Unit 2 Computer Generation & Classifications

Structure:

2.1 Introduction

As discussed in the previous unit, computers have become part of our life. Usage of computers in different fields has become a necessity in the present competitive world. Lot of work and evolutions has transpired from the initial computer systems to the present day computer systems.

In this unit, we will study the Generation and Classification of computer, Distributed and Parallel Computers.

The history of computer development is often referred to in reference to the different generations of computing devices. A generation refers to the state of improvement in the product development process. This term is also used in the different advancements of new computer technology. With each new generation, the circuitry has gotten smaller and more advanced than the previous generation before it. As a result of the miniaturization, speed, power, and computer memory has proportionally increased. New

discoveries are constantly being developed that affect the way we live, work and play.

Each generation of computers is characterized by major technological development that fundamentally changed the way computers operate, resulting in increasingly smaller, cheaper, powerful, efficient and reliable devices. Read about each generation and the developments that led to the current devices that we use today.

Learning Objectives:

After studying this unit you should be able to:

- explain the Generation of the Computers
- explain the classification of computers
- define Distributed Computer System
- explain Parallel Computers

2.2 Generation of Computer

The history of computer development is frequently stated to in reference to the different generations of computing devices. A generation refers to the state of improvement in the product development process. This term is also used in the different advancements of new computer technology. With each new generation, the circuitry has gotten smaller and more advanced than the previous generation before it. As a result of the diminishment, speed, power, and computer memory has proportionally increased. New discoveries are constantly being developed that affect the way we live, work and play.

Every generation of computers is considered by major technological development that fundamentally changed the way computers operate, resulting in increasingly smaller, cheaper, and more powerful and more efficient and reliable devices.

2.2.1 First Generation (1940-1956): Vacuum Tubes

The first generation computers used vacuum tubes for circuitry and magnetic drums for memory, and were often enormous, taking up entire rooms. A magnetic drum, also referred to as drum, is a metal cylinder coated with magnetic iron-oxide material on which data and programs can be stored. Magnetic drums were once used as a primary storage device but

have since been implemented as auxiliary storage devices. Figure 2.1 shows vacuum tubes which are used in the first generation computers.

Fig. 2.1: Vacuum Tubes

The tracks on a magnetic drum are assigned to channels located around the circumference of the drum, forming adjacent circular bands that wind around the drum. A single drum can have up to 200 tracks. As the drum rotates at a speed of up to 3,000 rpm, the device's read/write heads deposit magnetized spots on the drum during the write operation and sense these spots during a read operation. This action is similar to that of a magnetic tape or disk drive.

They were very expensive to operate and in addition to using a great deal of electricity, generated a lot of heat, which was often the cause of malfunctions. First generation computers relied on machine language to perform operations, and they could only solve one problem at a time. Machine languages are the only languages understood by computers. While easily understood by computers, machine languages are almost impossible for humans to use because they consist entirely of numbers. Computer Programmers, therefore, use either high level programming languages or an assembly language programming. An assembly language contains the same instructions as a machine language, but the instructions and variables have names instead of being just numbers.

Packages written in high level programming languages retranslated into assembly language or machine language by a compiler. Assembly language program retranslated into machine language by a program called an assembler (assembly language compiler). Every CPU has its own unique machine language. Programs must be rewritten or recompiled, therefore, to run on different types of computers. Input was based on punch card and paper tapes, and output was displayed on printouts.

The UNIVAC and ENIAC computers are examples of first-generation computing devices. The UNIVAC was the first commercial computer delivered to a business client, the U.S. Census Bureau in 1951.

Acronym for Electronic Numerical Integrator and Computer, the world's first operational electronic digital computer, developed by Army Ordnance to compute World War II ballistic firing tables. The ENIAC, weighing 30 tons, using 200 kilowatts of electric power and consisting of 18,000 vacuum tubes, 1,500 relays, and hundreds of thousands of resistors, capacitors, and inductors, was completed in 1945. In addition to ballistics, the ENIAC's field of application included weather prediction, atomic-energy calculations, cosmic-ray studies, thermal ignition, random-number studies, wind-tunnel design, and other scientific uses. The ENIAC soon became obsolete as the need arose for faster computing speeds.

