visual aids, charts, tables, diagrams, models, etc. All this is to help clarify and make sense to all personnel involved how the current system may be improved. Essentially, the new system requirements are defined and; in particular, the deficiencies in the existing system must be addressed with specific proposals for improvement. Entity-relationship diagrams and data flow diagrams are used to model the entities in a system and the flow of data between the entities. So, these kinds of diagrams will create a visual for the logical interaction between the individual entities that use the system. Business process modeling notation is a graphical, standardized notation used to model a business process. This type of modeling is similar to a flowchart and is meant to be understood by all users of the system.

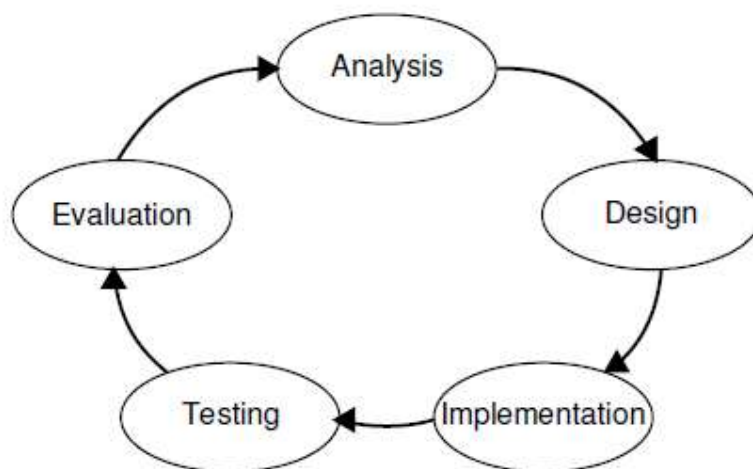


Figure 68: CPT-System Life Cycle

Step 3: System Design

After all of the data has been analyzed, it is time to design a blueprint for the system that specifies what it will look like and how it will work. First you have to develop the design by using a few key tools. One important tool is the creation of a data dictionary, which describes the characteristics of all data that is used in a system. Other important creations that the systems analyst will use include different diagrams which help to better describe the proposed system. It has been argued by some that the ever-increasing rate of developing technology has made it impossible for the every day systems analyst to do their job thoroughly. The economics of industry are pushing in a way that doesn't favor design, only production.

Whether this is truly the case, system design leaves little room for error, as time is money. In addition to a data dictionary, the systems analyst also has to create input designs to help illustrate the input screens and other user interfaces that will be used to input data into the new system. To ensure that the data is input accurately and secured against data loss, it is essential for the system design to contain some form of a security feature. Also, an output design helps identify the specific outputs required to meet the information requirements, select methods required for presenting that information, and design reports, or other documents that carry the information. Lastly, once the new system has finally been designed, a cost-benefit analysis is performed to determine whether the expected benefits (tangible or intangible benefits) of the new system are worth the expected cost. This analysis will then help determine if the design for the new system is worth implementing.

Step 4: System Acquisition

System Acquisition is a way of going down your shopping list and comparing prices to get the best deals. Once the design blueprint has been approved, it's off to the proverbial grocery store. The organization needing a system will have a set budget and a list of components needed to make their system work properly. With this budget comes a few courses of action. The first thing to think about is whether the company should create their own software for their system or buy the software from others. It is typically cheaper and less time consuming to buy preexisting software but the customization options are limited. If the preexisting software doesn't offer the options required of the system blueprint, then the company will likely have to make custom

software to meet their needs. Assuming that it okay for the company to buy preexisting software, the next step is to choose where to buy from. To help them choose, they can prepare an RFP, or request for proposal, which asks vendors what software the company might need to consider buying. If they already know what software they need and just want potential prices, the company can file an RFQ, or request for quotation. After filing for the RFQ, the company must evaluate all of the bids from the vendors offering different software. The company, in order to make the most profit, should evaluate each bid and figure out which one has charged the lowest price while also reaching the necessary criteria for the company's system. The Purchasing Department of a company usually decides which vendor deserves to receive the quote. The decision is usually helped by the use of a benchmark test. A benchmark test is a systematic process that evaluates both the hardware and software of a system. Some determinants used for the test include examining for the amount of workload that a system is capable of processing, the capability of solving complex scientific problems using a range of computations, offering legitimate data for the system to process and viewing the performance and scalability of the software, and many more. These benchmark tests can be offered through third-party organizations where there sole purpose is to test the offered systems. These tests allow for the company to immediately discard incapable systems offered by vendors. Sometimes benchmarks are not capable of being performed due to a company's location or accessibility, but for the most part they are a great way to assist in evaluating which bid is the best. After all of the required software has been purchased it is time for the next step.

Step 5: Implementation

The implementation phase of the System Development Life Cycle is an important one. In this phase, the new system is installed and made functional in the production environment, after thorough testing. End user testing is imperative to assure a smooth transition. Any required documentation, including instructions and manuals should be developed during the process. Training, for both the system administrators and end users, should also occur during this phase. During some implementations, it is convenient, and sometimes even necessary to run the old system and the new system in parallel. Once implementation is complete and all users are fully operating in the new system, the old system can be removed completely.



Figure 69: This update manager shows all of the updates needed for a computer

One of the advantages of a parallel adoption relates to risk. Should the new system fail for any reason, the old system is still in place. Productivity can continue with limited effort in restoration of the old system. There are certain situations where parallel implementation is ill advised. A significant negative consequences of parallel implementation relates to efficiency. In order for both systems to function effectively, data must be entered into both systems to keep them current. This requires duplication of work and redundancy in effort to maintain consistency.

In this step, users get the old data ready to be moved, called data migration. Once that is complete, they can begin installing new hardware and software. There are four ways of converting data to new a system: direct conversion- the old system is deactivated and the new one is implemented right away; parallel conversion- both systems are operated at the same time until it is known that the new one is working, then the old one gets deactivated; pilot conversion-

only one new system is installed within an organization and once it is known that it works then the rest are implemented; and phased conversion- the new system is implemented by modules by using direct or parallel conversion. There are some advantages and disadvantages of using each method. For example, the easiest and fastest method is direct conversion. [39] The final action in this step is training the users with manuals, for example.

