CSC 101/CSC 111 – INTRODUCTION TO COMPUTER SCIENCE (3 UNITS) LECTURE 3

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COURSE OUTLINE

- Definition of Computer
- History and Overview of Computing and Computers
- Evolution of Ideas and Machines from Mechanical Computer to Multimedia Computer
- Introduction to computing system
  - Basic elements of a computer system hardware
  - Block diagram, data/instruction flow, control flow
- Software types, packages and applications
- Characteristics of computer
- Problem solving using flowcharts and algorithms
- Data representation in computer system
- Communications and networks
  - World wide web, network access, network architectures, data communications. Safety and security
- File management in Windows and basic word processors, spreadsheets, presentation, graphics and other applications
- Introduction to programming:
  - Statements, symbolic names, arrays, expressions and control statements

COMPUTER CLASSIFICATION

- **ANALOGUE COMPUTERS**
  - These computers manipulate continuous data types and thus works on the principle of measurements
  - Modern analog computers usually employ electrical parameters, such as voltages, resistances or currents, to represent the quantities being manipulated.
  - Such computers do not deal directly with the numbers thus they measure continuous physical magnitudes.

- **DIGITAL COMPUTERS**
  - These computers manipulate discrete data types and thus works on the principle of counting.
  - They perform calculations and logical operations with quantities represented as digits.
  - Such computers process data into a digital value (in 0s and 1s).
  - They give the results with more accuracy and at a faster rate.

- **HYBRID COMPUTERS**
  - A combination of computers those are capable of inputting and outputting in both digital and analog signals.
  - They incorporate the measuring feature of an analog computer and counting feature of a digital computer.
  - For computational purposes, these computers use analog components and for storage, digital memories are used.

CHARACTERISTICS OF A COMPUTER

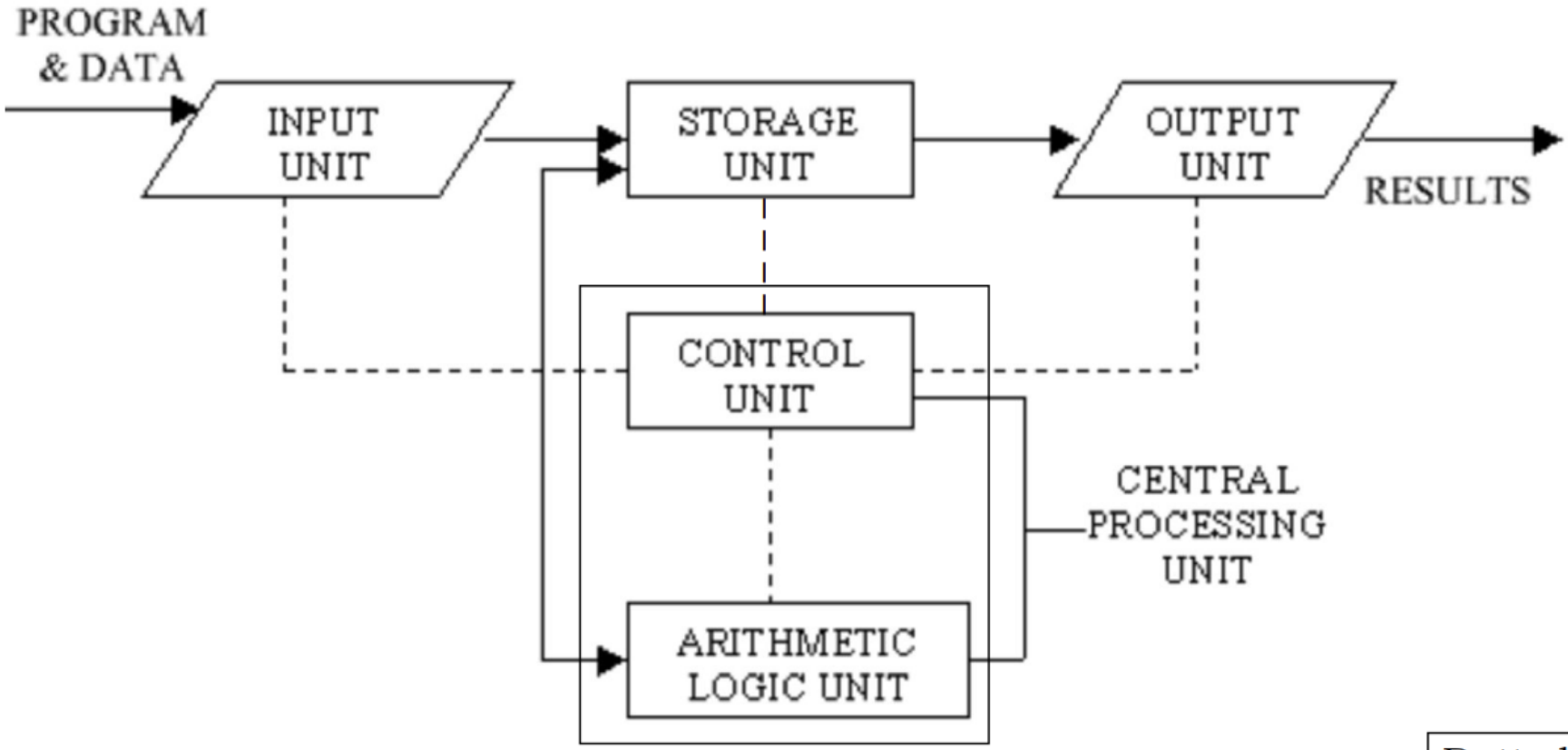
The characteristics of computers that have made them so powerful and universally useful are speed, accuracy, diligence, versatility and storage capacity