Self Assessment Questions

1. The UNIVAC and ENIAC computers are examples of _____ computing devices.
2. A single drum can have up to _____ tracks.

2.2.2 Second Generation (1956-1963): Transistors

Transistors replaced vacuum tubes and ushered in the second generation computer. Transistor is a device composed of semiconductor material that amplifies a signal or opens or closes a circuit. Invented in 1947 at Bell Labs, transistors have become the key ingredient of all digital circuits, including computers. Today's latest microprocessor contains tens of millions of microscopic transistors. Figure 2.2 shows various transistors which are used in the second generation computers.

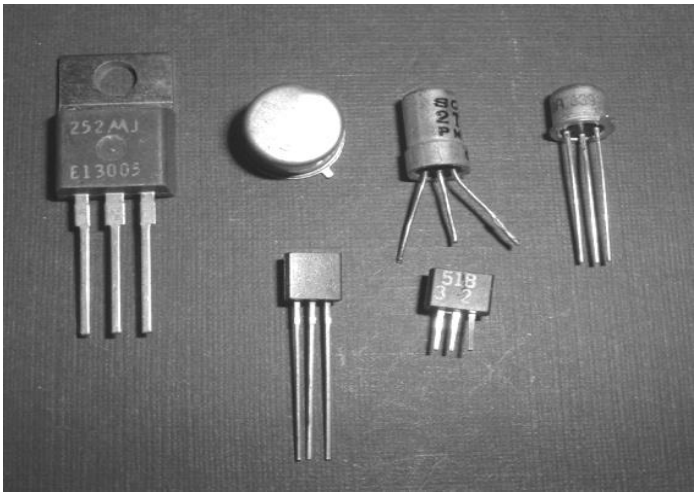

Fig. 2.2: Transistors

Prior to the invention of transistors, digital circuits were composed of vacuum tubes, which had many disadvantages. They were much larger, required more energy, dissipated more heat, and were more prone to failures. It's safe to say that without the invention of transistors, computing as we know it today would not be possible.

The transistor was invented in 1947 but did not see widespread use in computers until the late 50s. The transistor was far superior to the vacuum tube, allowing computers to become smaller, faster, cheaper, more energy-efficient and more reliable than their first-generation predecessors. Though the transistor still generated a great deal of heat that subjected the computer to damage, it was a vast improvement over the vacuum tube. Second-generation computers still relied on punched cards for input and printouts for output.

Second-generation computers moved from cryptic binary machine language to symbolic, or assembly, languages, which allowed programmers to specify instructions in words. High-level programming languages were also being developed at this time, such as early versions of COBOL and FORTRAN. These were also the first computers that stored their instructions in their memory, which moved from a magnetic drum to magnetic core technology.

The first computers of this generation were developed for the atomic energy industry.

Self Assessment Questions

3. _____ replaced vacuum tubes and ushered in the second generation computer.
4. Languages developed during second generation computers are _____.

2.2.3 Third Generation (1965-1971): Integrated Circuits

The development of the integrated circuit was the hallmark of the third generation of computers. Transistors were miniaturized and placed on silicon chips, called semiconductors, which drastically increased the speed and efficiency of computers.

A non-metallic chemical element in the carbon family of elements. Silicon – atomic symbol "Si" – is the second most abundant element in the earth's crust, surpassed only by oxygen. Silicon does not happen uncombined in nature. Sand and almost all rocks contain silicon combined with oxygen, forming silica. When silicon combines with other elements, such as iron, aluminum or potassium, a silicate is formed. Compounds of silicon also occur in the atmosphere, natural waters, and many plants and in the bodies of some animals.

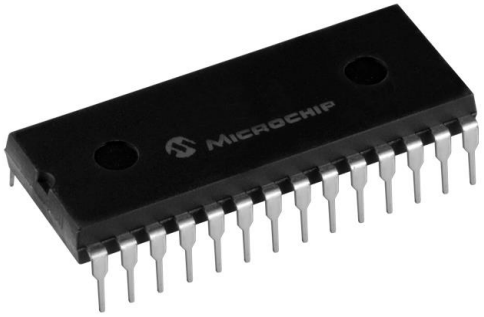

Fig. 2.3: Integrated Circuits

Silicon is the basic material used to make computer chips, transistors, silicon diodes and other electronic circuits and switching devices because its atomic structure makes the element an ideal semiconductor. Silicon is commonly doped, or mixed, with other elements, such as boron, phosphorous and arsenic, to alter its conductive properties.