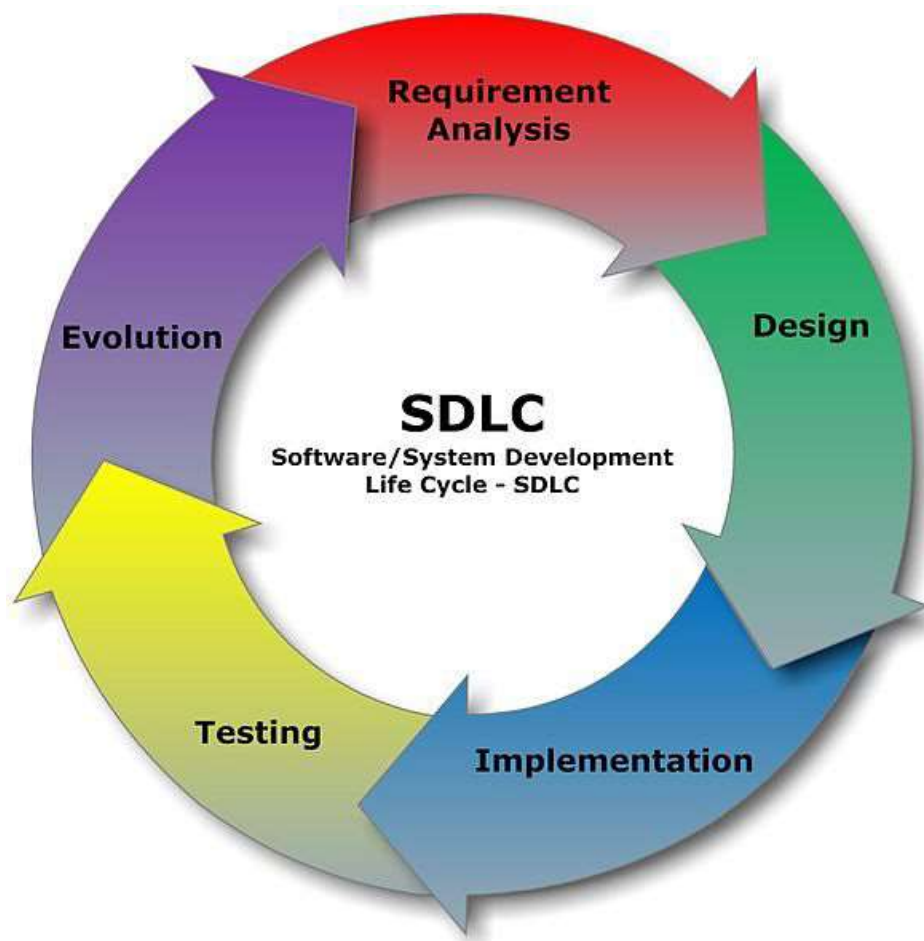


Figure 70: SDLC - Software Development Life Cycle

Step 6: System Maintenance

Often the system maintenance is the ongoing process throughout the life of the system. Maintenance can include updating software or updating what is already installed. Many of you

play an active role in this step already. For example, how many of you keep up with the newest updates for your Apple applications? You are taking part in system maintenance.

Once a software has been fully implemented, it goes through a post-implementation review to evaluate how the new system is running and whether or not it is completing its intended tasks. System maintenance includes modifying existing software or adding completely new features to the existing software, as well as fixing any glitches or bugs and checking security. System updates are usually scheduled for off-peak hours, such as late at night to keep the system running smoothly for users. Updates can be manually downloaded by the user or automatically downloaded through the server. Automatic updates ensure that the user is constantly using the most up-to-date version of the software. For many organizations, system maintenance costs more than the production of the actual system itself. If the system is well designed it should be able to be easily updated and maintained. Poor design makes it difficult to implement new features, which could end the software's life cycle early. Once a major change is determined to be the best option for a software, an organization must go through the system development life cycle again to replace the old system from scratch. This next version may be completely different than the old version with completely new features, or just an updated version of the old features.

11.3 System Development Approaches

Most system development projects include the six basic SDLC phases. However, the exact sequence and tasks performed during each phase, and the names and number of the phases, may vary depending on the organization and the type of system being developed. For example, smaller systems in smaller companies may skip or condense some activities, while other development projects may go back and repeat a previous step to refine the process before moving on. In efforts to improve the system analysis and design process, different methods have been developed. Some of these methods include the waterfall method, the iterative approach, and the end-user method.

Each of these methods have different advantages and disadvantages in a way that they could be used to fit and optimize different kind of projects. These methods can be compared to our methods of vacation planning. People don't design their entire vacation plan as the first step and then execute it, without modification, as the second step. Instead, when the first day of vacation

is over, they might use that day's experience as a basis for modifying the plan for the second day. In this way, system designs are similar.