- **SPEED**
  - Computers work at an incredible speed.
  - A powerful computer is capable of performing about 3-4 million simple instructions per second.
- **ACCURACY**
  - Errors that may occur can almost always be attributed to human error (inaccurate data, poorly designed system or faulty instructions/programs written by the programmer)
- **DILIGENCE**
  - Unlike human beings, computers are highly consistent.
  - They do not suffer from human traits of boredom and tiredness resulting in lack of concentration.
  - Computers, therefore, are better than human beings in performing voluminous and repetitive jobs.
- **VERSATILITY**
  - Computers are versatile machines and are capable of performing any task as long as it can be broken down into a series of logical steps.
  - The presence of computers can be seen in almost every sphere – Railway/Air reservation, Banks, Hotels, Weather forecasting and many more.
- **STORAGE CAPACITY**
  - Today's computers can store large volumes of data.
  - A piece of information once recorded (or stored) in the computer, can never be forgotten and can be retrieved almost instantaneously.

FUNCTIONS OF A COMPUTER

- **Input**
  - The computer accepts data from outside for processing as Input, which is the raw information entered into a computer from the input devices.
  - Transferring of information into the system can be done through a user input device - i.e. keyboard, mouse, scanner etc.. or though previously loaded software/program, cd etc.
- **Processing**
  - The computer performs operations on the data that it holds internally.
  - Processing is the operation of data as per given instruction which is an internal process of the computer.
  - This is where the computer actually does the 'work' of data manipulation and control.
- **Output**
  - The computer produces information for external use.
  - Output is the processed data given by computer after data processing which is also called a Result.
  - Output is the exact opposite of input.
  - Output is the function that allows a computer to display information, from the system, to the user.
  - This can be accomplished using the monitor (or other graphical display), printer, speakers etc.
- **Storage**
  - The computer stores data before, during and after processing.
  - One can save results of processing in the storage devices for the future use.
  - Most computers are able to store data both temporarily (short-term) and permanently (long-term)
  - Storage takes place on hard-drives or external storage devices.
- **Communication**
  - The computer can send or receive data to or from other computers when it is connected on a network

BASIC COMPUTER ORGANIZATION



Dotted lines (– – – –) indicate flow of instruction solid lines (————) indicate flow of data

FUNCTIONAL UNITS OF A COMPUTER

- **INPUT UNIT**
  - It accepts (or reads) the list of instructions and data from the outside world.
  - It converts these instructions and data in computer acceptable format.
  - It supplies the converted instructions and data to the computer system for further processing.

- **OUTPUT UNIT**
  - It accepts the results produced by the computer which are in coded form and hence cannot be easily understood by us.
  - It converts these coded results to human acceptable (readable) form.
  - It supplied the converted results to the outside world.

- **STORAGE UNIT**
  - All the data to be processed and the instruction required for processing (received from input devices).
  - Intermediate results of processing.
  - Final results of processing before these results are released to an output device.