A chip is a small piece of semi conducting material (usually silicon) on which an integrated circuit is embedded. A typical chip is less than ¼-square

inches and can contain millions of electronic components (transistors). Computers consist of many chips placed on electronic boards called printed circuit boards. There are different types of chips. For example, CPU chips (also called microprocessors) contain an entire processing unit, whereas memory chips contain blank memory.

Semiconductor is a material that is neither a good conductor of electricity (like copper) nor a good insulator (like rubber). The most common semiconductor materials are silicon and germanium. These materials are then doped to create an excess or lack of electrons.

Computer chips, both for CPU and memory, are composed of semiconductor materials. Semiconductors make it possible to miniaturize electronic components, such as transistors. Not only does miniaturization mean that the components take up less space, it also means that they are faster and require less energy.

Self Assessment Questions

5. The development of _____ was the hallmark of the third generation of computers.
6. _____ is the basic material used to make computer chips, transistors, silicon diodes and other electronic circuits and switching devices.

2.2.4 Fourth Generation (1971- Present): Microprocessors

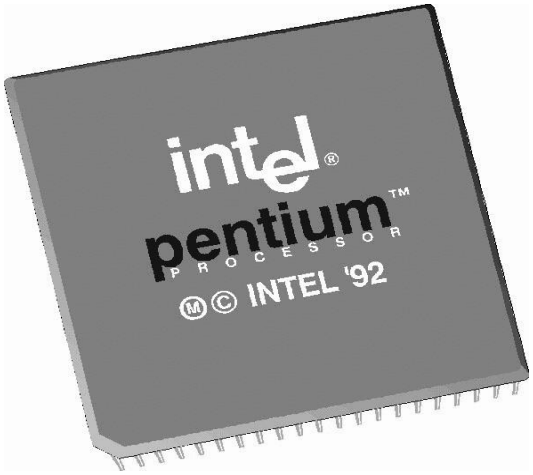

Fig. 2.4: Microprocessors

The microprocessor brought the fourth generation of computers, as thousands of integrated circuits we rebuilt onto a single silicon chip and this will contains a Central Processing Unit. In the world of personal computers, the terms microprocessor and CPU are used interchangeably. At the heart of all personal computers and most workstations sits a microprocessor. Microprocessors also control the logic of almost all digital devices, from clock radios to fuel-injection systems for automobiles.

Three basic characteristics differentiate microprocessors:

- **Instruction Set:** The set of instructions that the microprocessor can execute.
- **Bandwidth:** The number of bits processed in a single instruction.
- **Clock Speed:** Given in megahertz (MHz), the clock speed determines how many instructions per second the processor can execute.

In both cases, the higher the value, the more powerful the CPU. For example, a 32-bit microprocessor that runs at 50MHz is more powerful than a 16-bitmicroprocessor that runs at 25MHz. What in the first generation filled an entire room could now fit in the palm of the hand. The Intel 4004chip, developed in 1971, located all the components of the computer – from the central processing unit and memory to input/output controls – on a single chip.

Abbreviation of central processing unit, and pronounced as separate letters. The CPU is the brains of the computer. Sometimes referred to simply as the processor or central processor, the CPU is where most calculations take place. In terms of computing power the CPU is the most important element of a computer system.

On large machines, CPUs require one or more printed circuit boards. On personal computers and small workstations, the CPU is housed in a single chip called a microprocessor.

Two typical components of a CPU are:

- The arithmetic logic unit (ALU), which performs arithmetic and logical operations.
- The control unit, which extracts instructions from memory and decodes and executes them, calling on the ALU when necessary.

In 1981 IBM introduced its first computer for the home user, and in 1984 Apple introduced the Macintosh. Microprocessors also moved out of the realm of desktop computers and into many areas of life as more and more everyday products began to use microprocessors.

As these small computers became more powerful, they could be linked together to form networks, which eventually led to the development of the Internet. Fourth generation computers also saw the development of GUI's, the mouse and handheld devices.

Self Assessment Questions

7. What is the technology used in fourth generation computers?
8. Three basic characteristics of microprocessors are _____.

2.2.5 Fifth Generation Computer

Fifth generation computing devices, based on artificial intelligence, are still in development, though there are some applications, such as voice recognition, that are being used today.