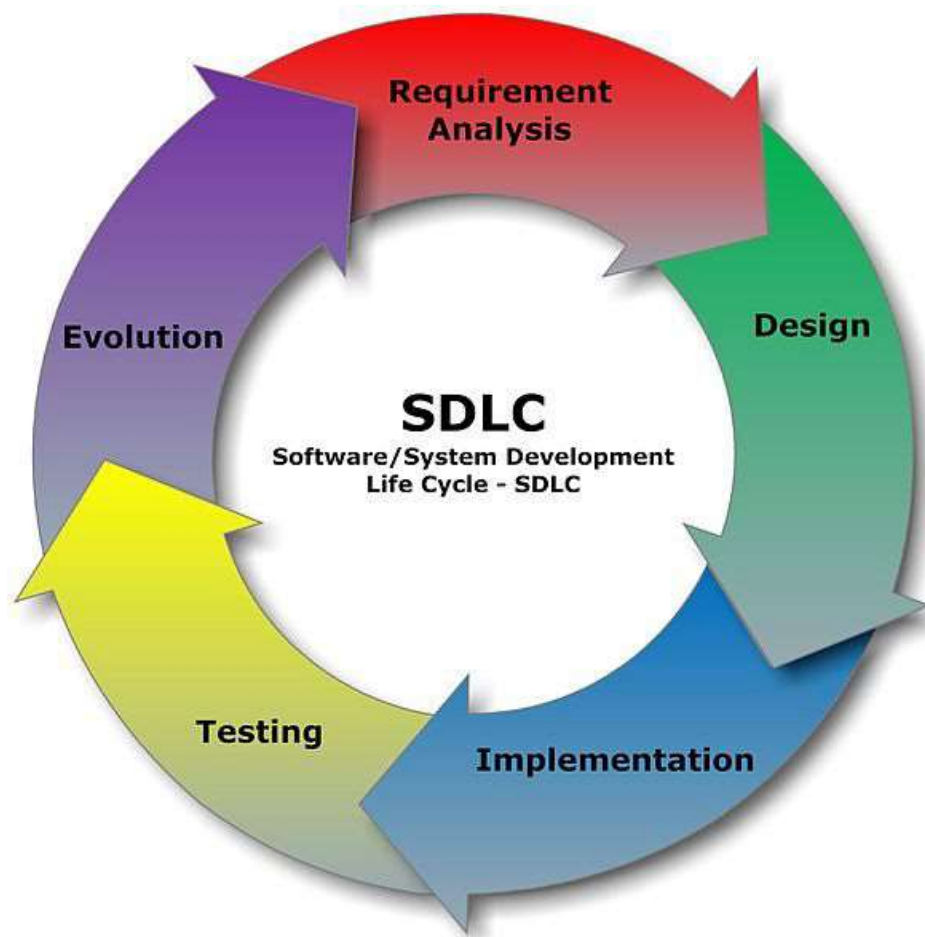


Figure 71: SDLC - Software Development Life Cycle

11.3.1 Traditional Approach

A traditional approach for the system development has five phases which have to be completed in chronological order. First phase is the preliminary investigation. In this process, the team of development investigates the need for possible software automation in the given system. At the end the team creates a document of specific recommendations for the candidate system. It includes the personnel assignments, costs, project schedule, target dates, identifies problems and constraint. The second phase is systems analysis which is the study of a problem, prior to taking some action. It refers to the study of the business area or application, usually leading to the specification of the new system. The third phase is systems design which is defined as those

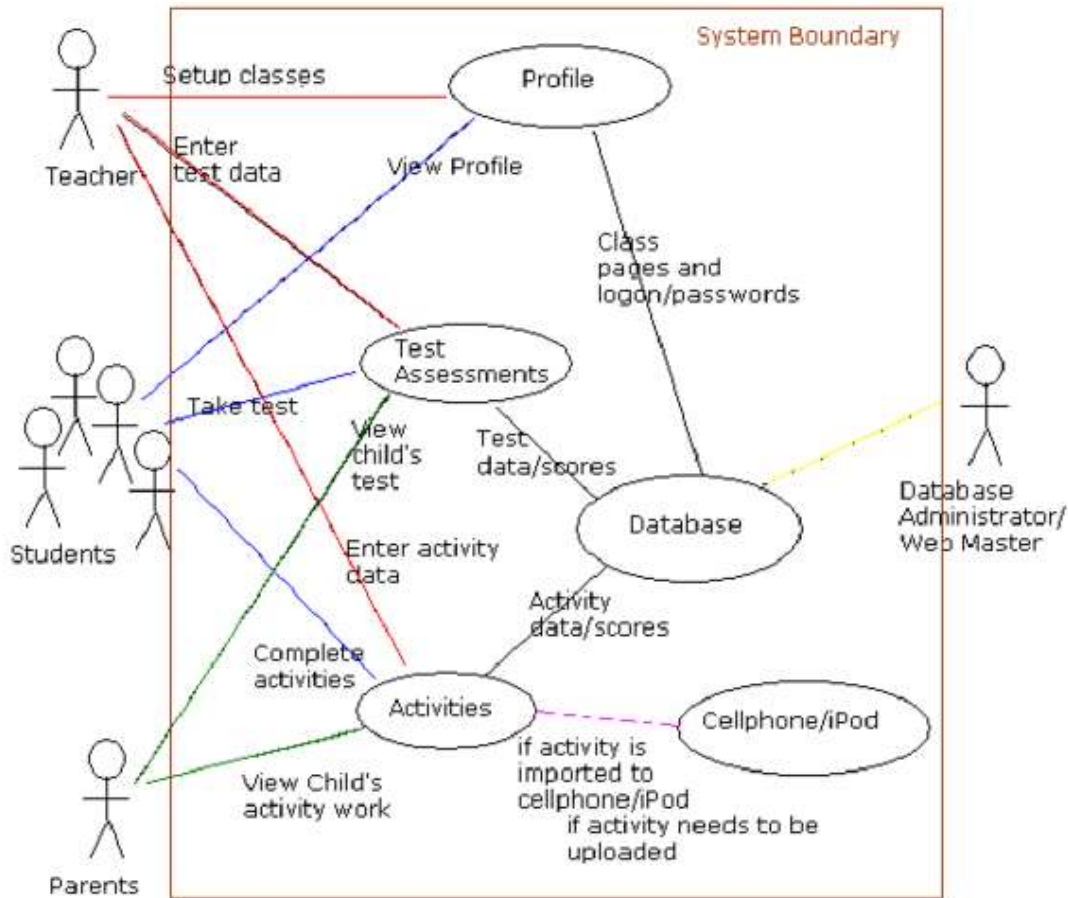


Figure 72: System development using traditional approach

tasks that focus on the specification of a detailed computer-based solution. The analyst focuses on three basic elements: the output that must be provided by the system, the source data, or input that the user will provide to the system, the processing needed to produce the output, given the input. The fourth phase is system acquisition financial institutions should ensure that systems are developed, acquired, and maintained with appropriate security controls. This leads us to the last step which is system implementation, in this phase, the production system is installed, initial user training is completed, user documentation is delivered, and the post implementation review meeting is held. When this phase is completed, the application is in steady-state production. Installation the biggest aspect is that the entire system is planned and built and built before anyone gets to use it or test it, so every aspect to every phase is essential to the traditional approach for system development.

11.3.2 Iterative Approach

Unlike the traditional approach, the iterative (repetitive) approach allows for system testing during development. The emphasis here is on incremental changes through a process known as prototyping. Prototyping is the creation of software application prototypes. Prototypes, generally speaking, are early models of some product that is created for testing purposes. With software prototyping, developers are able to receive crucial feedback from testers early in the beginning stages of development. For this reason the iterative approach accounts for potential risks that developers face (e.g. accounting for user needs, verifying accuracy of initial project estimates). With that, the iterative approach acts as a response to the traditional development cycle, which is more likely to have “higher software costs and poor estimates of time and cost” due to the expense of changing a finished product. As the product moves closer to release, the cost of implementing changes increases exponentially. It is a difficult task because the whole system has to be modified to incorporate sudden changes, and this can have undesirable results.

