Introduction to Computing

Objectives

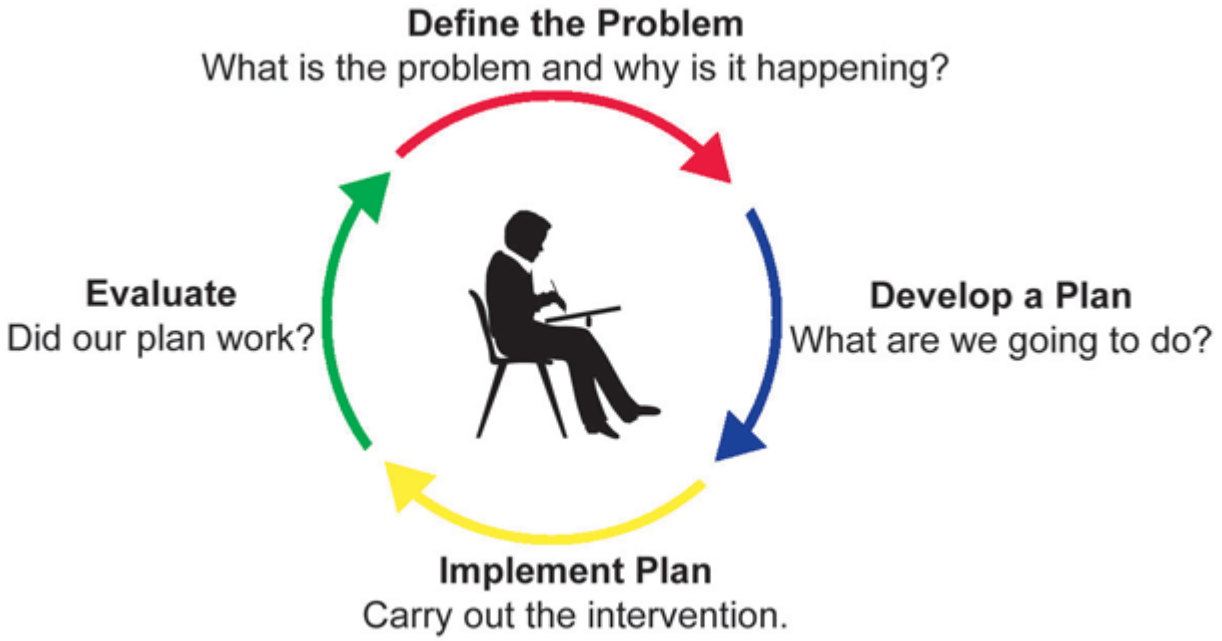
To learn and appreciate the following concepts

- ✓Problem solving basics
- ✓Logic and its importance in problem solving
- ✓Various computational problems and its classification
- ✓Computer Organization and operating system
- ✓Different types of languages
- ✓History of C, Typical C program development environment.