Artificial Intelligence is the branch of computer science concerned with making computers behave like humans. The term was coined in 1956 by John McCarthy at the Massachusetts Institute of Technology. Artificial intelligence includes the following:

Games playing: Programming computers to play games such as chess and checkers

Expert Systems: Programming computers to make decisions in real-life situations (for example, some expert systems help doctors diagnose diseases based on symptoms)

Natural Language: Programming computers to understand natural human languages

Neural Networks: Systems that simulate intelligence by attempting to reproduce the types of physical connections that occur in animal brains

Robotics: Programming computers to see and hear and react to other sensory stimuli. Currently, no computers exhibit full artificial intelligence (that is, are able to simulate human behavior). The greatest advances have occurred in the field of games playing. The best computer chess programs are now capable of beating humans. In May,1997, an IBM super-computer

called Deep Blue defeated world chess champion Gary Kasparov in a chess match. In the area of robotics, computers are now widely used in assembly plants, but they are capable only of very limited tasks. Robots have great difficulty identifying objects based on appearance or feel, and they still move and handle objects clumsily.

Natural-language processing offers the greatest potential rewards because it would allow people to interact with computers without needing any specialized knowledge. You could simply walk up to a computer and talk to it. Unfortunately, programming computers to understand natural languages has proved to be more difficult than originally thought. Some rudimentary translation systems that translate from one human language to another are in existence, but they are not nearly as good as human translators.

There are also voice recognition systems that can convert spoken sounds into written words, but they do not understand what they are writing; they simply take dictation. Even these systems are quite limited – you must speak slowly and distinctly.

Voice Recognition: In the field of computer science that deals with designing computer systems that can recognize spoken words. Note that voice recognition implies only that the computer can take dictation, not that it understands what is being said. Comprehending human languages falls under a different field of computer science called natural language processing. A number of voice recognition systems are available on the market. The most powerful can recognize thousands of words. However, they generally require an extended training session during which the computer system becomes accustomed to a particular voice and accent. Such systems are said to be speaker dependent.

Many systems also require that the speaker speak slowly and distinctly and separate each word with a short pause. These systems are called discrete speech systems. Recently, great strides have been made in continuous speech systems voice recognition systems that allow you to speak naturally. There are now several continuous-speech systems available for personal computers. Because of their limitations and high cost, voice recognition systems have traditionally been used only in a few specialized situations.

For example, such systems are useful in instances when the user is unable to use a keyboard to enter data because his or her hands are occupied or disabled. Instead of typing commands, the user can simply speak into a headset. Increasingly, however, as the cost decreases and performance improves, speech recognition systems are entering the mainstream and are being used as an alternative to keyboards. The use of parallel processing and superconductors is helping to make artificial intelligence a reality. Parallel processing is the simultaneous use of more than one CPU to execute a program. Ideally, parallel processing makes a program run faster because there are more engines (CPUs) are running. In practice, it is often difficult to divide a program in such a way that separate CPUs can execute different portions without interfering with each other.

First proposed in the 1970s, quantum computing relies on quantum physics by taking advantage of certain quantum physics properties of atoms or nuclei that allow them to work together as quantum bits, or qubits, to be the computer's processor and memory. By interacting with each other while being isolated from the external environment, qubits can perform certain calculations exponentially faster than conventional computers.

Qubits do not rely on the traditional binary nature of computing. While traditional computers encode information into bits using binary numbers, either a 0 or 1, and can only do calculations on one set of numbers at once, quantum computers encode information as a series of quantum-mechanical states such as spin directions of electrons or polarization orientations of a photon that might represent a 1 or 0, might represent a combination of the two or might represent a number expressing that the state of the qubit is somewhere between 1 and 0, or a superposition of many different numbers at once. A quantum computer can do an arbitrary reversible classical computation on all the numbers simultaneously, which a binary system cannot do, and also has some ability to produce interference between various different numbers. By doing a computation on many different numbers at once, then interfering the results to get a single answer, a quantum computer has the potential to be much more powerful than a classical computer of the same size. In using only a single processing unit, a quantum computer can naturally perform myriad operations in parallel.