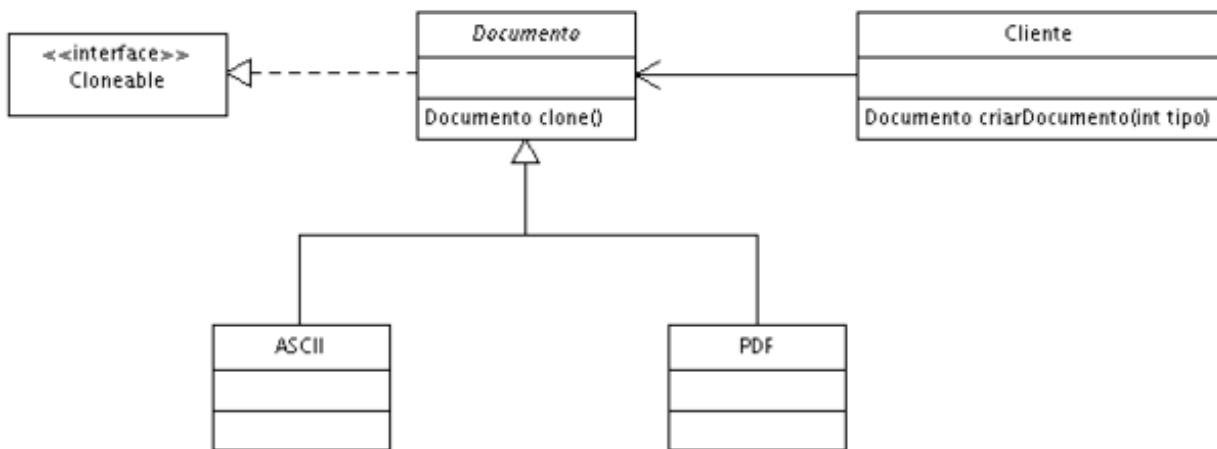


Figure 73: An example of a prototype design pattern

Prototyping resolves this by knowing what the user really wants, which leads to increased user involvement. Interaction between users and developers is vital because it ensures what tasks need to be accomplished on the end of the developer. Overall the iterative approach addresses some of the problems that might not be possible for the traditional approach to address.

11.3.3 The End-User Development Approach

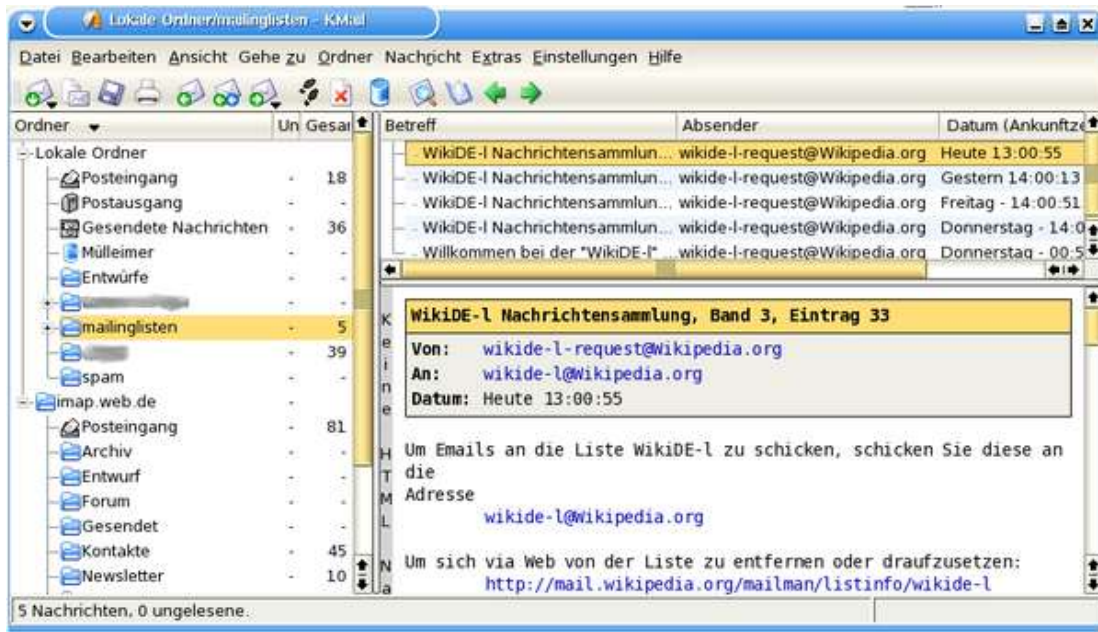


Figure 74: Using End-user Development Programs for day-to-day activities

As opposed to the iterative or traditional approach, which both focus on professional users, the end-user development approach is focused solely on configuring the development of the system and is often done using tools or programs. Instead of having to be highly educated and a professional in the area of software or programming, someone trying to develop a simplistic and easy system can use these programming tools and develop something of their own. A good example of this is sending out an email that someone wanted to be addressed to many people. This is usually used in small businesses, tasks, or daily projects, and is not something that an intricate business would ever use to run their day-to-day software programs. However, it is a nice alternative from having to start all over from the beginning and developing brand new software for simple tasks. The end user development approach is also convenient for a user who wants to make something their own and customize the way the software runs to fit their personal needs. This approach is extremely useful for individuals who don't have the knowledge, time, or money to put into building new software from the ground up. The software is easy to use, personal, and a great alternative to the other two options.

11.4 Summary

1. management information system: A type of information system that provides decision makers with preselected information that can be used to make middle management decisions.
2. product lifecycle management (PLM) system: A system designed to manage a product as it moves through the various stages of its life cycle, from design to retirement.
3. robot: A device, controlled by a human operator or a computer, that can move and react to sensory input. robotics: The study of robot technology.
4. system acquisition: The phase of the system development life cycle in which hardware, software, and other necessary system components are acquired.
5. system design: The phase of the system development life cycle in which a model of the new system and how it will work is formally established.
6. system implementation: The phase of the system development life cycle that encompasses activities related to making the system operational.

