

UNIT – 1

Problem solving with computer (Part I)

C PROGRAMMING (CSC115)
BSC CSIT FIRST SEMESTER (TU)

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Problem Solving with Computer

- There are a number of problems to be solved.
 - **Problem** – A problem is a task or question that needs a solution.
 - Problem solving is **finding a way to overcome a challenge or accomplish a task** efficiently.
- **How to solve these problems?**
 - **Write a program in computer.**
- **Problem Solving with Computer** – Implementing the solution in the form of a **program** that the computer can execute.

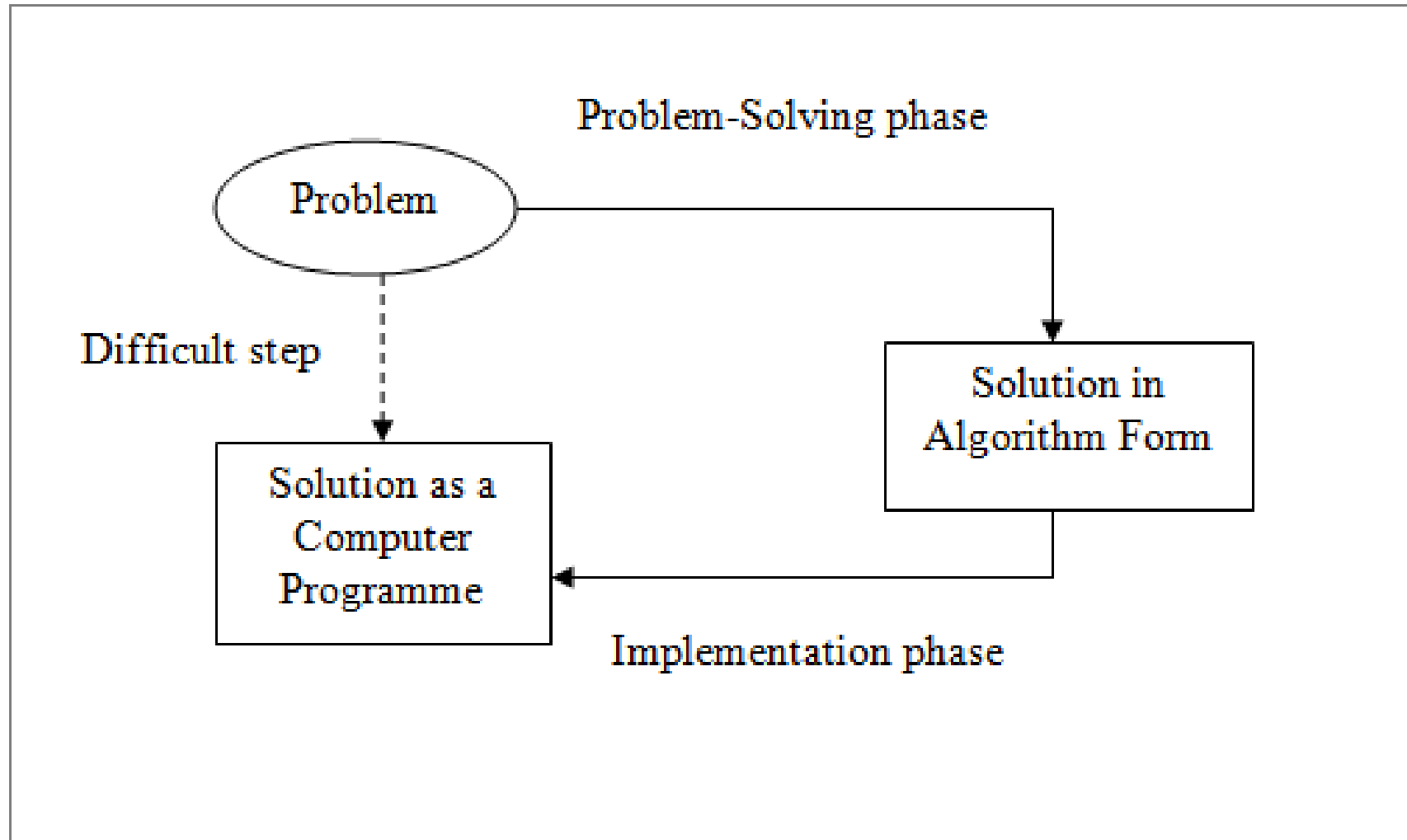
Why Problem Solving?