Quantum computing is not well suited for tasks such as word processing and email, but it is ideal for tasks such as cryptography and modeling and indexing very large databases. Nanotechnology is a field of science whose goal is to control individual atoms and molecules to create computer chips and other devices that are thousands of times smaller than current technologies permit. Current manufacturing processes use lithography to imprint circuits on semiconductor materials. While lithography has improved dramatically over the last two decades to the point where some manufacturing plants can produce circuits smaller than one micron (1,000 nanometers) – it still deals with aggregates of millions of atoms. It is widely believed that lithography is quickly approaching its physical limits. To continue reducing the size of semiconductors, new technologies that juggle individual atoms will be necessary. This is the realm of nanotechnology.

Although research in this field dates back to Richard P. Feynman's classic talk in 1959, the term nanotechnology was first coined by K. Eric Drexler in1986 in the book Engines of Creation. In the popular press, the term nanotechnology is sometimes used to refer to any sub-micron process, including lithography. Because of this, many scientists are beginning to use the term molecular nanotechnology when talking about true nanotechnology at the molecular level. The goal of fifth-generation computing is to develop devices that respond to natural language input and are capable of learning and self-organization. Here natural language means a human language. For example, English, French, and Chinese are natural languages. Computer languages, such as FORTRAN and C, are not.

Probably the single most challenging problem in computer science is to develop computers that can understand natural languages. So far, the complete solution to this problem has proved elusive, although great deal of progress has been made. Fourth-generation languages are the programming languages closest to natural languages.

Self Assessment Questions

9. Artificial intelligence contains _____.
10. _____ is the branch of computer science concerned with making computers behave like humans.

2.3 Classification of Computers

Computers are classified according to their data processing speed, amount of data that they can hold and price. Generally, a computer with high processing speed and large internal storage is called a big computer. Due to rapidly improving technology, we are always confused among the categories of computers.

Depending upon their speed and memory size, computers are classified into following four main groups.

1. Supercomputer
2. Mainframe computer
3. Mini computer
4. Microcomputer

2.3.1 Supercomputer

Supercomputer is the most powerful and fastest, and also very expensive. It was developed in 1980s. It is used to process large amount of data and to solve the complicated scientific problems. It can perform more than one trillions calculations per second. It has large number of processors connected parallel. So parallel processing is done in this computer. In a single supercomputer thousands of users can be connected at the same time and the supercomputer handles the work of each user separately. Super computer are mainly used for:

- Weather forecasting
- Nuclear energy research
- Aircraft design
- Automotive design
- Online banking
- To control industrial units

The supercomputers are used in large organizations, research laboratories, aerospace centers, large industrial units etc. Nuclear scientists use supercomputers to create and analyze models of nuclear fission and fusions, predicting the actions and reactions of millions of atoms as they interact. The examples of supercomputers are CRAY-1, CRAY-2, Control Data CYBER 205 and ETA A-10 etc.

2.3.2 Mainframe Computers

Mainframe computers are also large-scale computers but supercomputers are larger than mainframe. These are also very expensive. The mainframe computer specially requires a very large clean room with air-conditioner. This makes it very expensive to buy and operate. It can support a large number of various equipment's. It also has multiple processors. Large mainframe systems can handle the input and output requirements of several thousands of users. For example, IBM, S/390 mainframe can support 50,000 users simultaneously. The users often access then mainframe with terminals or personal computers.

There are basically two types of terminals used with mainframe systems.

1) ***Dumb Terminal:*** Dumb terminal does not have its own CPU and storage devices. This type of terminal uses the CPU and storage devices of mainframe system. Typically, a dumb terminal consists of monitor and a keyboard (or mouse).

2) ***Intelligent Terminal:*** Intelligent terminal has its own processor and can perform some processing operations. Usually, this type of terminal does not have its own storage. Typically, personal computers are used as intelligent terminals. A personal computer as an intelligent terminal gives facility to access data and other services from mainframe system. It also enables to store and process data locally.

The mainframe computers are specially used as servers on the World Wide Web. The mainframe computers are used in large organizations such as Banks; Airlines and Universities etc. where many people (users) need frequent access to the same data, which is usually organized into one or more huge databases. IBM is the major manufacturer of mainframe computers. The examples of mainframes are IBM S/390, Control Data CYBER 176 and Amdahl 580 etc.

2.3.3 Minicomputers

These are smaller in size, have lower processing speed and also have lower cost than mainframe. These computers are known as minicomputers because of their small size as compared to other computers at that time. The capabilities of a minicomputer are between mainframe and personal computer. These computers are also known as midrange computers. The

minicomputers are used in business, education and many other government departments. Although some minicomputers are designed for a single user but most are designed to handle multiple terminals.