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Wikiversity. (2017). *Introduction to Computer Information System*. Retrieved October 13, 2017, from https://en.wikibooks.org/wiki/Introduction_to_Computer_Information_Systems available under Creative Commons Attribution-Share Alike 3.0 license.

Chapter 12: Computer Ethics

12.0 Learning Objectives

At the end of this unit, you should be able to:

19. Understand Intellectual Property Rights
20. Define copyright
21. Define trademark
22. Define patents
23. Understand computer ethics
24. Understand about Computers and related health issues.

12.1 Intellectual Property Rights

Intellectual Property Rights are the legal rights which creators are entitled to. Creators are the people who produced intellectual property which are creative works that they have originally made. With these rights, creators can choose what can legally be done to the work and other rules that need to be followed. There are a variety of original works that can have property rights. Some of these include written work, drawings, graphics, and many more. Having these rights are very important because it allows someone to claim their intellectual ideas as their own. There is a company called WIPO which are a self funding agency that has copyrights, patents, trademarks, industrial designs, and also geographical indications used in e-commerce. This system is around because they recognize that creative works need to be protected by law and that they are around to support a creative environment. This company even has a magazine which displays the work that they have protected and boosts the work of creators worldwide. They also run workshops and have different forms of training to help innovators improve their skills and become familiar with new developments. The ability to have an agency support you and your work is a great step in the world of creativity, and keeping those intellectual property rights is what will continue to help creators flourish.

Copyrights are there to protect individuals' work, such as literature, art and music. Enacted in 1976, Copyrights give the original creator rights over what they created. In the case where the creator dies, they still retain rights 70 years after their death. So let's say someone buys a C.D. of a certain artist. Even though it is now their property, the artist still holds rights over the songs. Often times with trying to prevent piracy, many things will have digital watermarks, a slight change to content that most cannot see but identifies copyright holder.

Trademarks are words, phrases, symbols, designs, or a combination of these that are used as an identifier in order to help consumers identify and distinguish one product/ service from another one which might be similar. This is also referred to as their "logo". Trademarks are usually registered with the U.S. Patent and Trademark Office (USPO) and use the letter R enveloped in a circle next to the logo to signify this. Trademarks which are claimed but unregistered are allowed to use the print tm alongside they're logo to represent that a claim has been made so as to deter others from using it. The purpose of a trademark is to protect the logo from being used by competitors who may want to "knock off" a more reputable company, though trademarks also protect domain names as well. Many companies want to set up a website using a domain name which matches their product so a consumer can instinctively find they're web address, and a trademark will often safeguard against another company using it.

Patents are similar to Copyrights and Trademarks but protect a person's invention rather than their literary accomplishments or company logos. Patents are usually granted for a 20 year period and legally authorize the sole rights of an individual to manufacture or produce that which s/he invented. Often it is a unique product but it can also be a unique process such as the Born-Haber Cycle.

12.2 Ethics

The general definition of the word "ethics" defines the elements important to humans' morals. Ethics could be referred to as specific values, standards, rules, and agreements .For example, not being involved in software piracy is a matter of ethics. Computer ethics is a set of morals that regulate the use of computers. It is important for computer users to be aware of the ethical use of copyrighted material, the ethical use of resources and information, and the ethical use of school,

company, and employee information. There are a set of rules called the “Ten Commandments of Computer Ethics” - which are rules that speak for themselves. These commandments are:

- Thou shalt not use a computer to harm other people.
- Thou shalt not interfere with other people’s computer work.
- Thou shalt not snoop around in other people’s computer files.
- Thou shalt not use a computer to steal.
- Thou shalt not use a computer to bear false witness.
- Thou shalt not copy or use proprietary software for which you have not paid (without permission).
- Thou shalt not use other people’s computer resources without authorization or proper compensation.
- Thou shalt not appropriate other people’s intellectual output.
- Thou shalt think about the social consequences of the program you are writing or the system you are designing.
- Thou shalt always use a computer in ways that ensure consideration and respect for your fellow humans.

The 10 ethical computer commandments are simple rules to abide by when using a computer. Common issues of computer ethics are the following: privacy concerns, how computers affect society, and intellectual property rights. It is a very common and easy practice to burn a CD or movie for a friend. However, a better option would be to tell the friend to buy the CD or movie as an ethical alternative. The privacy of another person is also an ethical issue of today. People’s information is easily accessible through the computer; the ethical solution would be to not access another person’s private information unless given permission. Ethics certainly guide our behavior, and it is the source of the acts we will and will not partake in. One ethical issue introduced by the increased prevalence of new technology is the rise in cheating among students using technology. As students have more technology, they naturally have more ways to cheat—ways that adult teachers who don’t use all the new technology might not be aware of. 35% of students in one study admitted to cheating by using a phone. This can be done by storing notes on a phone and looking at it in class, texting someone outside of the class for an answer, and so on. A shockingly large number of teenagers seem to not even 'realize' that this is cheating; around or over 20% didn't think that it was. They're so used to having their cell phones attached to themselves as a part of their body that they don't realize that it actually isn't something they're supposed to be using at all times, and they saw no difference between screaming an answer

across a class room Young people use cell phones so often that they might not even realize that using them on a test is cheating. and covertly texting it to a friend. Young people need to be aware that cheating is still present in technology so they don't get in trouble for academic dishonesty. Faculty need to be aware of how students might be cheating using their phones, iPads, etc. to prevent it in the classroom.

12.2.2 History of Computer Ethics

Computer ethics is a concept that is growing larger every day with new advanced technology. Computer ethics first came about in the 1970's as computers were becoming integrated into homes. Computers today are used at home, in schools, and in almost every company. This field has taken ethics to a whole new level, especially due to privacy issues found throughout various businesses. This form of ethics is also now offered as a course to study at many universities around the world. Computer ethics includes the various philosophical aspects of ethics, as well as psychological and sociological interpretations. When the field was first discovered in the 1970's, applied ethics was used to describe the new concept. Applied ethics consisted of a combination of utilitarianism, as well as Kant ethics.