- Problem solving is **the heart of programming**, as it guides how a program is designed, coded, and executed effectively.
- **Importance of Problem Solving:**
 - **Foundation of Programming:** Programming is essentially about solving problems using a computer. Without problem-solving skills, writing effective programs is impossible.
 - **Efficient Solutions:** Good problem-solving helps create programs that are correct, efficient, and optimized, saving time and resources.
 - **Logical Thinking Development:** It enhances analytical and logical thinking, which is essential for designing algorithms and debugging code.
 - **Error Reduction:** Careful problem analysis and planning reduce errors and bugs in programs.
 - **Application in Real Life:** Problem-solving skills allow programmers to tackle real-world challenges, like managing data, automating tasks, or developing software applications.

Problem Solving with Computer

- **Problem Solving with Computers** can be defined in three points:
 1. **Understanding the Problem** – Analyze the problem clearly to know the inputs, outputs, and requirements.
 2. **Designing a Solution** – Plan a step-by-step method (algorithm) to solve the problem efficiently.
 3. **Implementing and Testing** – Convert the solution into a program using a programming language and verify that it works correctly.

Problem Solving with Computer



Sorting Problem

Input : A sequence of n numbers $\{a_1, a_2, \dots, a_n\}$.

Output : A permutation $\{a'_1, a'_2, \dots, a'_n\}$ of input sequence such that $a'_1 \leq a'_2 \leq \dots \leq a'_n$.

e.g.,

Input : 5, 2, 4, 6, 1, 3.

Output : 1, 2, 3, 4, 5, 6.

Steps in Solving Problem with Computer

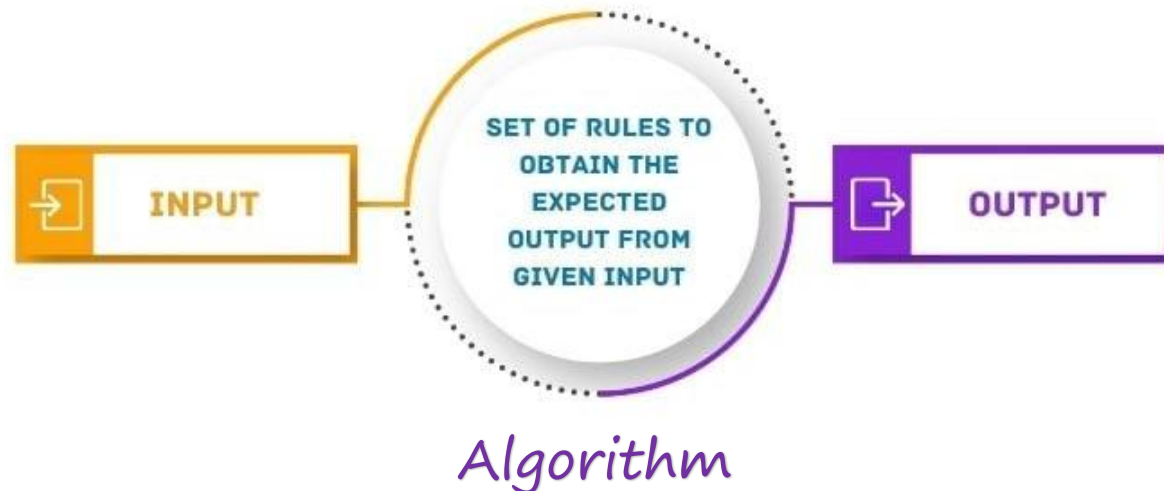
- There are a no. of steps while solving a problem using computer. They are:
 - 1) Problem Analysis
 - 2) Algorithm Development
 - 3) Flowcharting
 - 4) Coding
 - 5) Compilation & Execution
 - 6) Debugging & Testing
 - 7) Documentation

1. Problem Analysis

- **Problem Analysis** is the process of carefully understanding a problem to identify its inputs, outputs, constraints, and requirements before attempting to solve it.
- **Example**
- **Problem:** Find the largest of three numbers.
- **Problem Analysis:** Identify inputs (three numbers), process (compare numbers), and output (largest number).