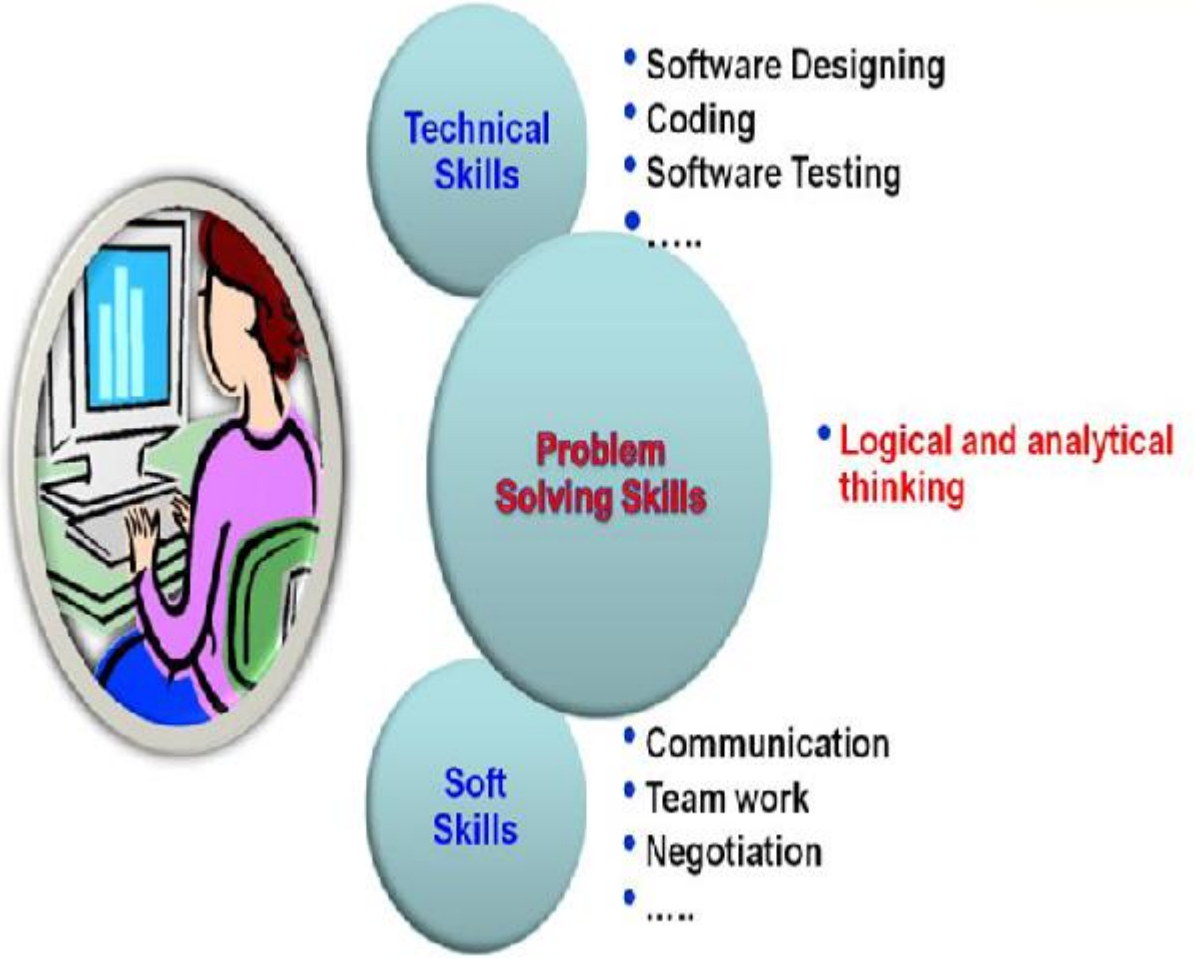
Session outcome

- At the end of session the student will be able to understand
  - Importance of problem solving techniques, Computer organization, Operating system, Types of languages
  - History of C, programming development environment

Introduction to problem solving



Skill set required for Software Engineers



What is a problem?

- A problem is a puzzle that requires logical thought or mathematics to solve
- A puzzle could be a set of questions on a scenario which consists of description of reality and a set of constraints about the scenario
- Eg: Scenario- Infosys Mysore campus has a library. The librarian issues book only to Infosys employees.

Description of reality: There is a library in Infosys Mysore campus . There is a librarian in the library

Constraints: librarian issues book only to Infosys employees.

Questions about the scenario: How many books are there in the library? How many books can be issues to an employee?

Does the librarian issue book to himself? Etc.

Logic

- A method of human thought that involves thinking in a linear, step by step manner about how a problem can be solved
- Logic is a language for reasoning. It is a collection of rules we use when doing reasoning.

Eg: John's mother has four children.

First child is April

Second child is May

Third child is June

What is the name of fourth child?

Importance of logic in problem solving

- Solution for any problem(eg: summation of two numbers) requires three things.

  Input: Input values(Eg: 3 and 2)

  Process: Process of summation

  Output: Output after process (Eg: sum of numbers,5)

- The process part(Eg: summation) of the solution requires logic(How to sum) or in other words based on the logic, process is developed.

Importance of logic in problem solving

- For solving a problem, there may be multiple valid logics, some may be simple and some may be complex.