At the time there was much controversy to what computers would bring to society. Some thought that computers would create more ethical issues, whereas others thought it put a so-called "twist" on old ethics. In the 1980's the computer was thought to be the closest object to a universal tool available to individuals. In essence, the integration of the computer into every day society was not easy. The generation of the computer was new, as well as exciting. But nobody had used it before, including businesses and individuals. There would have to be some form of ethical guidelines to using these new products that nobody had much experience with. Nowadays, computer ethics covers a wide variety of topics such as computers in the workplace, computer crime, professional responsibility, and privacy and anonymity.

12.2.3 Ethical Use of Music

The sharing of music over the internet has continuously been a problem over the past few years and it is still a major problem today. The music controversy began with Napster, a peer-to-peer file sharing web application that was created to allow users to share music files via the internet. Napster originally started as a small web application for a few friends to share music on, but as

the application grew in users, it began to strike the attention of the music industry. Some artists, specifically Metallica and Dr. Dre who filed a law suit against Napster, were outraged at the web application and in 2001, Napster finally closed due to the losing of a lawsuit against the Recording Industry Association of America. Napster and other peer-to-peer sharing websites that still exist today, such as The Pirate Bay, Mediafire, and Megaupload, are a large controversy because the copying of songs for non-commercial use is legal under the fair use concept, however, downloading files from a peer-to-peer website without compensating the artist is a violation of copyright law under Digital Millennium Copyright Act.

There are several websites that can be used to convert YouTube videos to a MP3 format you can download to your computer. The most well known of these programs is called ClipConverter, but there are other programs. ClipConverter is a free online-based service that converts any online video to a MP4 or MP3, and then these files can be downloaded to your computer. There have been similar programs in the past, but these have been deactivated due to pressure from Google, the owner of YouTube. ClipConverter converter continues to operate because of the guidelines and rules placed on users. Users are allowed to download the videos for fair use meaning personal, non-commercial use. Personal use of a video is legal, but if a user sells the video for profit, or passes it off as his/her own, that is a copyright violation, and illegal. As a condition of using the ClipConverter service, the user agrees to use the video only for personal use, and agrees to not involve ClipConverter in any type of copyright lawsuit brought against the user. It is this policy and other strict user rules and policies that allow ClipConverter to operate in a legal way.

To combat the infringement of copyright law due to illegal file sharing, the music industry began placing Digital Rights Management (DRM) control on downloaded files so that they couldn't be shared. However, this also stopped users from being able to transfer the files to other personal devices. Today, many music downloading services, such as Apple's iTunes, have switched to MP3 or MP4 formats to allow users to view files on multiple personal devices.

12.2.4 Film Piracy

The illegal copying and distribution of movies and TV shows is called film piracy. The rate at which people commit film piracy has been growing exponentially since 2004. This is most likely due to the fact that online peerto-peer file sharing has become a lot easier. According to the

Motion Picture Association of America (MPAA), film piracy causes an estimated loss of \$18 billion dollars per year worldwide. This statistic is estimated because the MPAA has to determine how many people would have actually watched the film if it weren't for free, or at a discounted price. Ever since 2004, authorities have been pushing to reduce film piracy. In 2005 the Family Entertainment and Copyright Act was put into place. This act makes recording a movie in a theatre illegal in the United States. Besides laws, there have also been things like visual FBI Anti-Piracy Warning Seal's added to DVD's.

This seal is shown when the DVD is played, and before the actual movie starts. However, this doesn't always effectively stop a pirate from stealing the movie. There are many software programs used by authorities and private companies to prevent the illegal trade of pirated movies. This software is able to monitor websites that host peer-to-peer file trading. If a company's film is being misused over the internet, the software is capable of sending infringement notices and collecting important data. All of this information could be used to build a court case against the violator.

12.2.5 Computer Hoaxes and Digital Manipulation

A computer hoax, or virus hoax, is an inaccurate statement or story spread through computers, typically through an email. Usually the email warns the user about a virus or worm and instructs the user to forward the message (which spreads the virus) or recommends that the receivers download an infected file attachment. These virus hoaxes can often be distinguished by their lofty and enticing wording or by claims that sound formal and authorized.

These types of emails use people's fear of the internet to manipulate their actions and thus spread a virus or computer hoax; many consider these fake emails to be worms in and of themselves because of this.

Digital Manipulation is editing or altering any type of digital content. The most commonly thought of is photoshop, which is editing an image so that it has little to no resemblance of the original image. This can be anything from adjusting the "exposure" on a photo or using an airbrush tool, to combing two photos to make one or adding portions that were not in the original (such as a large moon covering half the sky behind the Chicago skyline). But digital manipulation also includes altering text, music, movies, or voice interviews. The main issue

when it comes to ethics in digital manipulation is ensuring that copyrights are not violated and the original digital information is not misused or misinterpreted. Also, intentions and purpose are key in deciding “how far is too far” when it comes to photo-shop or other editing methods.

12.3 Computers and Your Health

12.3.1 Physical Health

There are some physical problems that can be caused by computer use such as eyestrain, blurred vision, fatigue, headaches, backaches, and wrist and finger pain. One kind of health problem that occurs is repetitive stress injuries, which is when doing the same thing over and over causes hand, wrist, shoulder, or neck pain. Using the keyboard and the mouse can cause repetitive stress injuries.

One repetitive stress injury that is related to repetitive finger movement is carpal tunnel syndrome, which is a painful condition of the hands and wrists. Another repetitive stress injury is related with typing on the smaller keyboards of mobile devices and this is called De- Quervain’s tendonitis. There can also be many eye problems caused by looking at a computer screen for too long. Another concern is hearing loss because many portable media devices can be turned up too loud and cause hearing problems. There is also a concern with radiation that can be emitted from wireless devices. Dr. Josh Axe, DNM, DC, CNS is a certified doctor of natural medicine and of chiropractic manipulation and is a clinical nutritionist, who believes electromagnetic radiation (EMR) from cell phones is harmful to our bodies and our brains, resulting in cancers, tumors and dementia. He also believes we need further testing to discover just how dangerous cell phones (and other EMR-emitting devices) really are. There are ways to avoid the physical health problems caused by computers. One way is to make sure that you are comfortable while at the computer and that you use a good chair that will be supportive for your back and neck. It is also important to just be aware of these possible physical health risks caused by computers because it is something that is often overlooked. Of course, to avoid EMR you’ll have to avoid using cell phones, which is highly unlikely to happen.