2. Algorithm Development

- Algorithm development is **planning a precise and logical sequence of steps to solve a problem** before writing a program.
- An **algorithm** is a **finite sequence of well-defined instructions** designed to solve a computational problem.
- It takes some input, processes it using a set of rules, and produces an output.
- Algorithms are independent of any programming language



Characteristics of Algorithms

- **Finiteness**

- The algorithm must **terminate after a finite number of steps**.
- It should not go into an infinite loop.
- *Example:* A sorting algorithm must stop once all elements are ordered.

- **Definiteness**

- Each step of the algorithm must be **clear, unambiguous, and well-defined**.
- There should be no confusion about what each instruction means.
- *Example:* “Add 1 to X” is clear; “Increase X” could be ambiguous.

- **Input**

- An algorithm should have zero or more inputs, which are provided before execution begins.
- *Example:* A search algorithm takes a list and a key as input.

- **Output**

- An algorithm should produce at least one output (the result).
- *Example:* A sorting algorithm outputs the sorted list.

- **Effectiveness**

- Each step of the algorithm should be simple enough to be carried out exactly and within a reasonable time.
- It should not require infinite resources or abstract operations that can't be implemented.

- **Generality**

- The algorithm should be applicable to a broad set of problems of a particular type, not just one specific case.
- *Example:* Binary Search works for any sorted list, not just one list.

- **Efficiency**

- A good algorithm should make optimal use of time and memory resources.

- **Correctness**

- The algorithm must produce the correct output for all valid inputs.

Control Structures of an Algorithm

- Control structures **define the flow of an algorithm**—whether steps are done sequentially, conditionally, or repeatedly.
- There are three main types of control structures:
 1. **Sequence (Process)**
 - Sequence refers to the execution of instructions **one after another in a fixed order**.
 - Every algorithm starts with a sequence of steps such as input, processing, and output.
 - *Example:* Reading data, performing calculations, and displaying results.
 2. **Decision (Selection)**
 - Decision allows an algorithm to choose between alternative paths based on a condition.
 - Example: if, if–else, switch statements to compare values and take actions.
 3. **Repetition (Iteration)**
 - Repetition enables a set of instructions to be **executed repeatedly** until a condition is met.
 - *Example:* for, while, and do–while loops for repeated tasks.

Problem 1: Write an algorithm for finding the sum of any two numbers

Algorithm

Step 1: Start

Step 2: Display “Enter two numbers”

Step 3: Read A and B

Step 4: $C = A + B$

Step 5: Display “C as sum of two numbers”

Step 6: Stop

Problem 2: Write an algorithm for calculating the simple interest using formula $SI = (P * T * R) / 100$.

Algorithm

Step 1: Start

Step 2: Display “Enter values of P, T and R”

Step 3: Read P, T and R

Step 4: Calculate $SI = (P * T * R) / 100$

Step 5: Display SI as simple interest

Step 6: Stop.

Problem 3: Write an algorithm to determine whether a number is positive or negative.

Algorithm

Step 1: Start

Step 2: Print “Enter a no. that is to be tested for positive or negative”

Step 3: Read NUM from keyboard

Step 4: If $\text{NUM} < 0$, then display message “The number is Negative”
otherwise display message “The number is Positive”

Step 5: Stop.

Problem 4: Write an algorithm to test whether a number is even or odd.

Algorithm

Step 1: Start

Step 2: Display “Enter a number that is to be tested for even or odd”

Step 3: Read NUM from user

Step 4: Calculate $REM = NUM \text{ MOD } 2$

Step 5: If $REM = 0$, then print “The number is even”
 else print “The number is odd”

Step 6: Stop

Problem 5: Write an algorithm to find the largest number among three numbers.