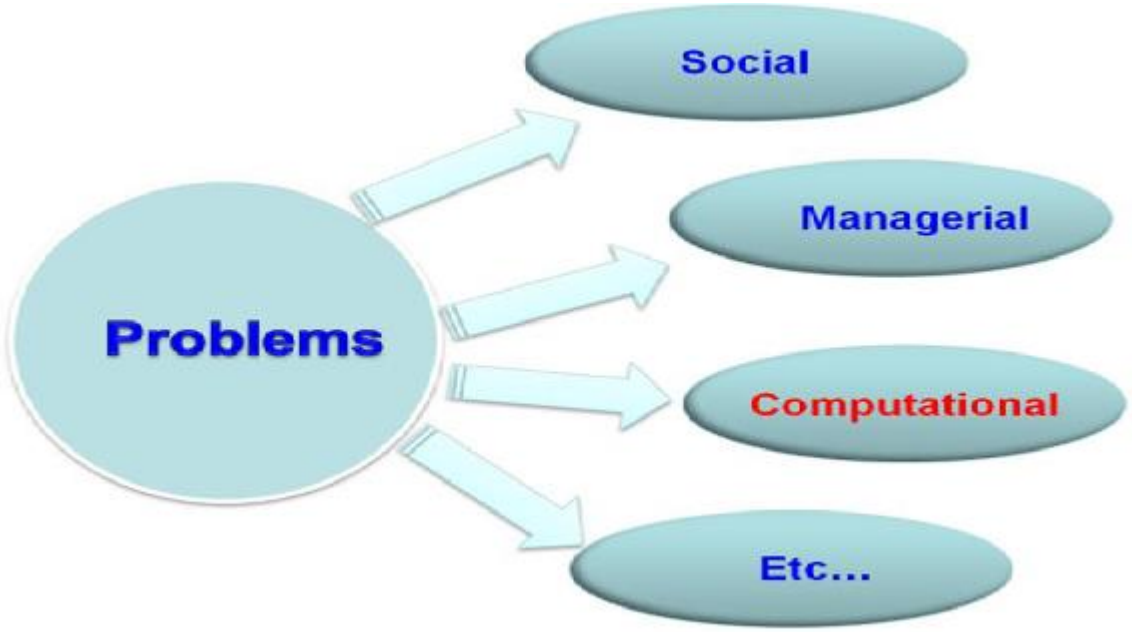
Eg: To determine whether the number is prime or not.

Logic 1- divide the number by all the numbers starting from 2 to one less than the number and if for all the division operations, the reminder is non zero, the number is prime. Else the number is not prime.

Logic 2 – same as logic 1 but divide the number from 2 to number/2

Logic 3 - same as logic 1 but divide the number from 2 to square root of the number