FUNCTIONAL UNITS OF A COMPUTER…

- **CENTRAL PROCESSING UNIT (CPU)**
  - The CPU processes instructions it receives in the process of decoding data.
  - In processing this data, the CPU performs four basic steps:
  - **Fetch**
    - Each instruction is stored in memory and has its own address.
    - The processor takes this address number from the program counter, which is responsible for tracking which instructions the CPU should execute next.
  - **Decode**
    - All programs to be executed are translated to into Assembly instructions.
    - Assembly code must be decoded into binary instructions, which are understandable to CPU.
  - **Execute**
    - While executing instructions the CPU can do one of three things:
      - Do calculations with its ALU,
      - move data from one memory location to another, or
      - jump to a different address.
  - **Store**
    - The CPU must give feedback after executing an instruction and the output data is written to the memory.

FUNCTIONAL UNITS OF A COMPUTER...

- **ARITHMETIC AND LOGICAL UNIT (ALU)**
  - An arithmetic logic unit (ALU) is a major component of the central processing unit of a computer system.
  - It does all processes related to arithmetic and logic operations that need to be done on instruction words.
  - In some microprocessor architectures, the ALU is divided into the arithmetic unit (AU) and the logic unit (LU).
  - ALUs routinely perform the following operations:
    - **Logical Operations**
      - These include AND, OR, NOT, XOR, NOR, NAND, etc.
    - **Bit-Shifting Operations**
      - This pertains to shifting the positions of the bits by a certain number of places to the right or left, which is considered a multiplication operation.
    - **Arithmetic Operations**
      - This refers to bit addition and subtraction.
      - Although multiplication and division are sometimes used, these operations are more expensive to make.
      - Addition can be used to substitute for multiplication and subtraction for division.

FUNCTIONAL UNITS OF A COMPUTER…

- **CONTROL UNIT (CU)**
  - A control unit (CU) handles all processor control signals.
  - It directs all input and output flow, fetches code for instructions from microprograms and directs other units and models by providing control and timing signals.
  - A CU component is considered the processor brain because it issues orders to just about everything and ensures correct instruction execution.

  - CU functions include the following:
    - Controls sequential instruction execution
    - Interprets instructions Guides data flow through different computer areas
    - Regulates and controls processor timing
    - Sends and receives control signals from other computer devices
    - Handles multiple tasks, such as fetching, decoding, execution handling and storing results

COMPUTER MEMORY

- **PRIMARY MEMORY**
  - Random Access Memory (RAM)
    - It is the place in a computer where the operating system, application programs and the data in current use are kept temporarily so that they can be accessed by the computer's processor.
    - It is said to be 'volatile' since its contents are accessible only as long as the computer is on.
    - The contents of RAM are no more available once the computer is turned off
  - Read Only Memory (ROM)
    - This is a special type of memory which can only be read and contents of which are not
    - lost even when the computer is switched off.
    - It typically contains manufacturer's instructions.
    - Among other things, ROM also stores an initial program called the 'bootstrap loader'.
      - The function is to start the operation of computer system once the power is turned on.

COMPUTER MEMORY…

- **SECONDARY MEMORY**
  - **Unlike the primary memory are less volatile and store data and programs permanently**

  - Hard Disks
    - Hard disks are made up of rigid material and are usually a stack of metal disks sealed in a box.
    - The hard disk and the hard disk drive exist together as a unit and is a permanent part of the computer where data and programs are saved.
    - These disks have storage capacities ranging from 1GB to 80 GB and more. Hard disks are rewritable.
  - Compact Disk (CD)
    - Compact Disk (CD) is portable disk having data storage capacity between 650-700 MB.
    - It can hold large amount of information such as music, full-motion videos, and text etc. CDs can be either read only or read write type.
  - Digital Video Disk (DVD)
    - Digital Video Disk (DVD) is similar to a CD but has larger storage capacity and enormous clarity.
    - Depending upon the disk type it can store several Gigabytes of data.
    - DVDs are primarily used to store music or movies and can be played back on the television or the computer too.
    - These are not rewritable.