Algorithm

Step 1: Start

Step 2: Display “Enter three numbers”

Step 3: Read A, B and C

Step 4: If $A \geq B$ and $A \geq C$, then print “A is greatest”

Step 5: If $B \geq A$ and $B \geq C$, then print “B is greatest”
 else print “C is greatest”

Step 6: Stop

Problem 6: Write an algorithm to read N numbers from user and display the sum of all entered numbers.

Algorithm

Step 1: Start

Step 2: Print "How many numbers?"

Step 3: Read N

Step 4: Initialize SUM=0 and COUNTER=1

Step 5: Print "Enter a number"

Step 6: Read NUM

Step 7: SUM = SUM+NUM

Step 8: COUNTER = COUNTER + 1

Step 9: If COUNTER <= N, then goto Step 5

Step 10: Print SUM

Step 11: Stop

Problem 7: Write an algorithm for finding the sum of the series $1+2+3+\dots$ upto N terms.

Algorithm

Step 1: Start

Step 2: Print “Enter the value of N”

Step 3: Read N

Step 4: Initialize $SUM=0$ and $COUNTER=1$

Step 5: $SUM = SUM + COUNTER$

Step 6: $COUNTER = COUNTER + 1$

Step 7: If $COUNTER \leq N$, then goto Step 5

Step 8: Print SUM

Step 9: Stop

Problem 8: Write an algorithm for finding the factorial of a given number.

Algorithm

Step 1: Start

Step 2: Print “Enter a number”

Step 3: Read NUM

Step 4: Initialize variables FACT=1 and COUNTER=1

Step 5: while COUNTER ≤ NUM

 FACT=FACT*COUNTER

 COUNTER=COUNTER+1

End of while





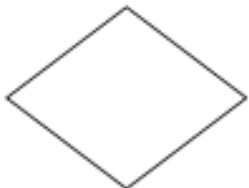

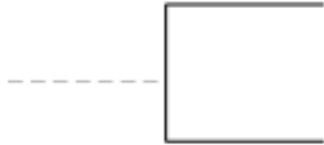
Step 6: Print FACT as factorial of the number NUM

Step 7: Stop

3) Flowchart

- Flowchart is the graphical representation of an algorithm using standard symbols.
- Programmers often use it as a program-planning tool to solve a problem.
- It makes use of symbols which are connected among them to indicate the flow of information and processing.

Standard Symbols used in Flowcharts

Flowchart Symbol	Symbol Name	Description
	Terminal (Start or Stop)	Terminals (Oval shapes) are used to represent start and stop of the flowchart.
	Flow Lines or Arrow	Flow lines are used to connect symbols used in flowchart and indicate direction of flow.
	Input / Output	Parallelograms are used to read input data and output or display information
	Process	Rectangles are generally used to represent process. For example, Arithmetic operations, Data movement etc.
	Decision	Diamond shapes are generally used to check any condition or take decision for which there are two answers, they are, yes (true) or no (false).
	Connector	It is used connect or join flow lines.
	Annotation	It is used to provide additional information about another flowchart symbol in the form of comments or remarks.

Advantages of Flowcharts

- **Communication:** They quickly and clearly provide logic, ideas and descriptions of algorithms to other programmers, students, and users.
- **Effective Analysis:** Flowcharts provide a clear overview of the entire problem and its algorithm for solution. With the help of flowcharts, problems can be analyzed more effectively.
- **Proper Documentation:** The flowchart provides a permanent recording of program logic.
- **Efficient Coding:** A programmer can code the programming instructions in a computer language with more ease with a comprehensive flowchart.