As mentioned before, most people today interact with some type of computer daily. We have learned that there are many risk factors associated with the extended use of computers. Some of

those risk factors include eye strain, fatigue and upper and lower body discomfort. Luckily, there is a solution to these problems. It is called ergonomics.

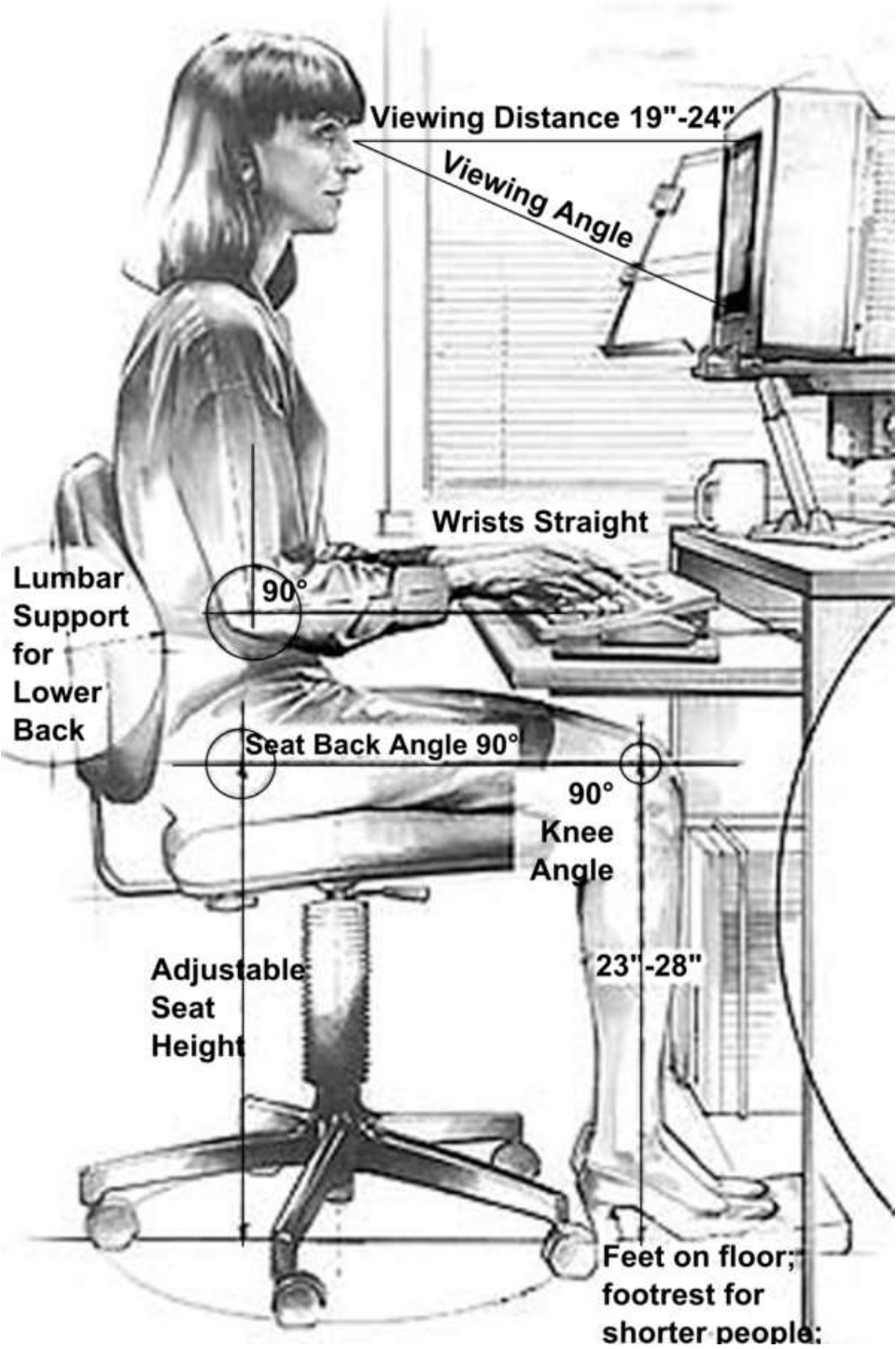


Figure 75: Computer Workstation Variables cleanup

Ergonomics is a technology which focuses on making the work space as functional, safe and comfortable as possible. One thing computer users should consider when using the computer is wrist strain. It is important for the user to keep his wrists as straight as possible. Some causes for a bent wrist can be the keyboard being too low or high, or it being tilted upward. A solution to this can be to adjust the keyboard to the appropriate height or adjust the height of the chair. Another solution could be to use a split keyboard or what is known as an ergonomic keyboard. Another risk people face with extended use of the computer is back discomfort or even back disorder. This can be caused by an inadequate chair that lacks support for the back. It can also be caused by a lack of foot support or from slouching due to fatigue. Some solutions to these problems would be to use a lumbar cushion or to utilize a foot rest. It is also important for a user to take frequent breaks and change positions Computer Workstation Variables cleanup often. Many people today are exposed to extended computer use whether it is for a job or for entertainment. It is important for computer users to know the risks associated with over-usage and to be familiar with ergonomics in order to create the safest and most comfortable environment for themselves.

12.3.1.1 Computers in Medicine

In the same way that computers can be hazardous to one's long term health, they can also be used to monitor and, in-fact, encourage healthy habits. Sitting at a computer sedentary for hours on end day-in and day-out can lead to eyestrain, headaches, etc. as was previously discussed. However, in recent years, health and medicine have capitalized on the use of computers to further their industry. In hospitals and labs, CAT scans, X-rays, EEGs, EKGs, heart monitors, blood pressure and blood sugar scanners, and much more have been used to assess and monitor an individual's health. Certainly these additions to the medical field have made medicine a much more precise science and helped countless individuals who were suffering. However, computers have not only been used in reactive situations. They now can also help an individual be proactive about their health with the introduction of embedded computers, monitors, and biometrics. One example of this is the three-dimensional accelerometer (better known by the brand name "Fitbit"). These technologies allow the mechanism to gather data about the human body, interpret the data into usable information, and also store it in case a medical professional needs access to real-time health records. They can give an individual information about heartbeat/heart

rate, sleep patterns, amount of physical activity, etc. and, in some cases, can even recommend that a person change certain behavior to combat unhealthy habits.