PRIMARY AND SECONDARY MEMORY

S/N	PRIMARY MEMORY	SECONDARY MEMORY
1	• Stores programs and data while computer is running for current use.	• Store programs and data for later use
2	• Fast and limited in storage capacity	• Slow and large in storage capacity
3	• Volatile	• Non-volatile
4	• Memory devices used are semiconductor memories	• Memory devices are either magnetic or optical.
5	• Also called main or internal memory	• Also called back-up or external memory
6	• Primary memory devices are connected to the computer using slots	• Secondary memory devices are connected using cables
7	• Communicate directly with the CPU.	• Do not communicate directly with the CPU.
8	• They are more expensive.	• They are less expensive.

INPUT/OUTPUT (I/O) DEVICES

- **INPUT DEVICES**
  - **An input device is any device that provides input to a computer.**
  - **There are many input devices, but the two most common ones are a keyboard and mouse.**
  - **Keyboard**
    - The keyboard is very much like a standard typewriter keyboard with a few additional keys.
    - The basic QWERTY layout of characters is maintained to make it easy to use the system.
    - The additional keys are included to perform certain special functions.
      - These are known as function keys that vary in number from keyboard to keyboard.
  - **Mouse**
    - It is a device that controls the movement of the cursor or pointer on a display screen.
    - A mouse is a small object you can roll along a hard and flat surface.
    - As you move the mouse, the pointer on the display screen moves in the same direction.
  - **Touch Screen**
    - It allows the user to operate/make selections by simply touching the display screen.
    - A display screen that is sensitive to the touch of a finger or stylus.
    - It is widely used on ATM machines, retail point-of-sale terminals, car navigation systems, medical monitors and industrial control panels.
    - A number of laptop computers today support touch-screen functionalities.

INPUT/OUTPUT (I/O) DEVICES…

- **INPUT DEVICES**
  - **Magnetic Ink Character Recognition (MICR)**
    - MICR can identify character printed with a special ink that contains particles of magnetic material.
    - This device particularly finds applications in banking industry.
  - **Optical Mark Recognition (OMR)**
    - Optical mark recognition, also called mark sense reader is a technology where an OMR device senses the presence or absence of a mark, such as pencil mark.
    - OMR is widely used in tests such as aptitude test..
  - **Bar Code (or QR Code) Reader**
    - Bar-code readers are photoelectric scanners that read the bar codes or vertical zebra strips marks (or square blocks in the case of QR codes), printed on product containers.
    - These devices are generally used in super markets, bookshops etc.
  - **Scanner**
    - Scanner is an input device that can read text or illustration printed on paper and translates the information into a form that the computer can use.
    - A scanner works by digitizing an image.

INPUT/OUTPUT (I/O) DEVICES…

- **OUTPUT DEVICES**
  - **Output device receives information from the CPU and presents it to the user in the desired from.**
  - **The processed data, stored in the memory of the computer is sent to the output unit, which then converts it into a form that can be understood by the user.**
  - **The output is usually produced in one of the two ways – on the display device, or on paper (hard copy).**
  - **Monitor**
    - Monitor is an output device that resembles the television screen.
    - It may use a Cathode Ray Tube (CRT). Light Emitting Diodes (LED) or Liquid Crystal Display (LCD) to display information.
    - The monitor is associated with a keyboard for manual input of characters and displays the information as it is keyed in. It also displays the program or application output.
  - **Printer**
    - Printers are used to produce paper (commonly known as hardcopy) output. Based on the technology used, they can be classified as Impact or Non-impact printers.
      - **Impact Printers** - use the typewriting printing mechanism wherein a hammer strikes the paper through a ribbon in order to produce output.
      - **Non-impact Printers** - do not touch the paper while printing. They use chemical, heat or electrical signals to etch the symbols on paper

COMPUTER SOFTWARE

- Computer software is the set of programs that makes the hardware perform a set of tasks in particular order.
- Hardware and software are complimentary to each other.
- Both have to work together to produce meaningful results.
- Computer software is classified into two broad categories; system software and application software.
  - **System Software**
    - System software consists of a group of programs that control the operations of a computer equipment including functions like managing memory, managing peripherals, loading, storing, and is an interface between the application programs and the computer.
    - MS DOS (Microsoft's Disk Operating System), UNIX are examples of system software..
  - **Application Software**
    - Software that can perform a specific task for the user, such as word processing, accounting, budgeting or payroll, fall under the category of application software.
    - Word processors, spreadsheets, database management systems are all examples of general purpose application software.