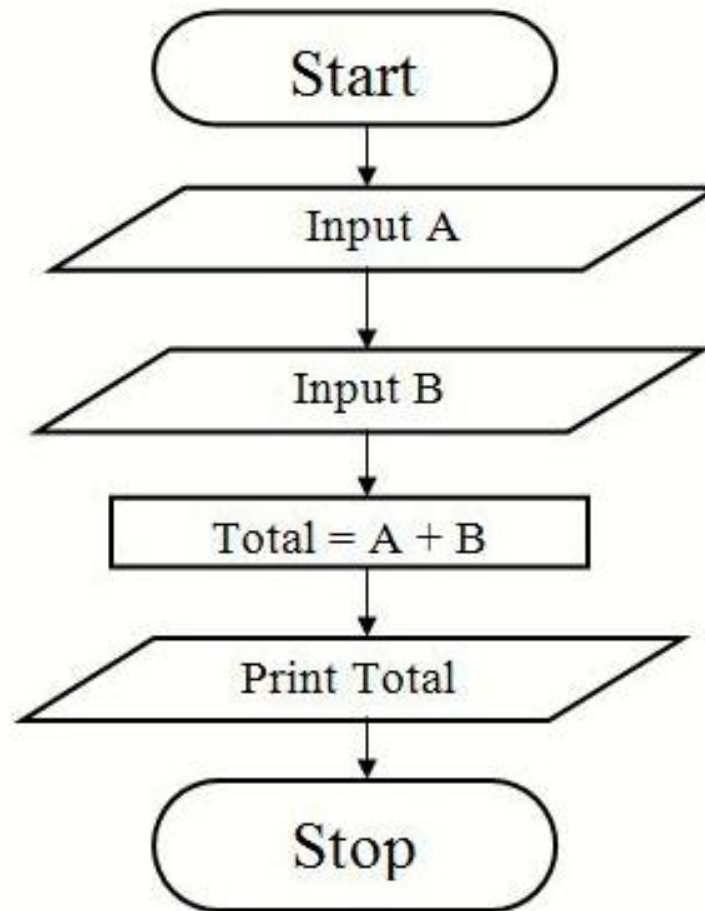
Limitations of Flowchart

- **Complex Logic:** A flowchart becomes complex and clumsy when the program logic is quite complicated.
- **Difficulty in alteration and modifications:** If alterations are required; the flowchart may need to be redrawn completely.