Minicomputers are commonly used as servers in network environment and hundreds of personal computers can be connected to the network with a minicomputer acting as server like mainframes, minicomputers are used as web servers. Single user minicomputers are used for sophisticated design tasks. The first minicomputer was introduced in the mid-1960s by Digital Equipment Corporation (DEC). After this IBM Corporation (AS/400 computers) Data General Corporation and Prime Computer also designed the mini computers.

2.3.4 Microcomputer

The microcomputers are also known as personal computers or simply PCs. Microprocessor is used in this type of computer. These are very small in size and cost. The IBM's first microcomputer was designed in 1981 and was named as IBM-PC. After this many computer hardware companies copied the design of IBM-PC. The term "PC-compatible" refers any personal computer based on the original IBM personal computer design.

The most popular types of personal computers are the PC and the Apple. PC and PC-compatible computers have processors with different architectures than processors in Apple computers. These two types of computers also use different operating systems. PC and PC-compatible computers use the Windows operating system while Apple computers use the Macintosh operating system (MacOS). The majority of microcomputers sold today are part of IBM-compatible. However the Apple computer is neither an IBM nor a compatible. It is another family of computers made by Apple computer.

Personal computers are available in two models. These are:

- Desktop PCs
- Tower PCs

A desktop personal computer is most popular model of personal computer. The system unit of the desktop personal computer can lie flat on the desk or table. In desktop personal computer, the monitor is usually placed on the system unit.

Another model of the personal computer is known as tower personal computer. The system unit of the tower PC is vertically placed on the desk of table. Usually the system unit of the tower model is placed on the floor to make desk space free and user can place other devices such as printer, scanner etc. on the desktop. Today computer tables are available which are specially designed for this purpose. The tower models are mostly used at homes and offices.

Microcomputers are further divided into following categories.

1. Laptop computer
2. Workstation
3. Network computer
4. Handheld computer

1. Laptop computer

Laptop computer is also known as notebook computer. It is small size (85-by-11 inch notebook computer and can fit inside a briefcase. The laptop computer is operated on a special battery and it does not have to be plugged in like desktop computer. The laptop computer is portable and fully functional microcomputer. It is mostly used during journey. It can be used on your lap in an airplane. It is because it is referred to as laptop computer.

The memory and storage capacity of laptop computer is almost equivalent to the PC or desktop computer. It also has the hard disc, floppy disk drive, Zip disk drive, CD-ROM drive, CD-writer etc.

It has built-in keyboard and built-in trackball as pointing device. Laptop computer is also available with the same processing speed as the most powerful personal computer. It means that laptop computer has same features as personal computer. Laptop computers are more expensive than desktop computers. Normally these computers are frequently used in business travelers.

2. Workstations

Workstations are special single user computers having the same features as personal computer but have the processing speed equivalent to minicomputer or mainframe computer. A workstation computer can be fitted on a desktop. Scientists, engineers, architects and graphic designers mostly use these computers. Workstation computers are expensive and powerful

computers. These have advanced processors, more RAM and storage capacity than personal computers. These are usually used as single-user applications but these are used as servers on computer network and web servers as well.

3. Network computers

Network computers are also version of personal computers having less processing power, memory and storage. These are specially designed as terminals for network environment. Some types of network computers have no storage. The network computers are designed for network, Internet or Intranet for data entry or to access data on the network. The network computers depend upon the network's server for data storage and to use software. These computers also use the network's server to perform some processing tasks.

In the mid-1990s the concept of network computers became popular among some PC manufacturers. As a result several variations of the network computers quickly became available. In business, variations of the network computer are Windows terminals, NetPCs and diskless workstations. Some network computers are designed to access only the Internet or to an Intranet. These devices are sometimes called Internet PCs, Internet boxes etc. In home some network computers do not include monitor. These are connected to home television, which serves as the output devices. A popular example of a home-based network computer is Web TV, which enables the user to connect a television to the Internet. The Web TV has a special set-top box used to connect to the Internet and also provides a set of simple controls which enable the user to navigate the Internet, send and receive e-mails and to perform other tasks on the network while watching television. Network computers are cheaper to purchase and to maintain than personal computers.