APPLICATION SOFTWARE

- **Word Processing Software**
  - The main purpose of this software is to produce documents.
- **Database Software**
  - Database is a collection of related data.
  - The purpose of this software is to organize and manage data.
  - The advantage of this software is that you can change the way data is stored and displayed.
- **Spreadsheet Software**
  - The spread sheet software is used to maintain budget, financial statements, grade sheets, and sales records.
  - The purpose of this software is organizing numbers.
  - It also allows the users to perform simple or complex calculations on the numbers entered in rows and columns.
- **Presentation Software**
  - This software is used to display the information in the form of slide show.
  - The functions include editing that allows insertion and formatting of text, including graphics in the text and executing the slide shows.
- **Multimedia Software**
  - This software will allow the user to create audio and videos.

COMPUTER HARDWARE AND SOFTWARE

S/N	COMPUTER HARDWARE	COMPUTER SOFTWARE
1	• Physical components of a computer system. • Devices that are required to store and execute (or run) the software.	• Intangible components of a computer system, which are programs or instructions that enables a user to interact with the computer.
2	• Input, Storage, Processing, Control and Output devices	• System software, Programming software, and Application software
3	• CD-ROM, monitor, printer, video/sound card, scanner, routers, modems, switches, keyboards	• Word processor, Spreadsheet application, WhatsApp, Facebook, Instagram, PDF reader, e-book reader
4	• Serves as the delivery system for software • Infrequently changed	• Perform specific task needed • Generally not needed for hardware to perform basic task
5	• Starts functioning once software is loaded	• Software is installed in order to deliver its set of instructions
6	• Hardware failure is random. • Failure rate increases with use.	• Software failure is systematic • Failure rate does not increase over time.
7	• Wears out over time	• Does not wear out over time. • However, bugs are discovered over time.
8	• Physical (tangible) in nature	• Logical (intangible) in nature

COMPUTER SOFTWARE LANGUAGES

- Computer language or programming language is a coded syntax used by computer programmers to communicate with a computer.

- Computer language establishes a flow of communication between software programs.

- The language enables a computer user to dictate what commands the computer must perform to process data.

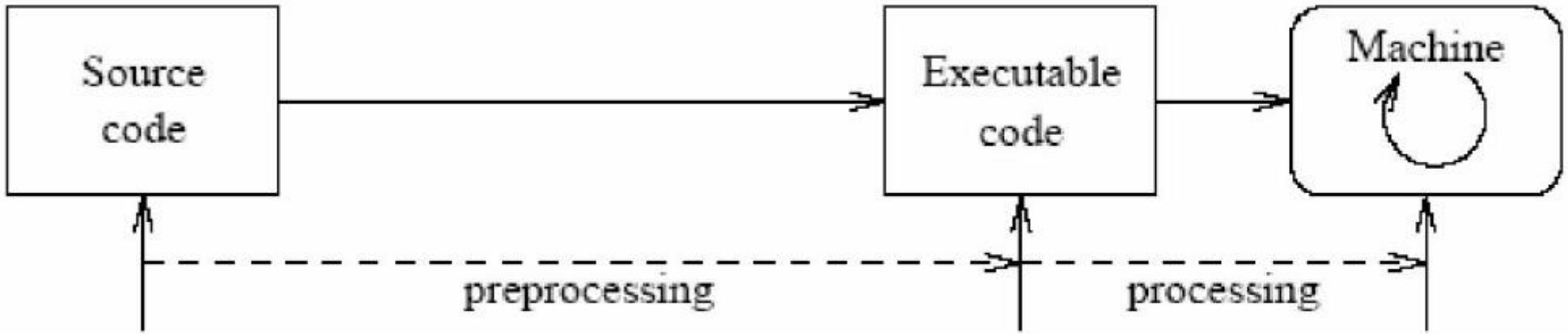
- These languages can be classified into following categories:
  - Machine Language
  - Assembly Language
  - High Level Language

COMPUTER SOFTWARE LANGUAGES...