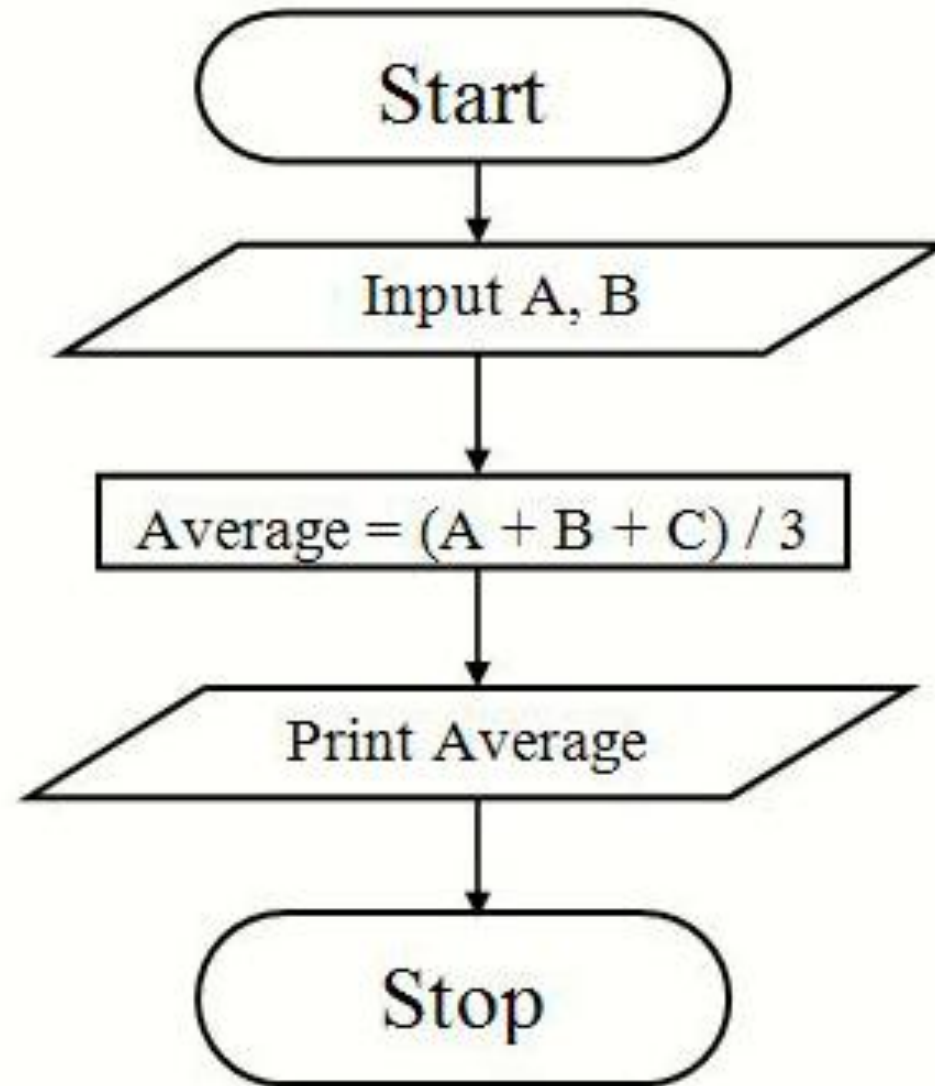
Guidelines in Flowcharting

- Only standard flowchart symbols are to be used.
- There should be Start and Stop to the flowchart.
- Only one flow line is used in conjunction with a Start and Stop symbol.
- Only one flow line should emerge from a process symbol.
- Only one flow line should enter a decision symbol but two flow lines, one