Types of problems

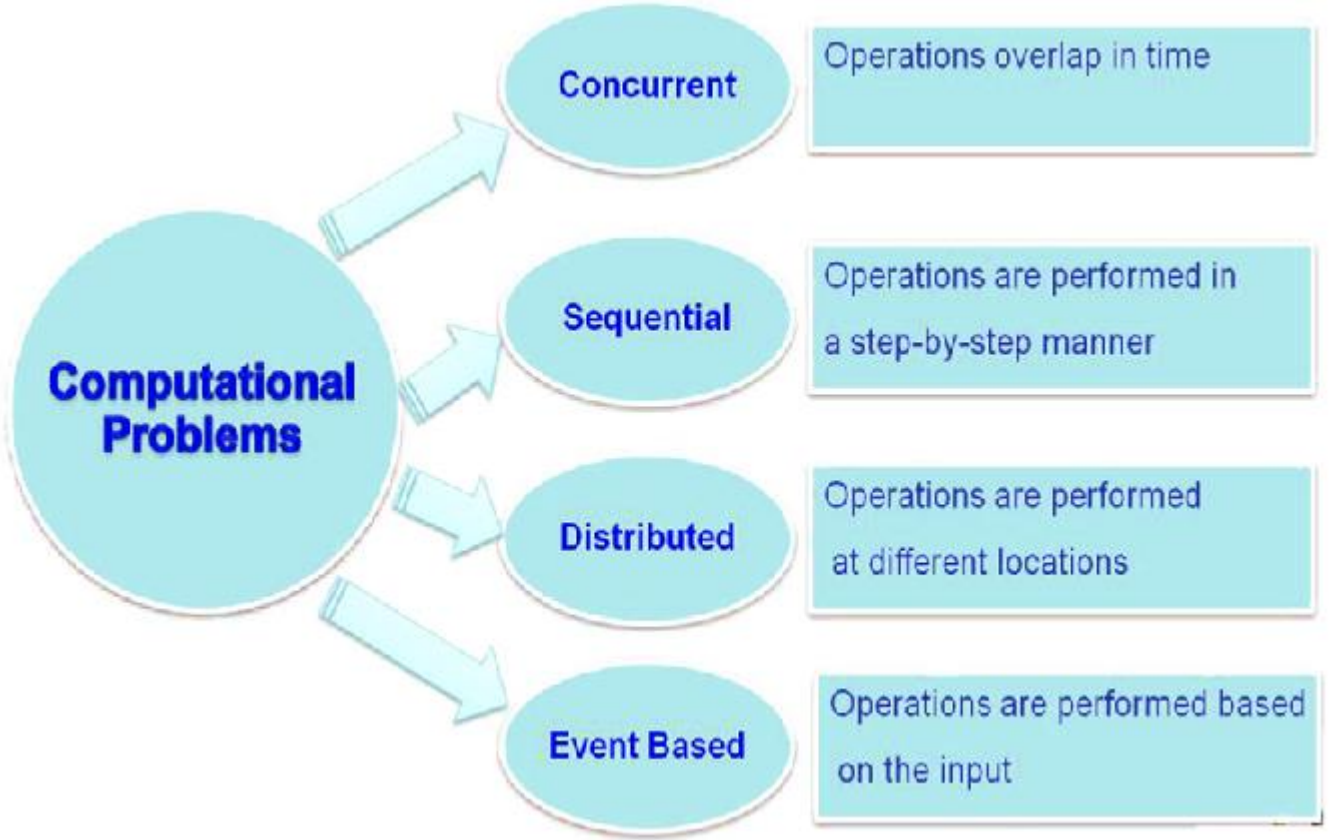


Computational Problems

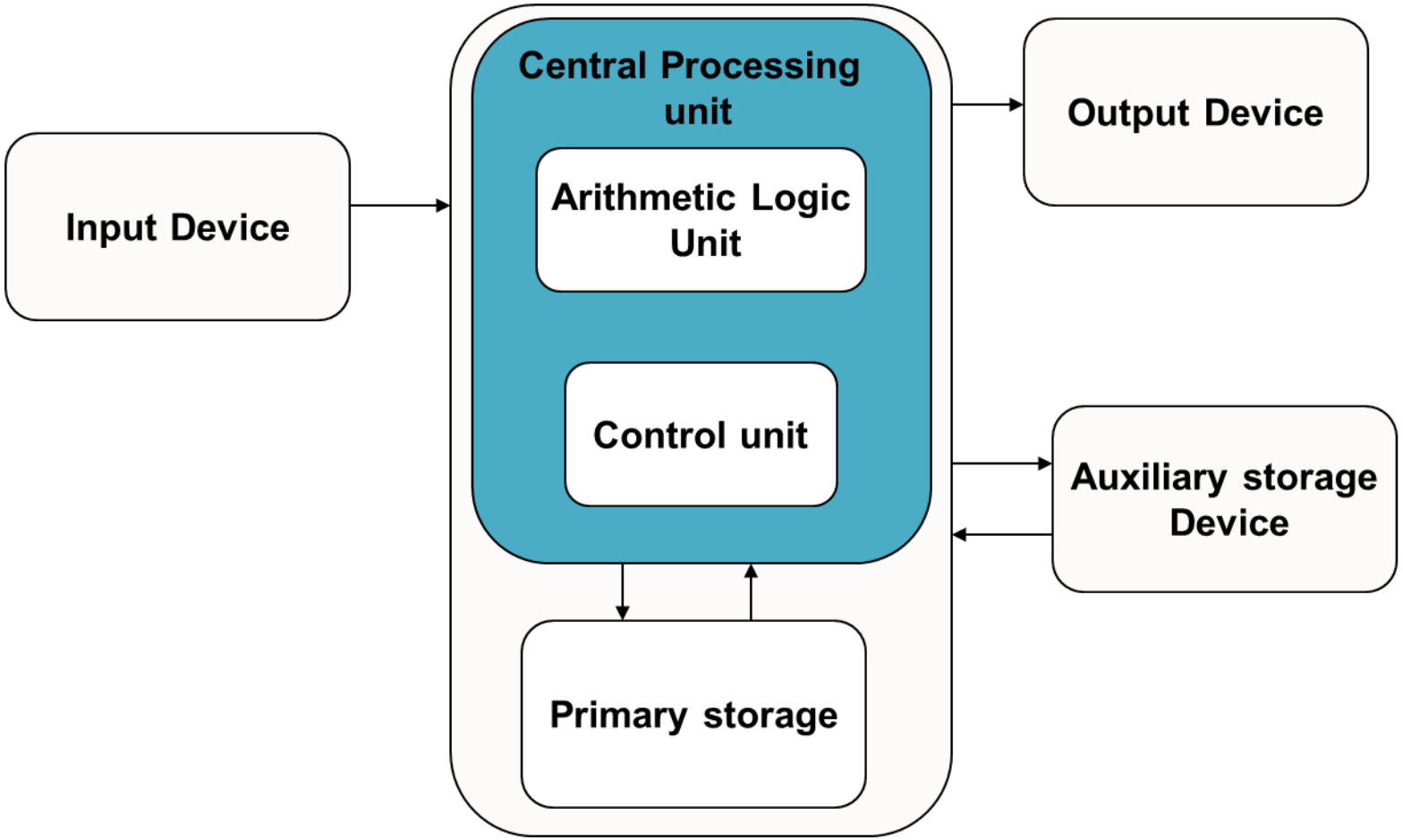
- Definition: Computation is a process of evolution from one state to another in accordance with some rules.