12.3.1.2 Stress of Ever-Changing Technology

Today we see many kinds of changes that are causing a great deal of stress and anxiety. Most of these changes are directly related to the digital revolution and have only become problems in the last 10 to 20 years. Modern technology has infiltrated the workplaces, people's cars and their homes. According to the Angus Reid, 14% of Canadian workers identified new technology in the workplace as a significant source of stress. Never before have individuals been asked to adapt as rapidly. Instant communication and exponentially growing technology lead us to one of the few absolute truths – technology change is constant. Technology has reconfigured the nature of work and our social relationships on the job. People feel overwhelmed by the volume of emails and calls that they receive. Though people cannot stop this technology roller coaster, they can use a variety of practical strategies to develop resilience and renew and replenish themselves. Some of the simplest skills that the people can learn to be more resilient to stress are deep relaxation and selfcare. It can convert fatigue into energy and restlessness into calmness.

12.3.2 Emotional Health

Because of our fast growth and use of technology there are many positive advantages of using computers; however, in recent years emotional health has become an important factor when using computers and technology. The use of computers in general can cause much stress and anxiety for workers in different fields today. When computers were first introduced to the working field, secretaries had to learn how to change from a typewriter to a keyboard. Many people now widely understand the use of computers, but the downfall is keeping up with the changing technology. Every few years a new system, computer design, etc. is updated and sent out to the market. This makes operating a company more difficult when programs and systems need to be updated. Because the Internet can be accessed 24/7 the stress of being “on-call” is worrisome to many workers. They worry they do not have enough down time for themselves once they come home from work that day. In the U.S. information is right at citizens' fingertips, which can sometimes create an information overload. There is always news to be caught up on, as well as catching up with email, text messages, and social media. Many can become exhausted from being on the computer (or cell phone) too much. This is called burnout which is long-term

exhaustion and diminished interest in work. A more common type of “emotional health” deals with teenagers who have a technology addiction. Social media plays a huge role in this today.

12.3.3 Internet Addiction

The virtual world is similar to reality. People can play their chosen online roles, similar to the masks people put on everyday. At the same time the virtual world seems to have advantages over the real world. You can achieve success through creativity while concealing defects. Virtual reality (VR) gives individuals the opportunity to take on any role without having to take any of the responsibility and without fear of the consequences of rejection or condemnation. The person feels protected and inaccessible and can easily express their opinions, even if they are not able to do so in real life. The virtual world gives the illusion of protection from loneliness. At the same time it provides an opportunity to get away from communicating with real people, whose opinion would have to be considered. VR allows you to simulate reality by creating a state of endless possibilities. Surfing the Net gives the feeling of being in the “flow” and a disconnection from reality with a sense of being in another world, another time, another dimension.

Many people today are addicted to the internet but do not know that they are. There are many signs of internet addiction. A good example is if they are always thinking about the internet. If a person is using the internet more and more in order to receive satisfaction, this could be a sign of addiction. If they feel restless or depressed because they're not on the internet, this too could be a tell-tale sign of internet addiction. Some tips on breaking this internet addiction are to understand that they have a problem with the internet. Next is to build coping skills. Many people become addicted to the internet because it is their outlet for stress and anger. Being able to change the way a person copes with their problems would be extremely beneficial. There is also therapy, counseling and support groups to take advantage of and help with this addiction. It is important to be able to overcome an internet addiction to be able to fully appreciate life.

12.3.4 Cyberbullying

According to stopcyberbullying.org, cyberbullying occurs when a minor is tormented, threatened, harassed, humiliated, embarrassed or otherwise targeted by another minor using the Internet. These acts can be committed through interactive and digital technologies, or mobile phones. To be considered a true cyberbullying incident, minors must be involved on both sides,

or at least instigated by one in an attempt to harm, another. If and when adults become involved, it then becomes cyber-harassment or cyberstalking, and is wholly different from cyberbullying.

For most, it is usually not a one time event, unless it is a legitimate threat of serious harm. Children are typically aware of the extent of danger or hurtful ideas, while parents may be more concerned about offensive language used. Ultimately, cyberbullying could lead to a misdemeanor charge, though if the child is young enough, juvenile delinquency is an option. Often, it does not go that far, yet many parents try to pursue criminal charges. If hacking, password breach, or identity theft is involved, it can be a crime of state and federal law.

12.4 Summary

1. assistive technology Hardware and software specifically designed for use by individuals with physical disabilities.
2. burnout A state of fatigue or frustration usually brought on by overwork.
3. business ethics Standards of moral conduct that guide a business's policies, decisions, and actions. carpal tunnel syndrome (CTS) A painful and crippling condition affecting the hands and wrist that can be caused by computer use.
4. code of conduct A policy, often for a school or business, that specifies allowable use of resources, such as computers and other equipment.
5. code of ethics A policy, often for an organization or industry, that specifies overall moral guidelines adopted by that organization or industry.
6. computer ethics Standards of moral conduct as they relate to computer use.
7. computer hoax An inaccurate statement or story spread through the use of computers.
8. copyright The legal right to sell, publish, or distribute an original artistic or literary work; it is held by the creator of a work as soon as it exists in physical form.
9. cybersquatting The act of registering a domain name
10. with the intent to profit from the goodwill of a trademark belonging to someone else.
11. DeQuervain's tendonitis A condition in which the tendons on the thumb side of the wrist are swollen and irritated.
12. digital divide The gap between those who have access to technology and those who do not.

13. digital manipulation The alteration of digital content, usually text or photographs.
- digital rights management (DRM) software Software used to protect and manage the rights of creators of digital content, such as art, music, photographs, and movies.
14. digital watermark A subtle alteration of digital content that is not noticeable when the work is viewed or played but that identifies the copyright holder.
15. docking station A device designed to easily connect a portable computer to conventional hardware, such as a keyboard, mouse, monitor, and printer.

Reference

Wikiversity. (2017). *Introduction to Computer Information System*. Retrieved October 13, 2017, from https://en.wikibooks.org/wiki/Introduction_to_Computer_Information_Systems available under Creative Commons Attribution-Share Alike 3.0 license.

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