for each possible answer, can leave the decision symbol.
- The contents of each symbol should be written legibly. English should be used in flowcharts, not specific programming language.
- If the flowchart becomes complex, connector symbols should be used to reduce the number of flow lines.

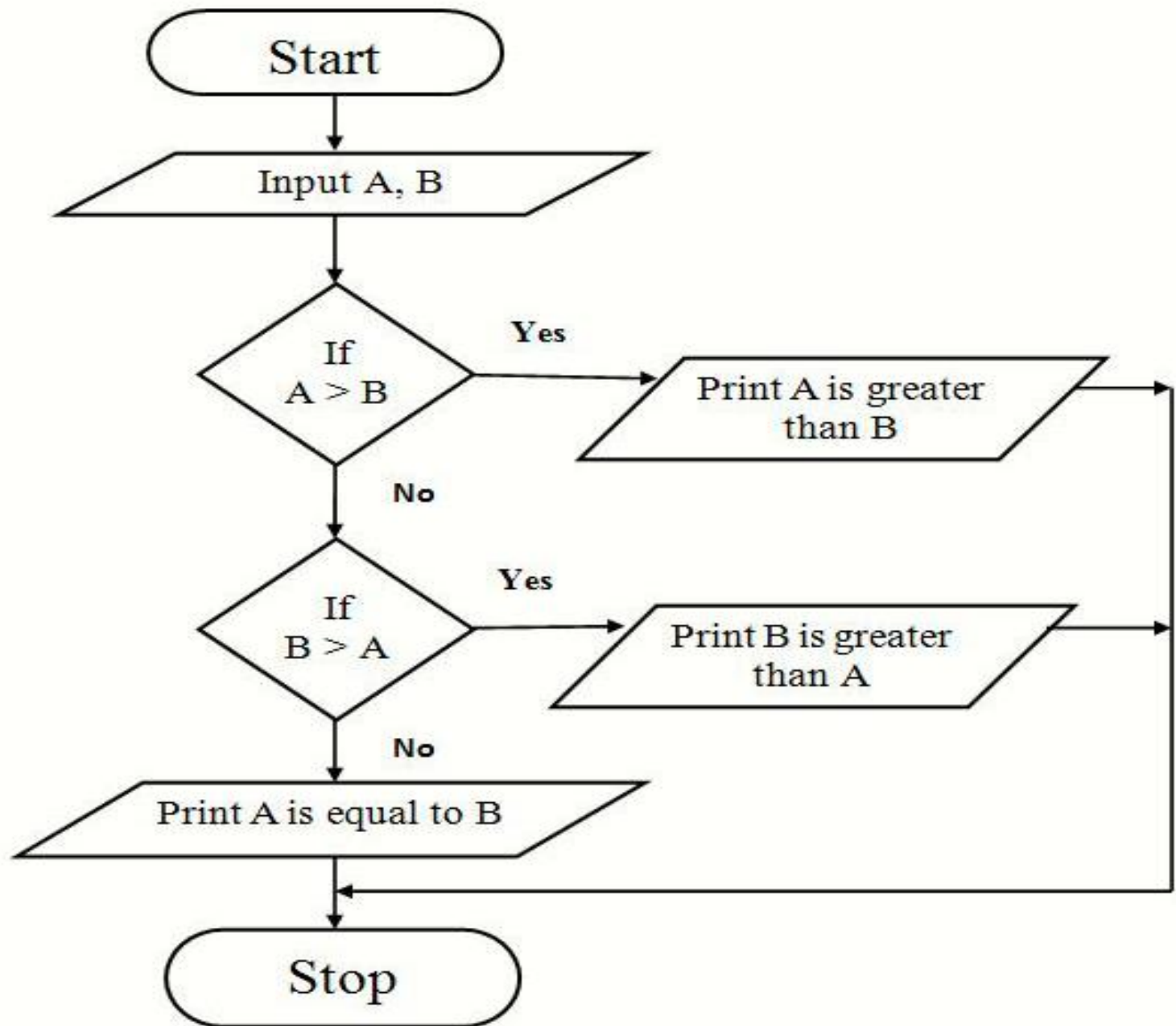
Flow chart to add two numbers.