Broad applications of Computational Problem

Classification of computational problems



Computer Organization



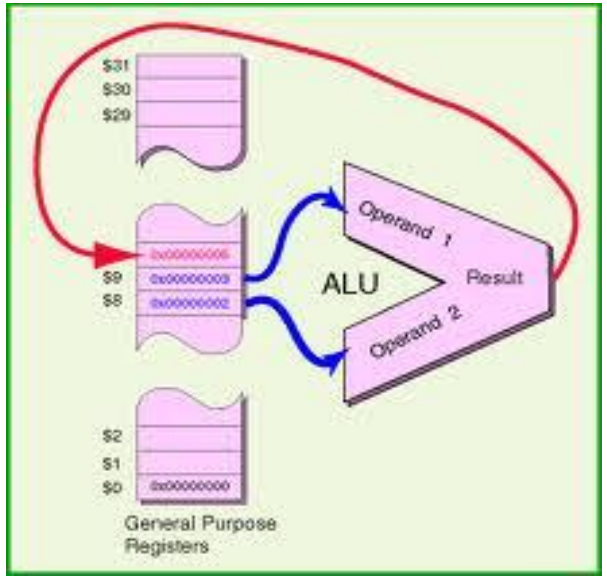
Central Processing Unit

- Data and instructions are processed in CPU

- Consists of two functional units
  - Control Unit (CU)
  - Arithmetic and Logic Unit (ALU)

Arithmetic and Logical unit

- Performs arithmetic and logical operations:
  - Example:
  - arithmetic(+,-,*,/ etc..) and
  - logical (AND, OR, NOT, <,= etc..) operations



Control unit

- Controls the order in which your program instructions are executed.
  - Functions of CU:
  - Fetches data and instructions to main memory
  - Interprets these instructions
  - Controls the transfer of data and instructions to and from main memory
  - Controls input and output devices.
  - Overall supervision of computer system

Memory unit

- Storage device where the data and instructions fed by the user are stored
- An ordered sequence of storage cells, each capable of holding a piece of information
  - Each cell has its own unique address
- The information held can be input data, computed values, or your program instructions.