4. Handheld computer

In the mid1990s, many new types of small personal computing devices have been introduced and these are referred to as handheld computers. These computers are also referred to as Palmtop Computers. The handheld computers sometimes called Mini-Notebook Computers. The type of computer is named as handheld computer because it can fit in one hand while you can operate it with the other hand. Because of its reduced size,

the screen of handheld computer is quite small. Similarly it also has small keyboard. The handheld computers are preferred by business traveler. Some handheld computers have a specialized keyboard. These computers are used by mobile employees, such as meter readers and parcel delivery people, whose jobs require them to move from place to place.

The examples of handheld computers are:

1) Personal Digital Assistance
2) Cellular telephones
3) H/PC Pro devices

1. Personal Digital Assistance (PDAs)

The PDA is one of the more popular lightweight mobile devices in use today. A PDA provides special functions such as taking notes, organizing telephone numbers and addresses. Most PDAs also offer a variety of other application software such as word processing, spreadsheet and games etc. Some PDAs include electronic books that enable users to read a book on the PDA's screen.

Many PDAs are web-based and users can send/receive e-mails and access the Internet. Similarly, some PDAs also provide telephone capabilities. The primary input device of a PDA is the stylus. A stylus is an electronic pen and looks like a small ballpoint pen. This input device is used to write notes and store in the PDA by touching the screen. Some PDAs also support voice input.

2. Cellular phones

A cellular phone is a web-based telephone having features of analog and digital devices. It is also referred to as Smart Phone. In addition to basic phone capabilities, a cellular phone also provides the functions to receive and send e-mails & faxes and to access the Internet.

3. H/PC Pro Devices

H/PC Pro device is new development in handheld technology. These systems are larger than PDAs but they are not quite as large as typical notebook PCs. These devices have features between PDAs and notebook PCs. The H/PC Pro device includes a full-size keyboard but it does not include disk. These systems also have RAM with very low storage capacity and slow speed of processor.

2.4 Distributed Computer System

Distributed computing exploits a network of many computers, each accomplishing a portion of an overall task, to achieve a computational result much more quickly than with a single computer. In addition to a higher level of computing power, distributed computing also allows many users to interact and connect openly. Different forms of distributed computing allow for different levels of honesty, with most people accepting that a higher degree of openness in a distributed computing system is beneficial. The segment of the Internet most people are most familiar with, the World Wide Web, is also the most recognizable use of distributed computing in the public arena.

A home computer is used, for example, to run the browser and to break down the information being sent, making it accessible to the end user. A server at your Internet service provider acts as a gateway between your home computer and the greater Internet. These servers speak with computers that comprise the domain name system, to help decide which computers to talk based on the URL the end user enters. In addition, each web page is hosted on another computer.

Another type of distributed computing is known as grid computing. Grid computing consists of many computers operating together remotely and often simply using the idle processor power of normal computers. The highest visibility example of this form of distributed computing is at Home project of the Search for Extra-Terrestrial Intelligence (SETI). SETI uses the processing power of over five million home computers to utilize computational power far in excess of even the greatest supercomputers. SETI makes available a free piece of software a home user may install on a computer. The software runs when the computer is left idle, and each computer with the software contacts a central server in Berkeley and downloads a 250k file which tells it what to analyze. The distributed computing system then analyzes this data for specific patterns, which in theory represent a high likelihood of intelligent design.

Many home computers are also examples of distributed computing – although less drastic ones. By using multiple processors in the same machine, a computer can run separate processes and reach a higher level of efficiency than otherwise. Many home computers now take advantage of

multiprocessing, as well as a similar practice known as multithreading, to achieve much higher speeds than their single-processor counterparts.

2.5 Parallel Computers

Parallel computing is the simultaneous use of multiple processors (CPUs) to do computational work. In traditional (serial) programming, a single processor performs the program instructions in a step-by-step manner. Some operations, however, have many steps that do not have time dependencies and can therefore be broken up into multiple tasks to be executed simultaneously. For instance, adding a number to all the elements of a matrix does not require that the result obtained from summing one element be acquired before summing the next element. Elements in the matrix can be made available to several processors and the sums performed simultaneously, with the results available much more quickly than if the operations had all been performed serially.

Parallel computations can be accomplished on shared-memory systems with multiple CPUs, or on distributed-memory clusters made up of smaller shared-memory systems or single-CPU systems. Organizing the concurrent work of the multiple processors and synchronizing the results are handled by program calls to parallel libraries; these tasks usually require parallel programming expertise. At Indiana University, the High Performance Applications team offers programmers help in converting serial codes to parallel code, and optimizing the performance of parallel codes.