- **Machine Language**
  - Machine language or machine code is the native language directly understood by the computer's central processing unit or CPU.
  - This type of computer language is not easy to understand, as it only uses a binary system, an element of notations containing only a series of numbers consisting of one and zero, to produce commands.
- **Assembly language**
  - Assembly Level Language is a set of codes that can run directly on the computer's processor.
  - This type of language is most appropriate in writing operating systems and maintaining desktop applications.
  - With the assembly level language, it is easier for a programmer to define commands.
  - It is easier to understand and use as compared to machine language.
- High Level Language
  - High Level Languages are user-friendly languages which are similar to English with vocabulary of words and symbols.
  - These are easier to learn and require less time to write.
  - They are problem oriented rather than 'machine' based.
  - Program written in a high-level language can be translated into many machine languages and therefore can run on any computer for which there exists an appropriate translator.

COMPILERS AND INTERPRETERS

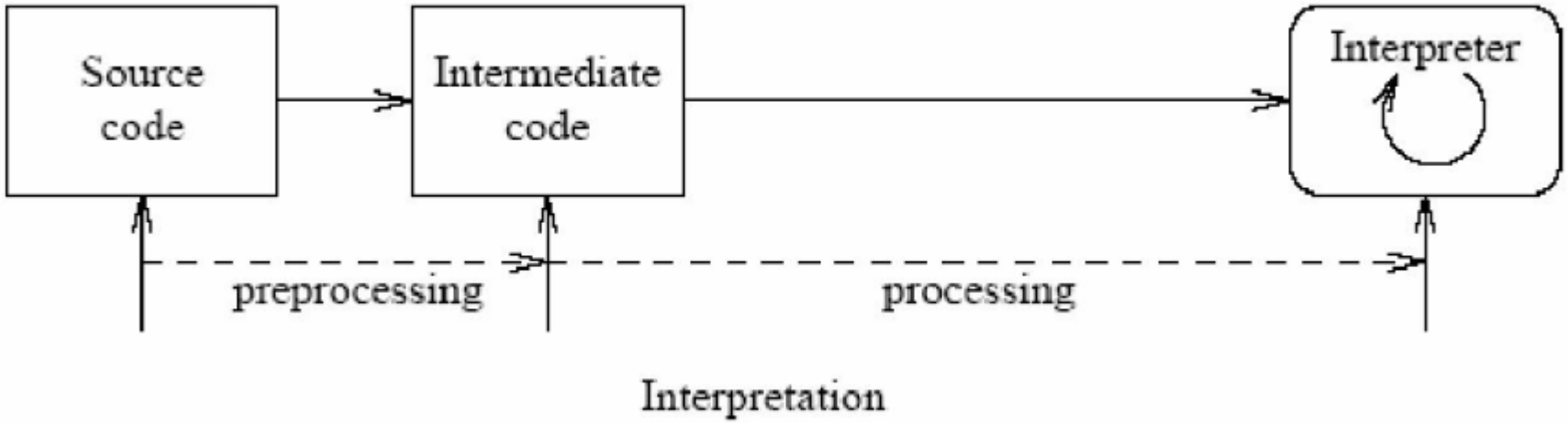
- **Compiler**
  - A compiler is a special program that processes statements written in a particular programming language called as source code and converts them into machine language or "machine code" that a computer's processor uses.
  - Compiler translates high level language programs directly into machine language program.
  - This process is called compilation.



Compilation

COMPILERS AND INTERPRETERS...

- **Interpreter**
  - An interpreter translates high-level instructions into an intermediate form, which it then executes.
  - Compiled programs generally run faster than interpreted programs.
  - The advantage of an interpreter, however, is that it does not need to go through the compilation stage during which machine instructions are generated.
  - This process can be time-consuming if the program is long.



OPEN-SOURCE SOFTWARE

- Open source refers to a program or software in which the source code (the form of the program when a programmer writes a program in a particular programming language) is available to the general public for use and/or modification from its original design free of charge.

- Open source code is typically created as a collaborative effort in which programmers improve upon the code and share the changes within the community.

- The rationale for this movement is that a larger group of programmers not concerned with proprietary ownership or financial gain will produce a more useful and bug-free product for everyone to use.

- The basics behind the Open Source Initiative is that when programmers can read, redistribute and modify the source code for a piece of software, the software evolves.

- Open source sprouted in the technological community as a response to proprietary software owned by corporations.

PROPRIETARY SOFTWARE

- Proprietary software is privately owned and controlled.
- In the computer industry, proprietary is considered the opposite of open.
- A proprietary design or technique is one that is owned by a company.
- It also implies that the company has not divulged specifications that would allow other companies to duplicate the product.