Address	Contents
00000000	11100011
00000001	10101001
⋮	⋮
11111100	00000000
11111101	11111111
11111110	10101010
11111111	00110011

Memory unit

- The computer memory is measured in terms of **bits, bytes** and **words.**
- A **bit** is a **binary digit** either 0 or 1.
- A **byte** is unit of memory and is defined as sequence of 8 bits.
- The **word** can be defined as a sequence of 16/32/64 bits or 2/4/8 bytes respectively depending on the machine architecture

Computer memory classifications

- Main memory-Primary storage
- Secondary memory-Auxiliary storage
- Cache memory

Main memory

- Memory where the data and instructions, currently being executed are stored
  - Located outside CPU
  - High speed
  - Data and instructions stored get erased when the power goes off
- Also referred as **primary** / **temporary** memory
  - Semiconductor memory
  - Measured in terms of megabytes and gigabytes

Primary storage: RAM & ROM

- RAM stands for Random Access Memory
  - Read and write memory
  - Information typed by the user are stored in this memory
  - Any memory location can be accessed directly without scanning it sequentially (random access memory)
  - During power failure the information stored in it will be erased → volatile memory
- ROM stands for Read Only Memory
  - Permanent memory and non volatile
  - Contents in locations in ROM can not be changed
  - Stores mainly stored program and basic input output system programs

Secondary memory

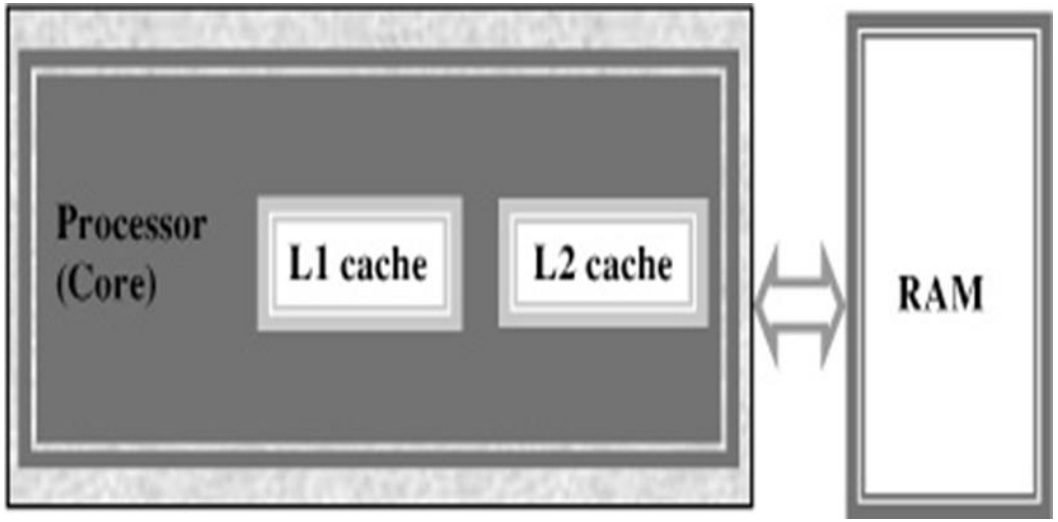
- Main memory is volatile and limited
  - Hence it is essential for other types of storage devices where programs and data can be stored when they are no longer being processed
- Installed within the computer at the factory or added later as needed

Secondary memory

- Non-volatile memory
- Made up of magnetic material
- Stores large amount of information for long time
- Low speed
- Holds programs not currently being executed