Assume that you have a lot of work to be done, and want to get it done much faster, so you hire 200 workers. If the work is 200 separate jobs that don't depend on each other, and they all take the same amount of time and can be easily parceled out to the workers, then you'll get it done about 200 times faster. This is so easy that it is called embarrassingly parallel. Just because it is embarrassing doesn't mean you shouldn't do it, and in fact it is probably exactly what you should do. Parallelizing each job and then running these parallelization one after another is probably a less efficient way of doing the work. Occasionally this isn't true because on computers, doing all of the job on one processor may require storing many results on disk, while the parallel job may spread the intermediate results in the RAM of the different processors. RAM is much faster than disks. Though, if the program isn't spending a lot of time using the disk then awkwardly parallel is

the smart way to do. Assume this is what you should do unless you analyze the situation and determine that it isn't. Embarrassingly parallel is simple, and if you can get the workers do it for free then it is the cheapest solution as well.

Suppose instead that this work you have is only a single job, but it takes a very long time. Now you have to do something to reorganize the job, somehow breaking it into pieces that can be done concurrently. For example, if the job is to build a house, it can be broken up into plumbing, electrical, etc. However, while many jobs can be done at the same time, some have specific orderings, such as putting in the foundation before the walls can go up. If all of the workers are there all of the time, then there will be periods when most of them are just waiting around for some task (such as the foundation) to be finished. Not very cost-effective, and you are not getting the job done 100 times faster. Such is the life of a parallel programmer.

Self Assessment Questions

11. The examples of supercomputers are _____.
12. Personal computers are available in two models _____ & _____.
13. The examples of handheld computers are _____.

2.6 Summary

Let us summarize what we have learnt so far in this unit.

- The first computers used vacuum tubes for circuitry and magnetic drums for memory, and were often enormous, taking up entire rooms.
- Transistors replaced vacuum tubes and ushered in the second generation computer.
- The development of the integrated circuit was the hallmark of the third generation of computers.
- The microprocessor brought the fourth generation of computers, as thousands of integrated circuits we rebuilt onto a single silicon chip.
- Fifth generation computing devices, based on artificial intelligence, are still in development, though there are some applications, such as voice recognition, that are being used today.

- Super computer are mainly used for: Weather forecasting, Nuclear energy research, Aircraft design, Automotive design, Online banking and to control industrial units.
- Personal computers are available in two models Desktop PCs & Tower PCs.
- The examples of handheld computers are: Personal Digital Assistance, Cellular telephones & H/PC Pro devices.
- A server at your Internet service provider acts as a gateway between your home computer and the greater Internet.
- Parallel computing is the concurrent use of multiple processors (CPUs) to do computational work.

2.7 Terminal Questions

1. Briefly explain first generation computer.
2. What is the technology used in second and third generation computers?
3. What is the difference between fourth and fifth generation computer?
4. Write a note on: Robotics and Voice Recognition
5. Briefly explain classification of the Computers.
6. Define distributed computer system?

2.8 Answers

Self Assessment Questions

1. First-generation
2. 200 tracks
3. Transistors
4. COBOL and FORTRAN
5. integrated circuit
6. Silicon
7. Microprocessor
8. Instruction Set, Bandwidth and Clock Speed
9. Games playing, Expert Systems, Natural Language, Neural Networks & Robotics
10. Artificial Intelligence
11. CRAY-1, CRAY-2, Control Data CYBER 205 and ETA A-10
12. Desktop PCs & Tower PCs
13. Personal Digital Assistance, Cellular telephones & H/PC Pro devices

Terminal Questions

1. The first computers used vacuum tubes for circuitry and magnetic drums for memory, and were often enormous, taking up entire rooms. (Refer section 2.2.1).
2. Transistors replaced vacuum tubes and ushered in the second generation computer. (Refer section 2.2.2).
3. The microprocessor brought the fourth generation of computers, as thousands of integrated circuits we rebuilt onto a single silicon chip. (Refer section 2.2.4).
4. Programming computers to see and hear and react to other sensory stimuli. (Refer section 2.2.5).
5. Computers are classified according to their data processing speed, amount of data that they can hold and price. (Refer section 2.3).
6. Distributed computing utilizes a network of many computers. (Refer section 2.4).