

**Topic 1: Problem solving**

GOAL: “Become a good Problem Solver”

**Concept:** The process of finding a solution of any problem/complex problem in an efficient and effective way.

- Finding an **effective** solution of a problem.
- Important feature of a scientist (computer scientist, Cyber security Expert)
- Problem solving skill is a learning skill can improve with practice, awareness and hardship.

**Steps involved in problem solving:**

Usually, four steps but can be vary.

**1) Identification of problem:** (Super important step)

- a) Defining the problem: (**Thinking Step**)
  - Foremost and very Important to define and understanding the problem. Define “what, when, how, where, who and why” about the problem.
  - Clarity about problem.
- b) Define goals, output and objectives for solving problem
- c) Find limitations/constraints and dependencies of problem.
- d) Brainstorming.
- e) Sometime also, consult with expert in that area and explore state of the art regarding that problem.

**2) Designing the solution:** (**Thinking Step**)

- Appropriate plan, model or design of the solution.
- It defines the complete flow or steps from start to end to solve the problem.
- Device some algorithm: It gives a ***step-by-step*** model/solution to solve a problem
  - Divide a problem into small steps. Those steps should be:
    - Appropriate
    - Meaningful
    - Concrete
    - Accurate
    - Sequence

- Efficient/Fast
- Scalable
- Finite steps
- Atomic steps
- We can test an algorithm (DRY RUN)
- Helpful in creating/clearing concepts and modules of a complete system

### 3) **Build/implement the solution:**

- Actual implementing the design/plan and creating an actual a working prototype.
- Coding (implementing the solution in a programming language to communicate it with the computer).

### 4) **Test and Debug:**

- **Test:** Finding that our implemented solution meets requirements and goals defined in step 1.
- Testing is very rigorous mechanism and is a complete field (Quality assurance, Tester or **Penetration testing** is used)
- If our solution is not working according to requirements as defined then it is debugged (that is look back and find out where is the actual problem is).
- **Debug:** Debugging is actually removing all mistakes and error from the solution to make it work properly.

### **Topic 2: Algorithm vs Flow-chart**

Flow chart is pictorial representation of solution that represents a flow and plan of solution. A flowchart can also be defined as a diagrammatic representation of an algorithm, a systematic approach to solving a task.

Some examples of algorithms and flow charts.

### **Topic 3: Computer Programs**

**Concept:** Computers can do many different jobs because they are programmable. Moreover, we have to write effective programs for them.

*A program is a set of instructions a computer follows in order to perform a task. A programming language is a special language used to write computer programs.*

*When a program executes, at lower level it changes the electrical impulses and alter the internal states of computer. At higher level, more abstract level*

***computer users accomplish real world problems or tasks to derive actual pleasure.***

For some people computer is a calculator, gaming, fun, entertainment and networking tool. For some people it is research, learning and teaching/study tool.

Computer programs are written in programming languages. These are:

1. Low Level Languages (Machine Language): Target or binary code
  2. Middle level Language: Assemble code
  3. High Level language: Source code
- Assemble code have one to one mapping with Machine code whereas one instruction of high-level language is mapped to more than one instruction of Machine code (or even assembly code)
  - We will C++ as our HLL.

Translators: translate source code to machine or object code

- Interpreter: Line by line translation
- Compiler: Translate whole source code to object code/ Machine code
- Assembler
  - Syntax (Grammar or rules of program)
  - Semantics (meaning or Logic of a program)
  - Syntax error: error of grammar or syntax can be detected by translator
  - Semantic error: Error of logic cannot be detected by translator
    - Debugging
  - Interpreted vs Compiled languages
  - General purpose vs Special purpose languages