Cache memory

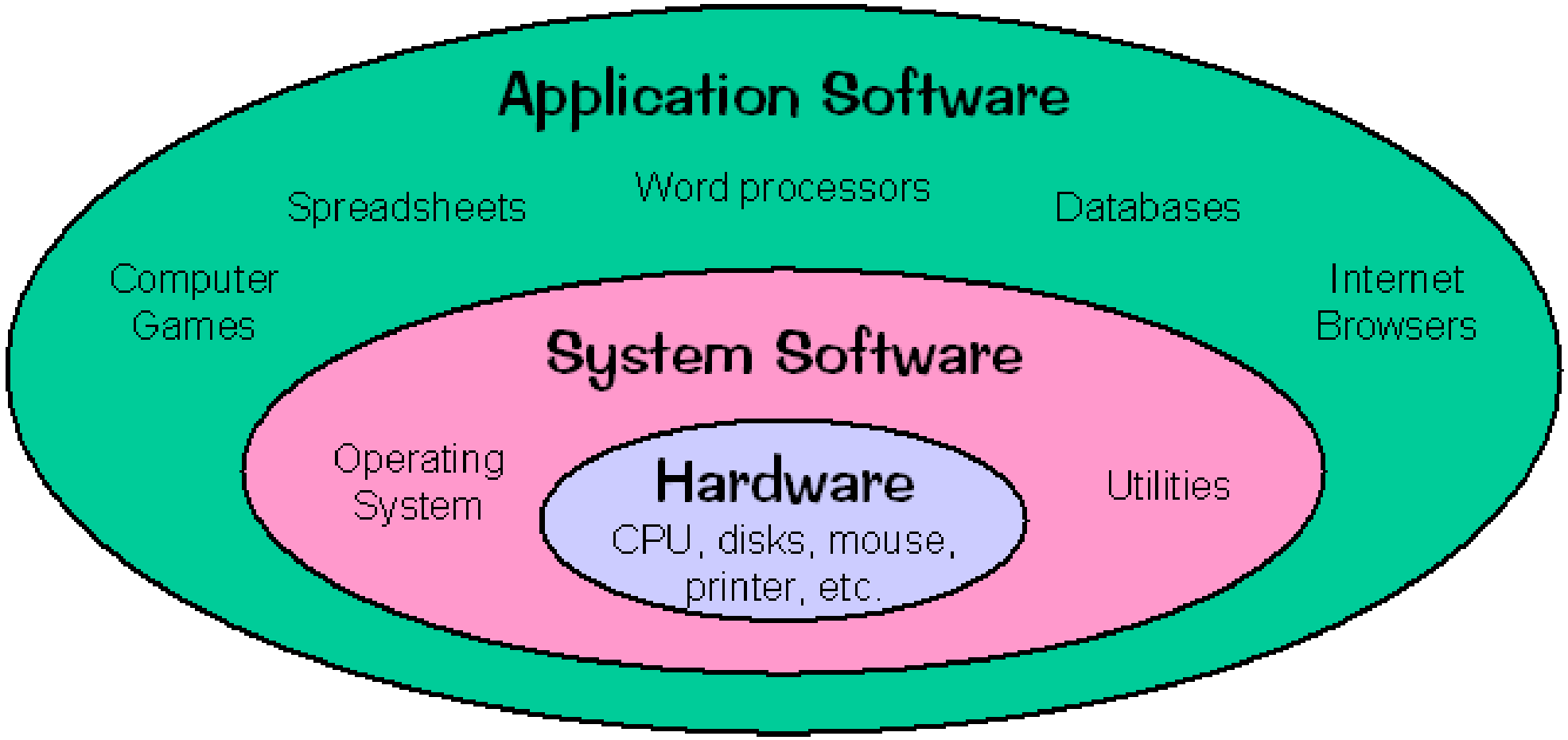
- High speed memory placed between CPU and main memory
- Stores data and instructions currently to be executed
- More costlier but less capacity than main memory
- Users can not access this memory



Operating System

- OS is an integrated collection of programs which make the computer operational and help in executing user programs.
- It acts as an interface between the man and machine.
- It manages the system resources like memory, processors, input-output devices and files.
- Windows, Linux, DOS

Application software, System software & Hardware



Computer Languages

- Machine Language- The only programming language available in earlier days
  - Consists of only 0's and 1's; e.g.:- 10101011
- Symbolic language or Assembly language-
  - symbols or mnemonics are used to represent instructions
  - hardware specific
  - e.g. MASM : ADD X,Y; Add the contents of y to x
- High-level languages- English like language using which the programmer can write programs to solve a problem.
  - more concerned with the problem specification
  - not oriented towards the details of computer
  - e.g.: C, C++, C#, Fortran, BASIC, Pascal etc.

Language Translator

- Compiler : Program that translates entire high level language program into machine language at a time. e.g.:- C, C++ compilers.

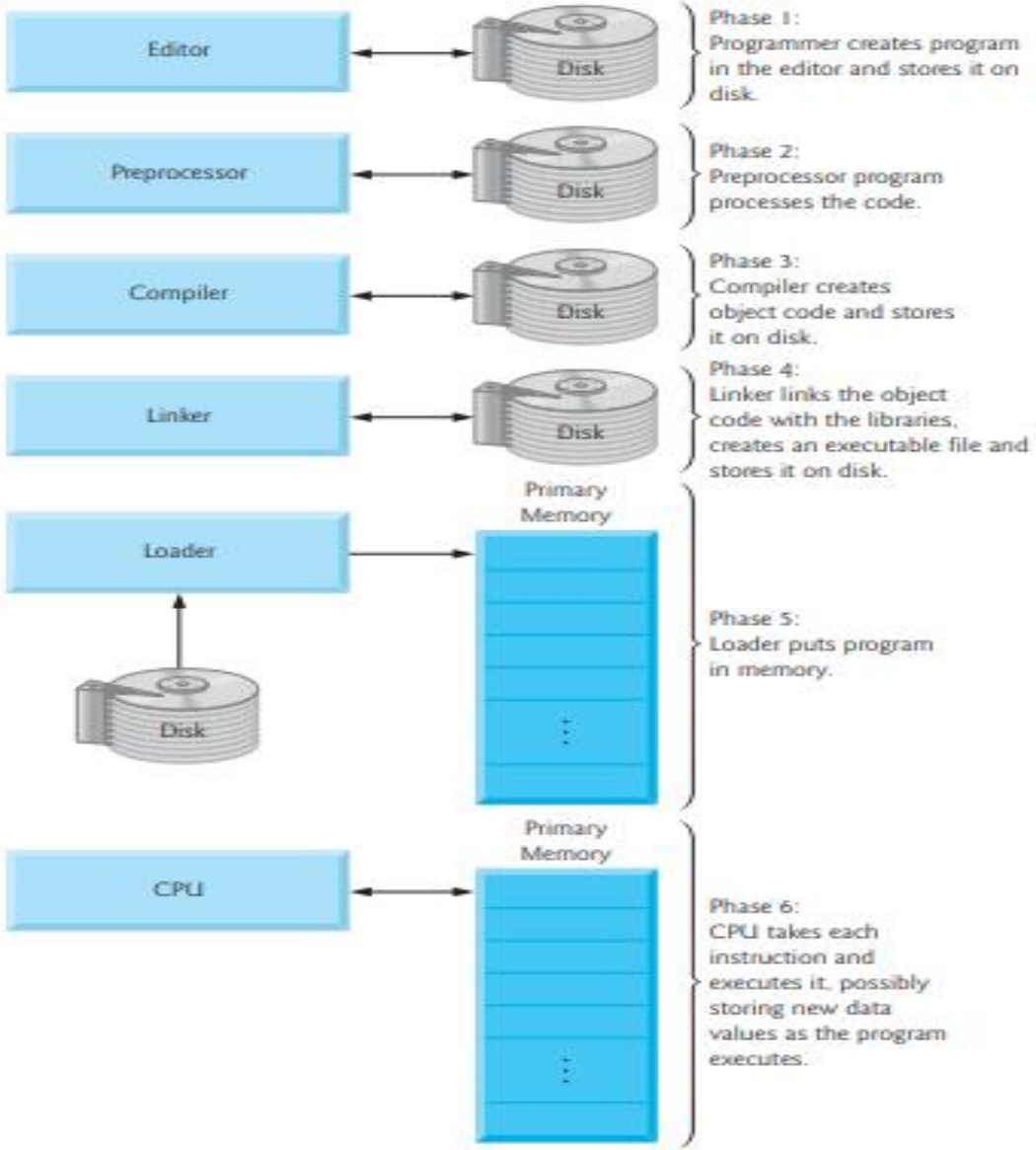
- Interpreter : Program which translates one statement of a high level language program into machine language at a time and executes it.

  e.g.:- Basic Interpreters, Java Interpreters.

- Assembler : Program which translates an assembly language program into machine language.

  e.g.:- TASM(Turbo ASseMbler), MASM(Macro ASseMbler).

Typical C program development environment



Typical C program development environment

- C programs typically go through six phases to be executed. These are: edit, preprocess, compile, link, load and execute
- Phase 1 : creating a program
- Phases 2 and 3: Preprocessing and Compiling a C Program
- Phase 4: Linking
- Phase 5: Loading
- Phase 6: Execution

Summary

- ✓Problem solving
- ✓Logic and its importance in problem solving
- ✓Computational problems and its classifications
- ✓Computer organization and operating system
- ✓Different computer languages
- ✓Typical C program development environment