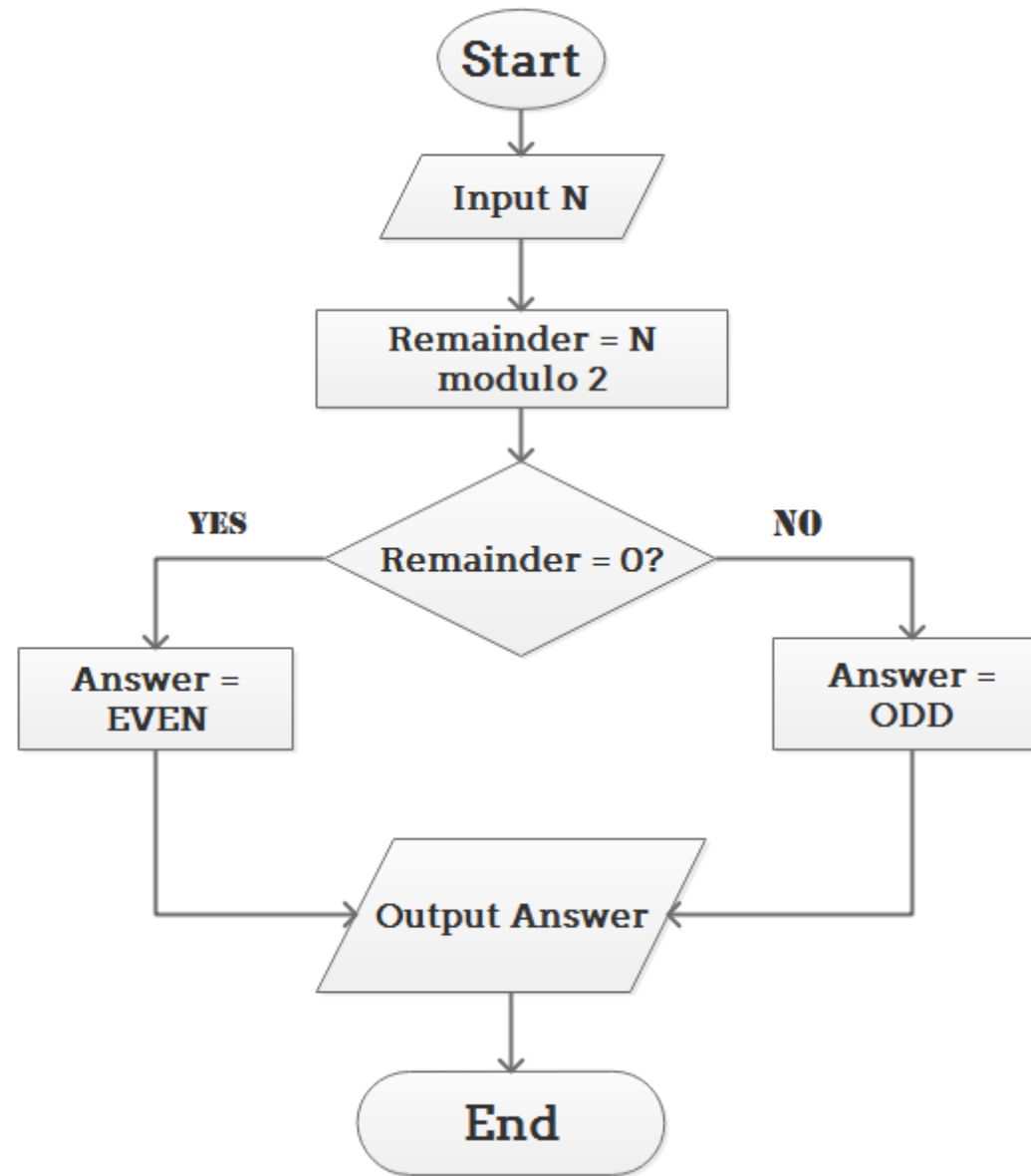
Flowchart to find Average of 3 numbers



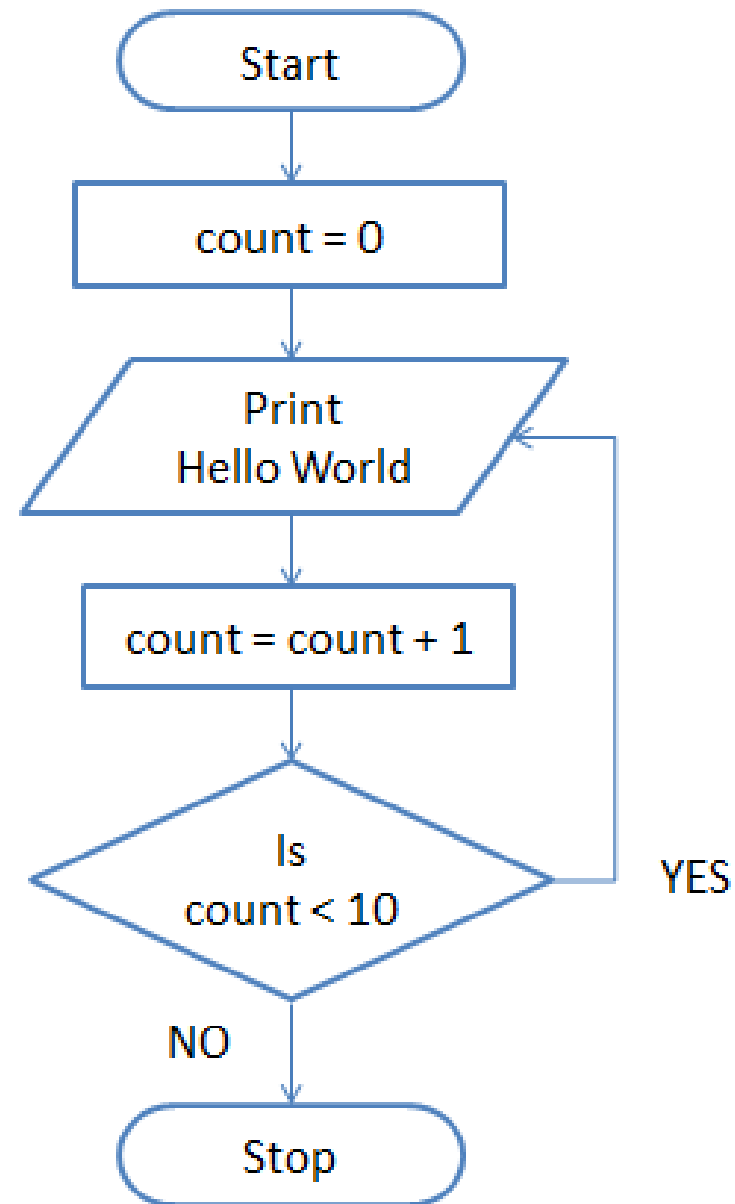
Flow chart to find the larger of two numbers.



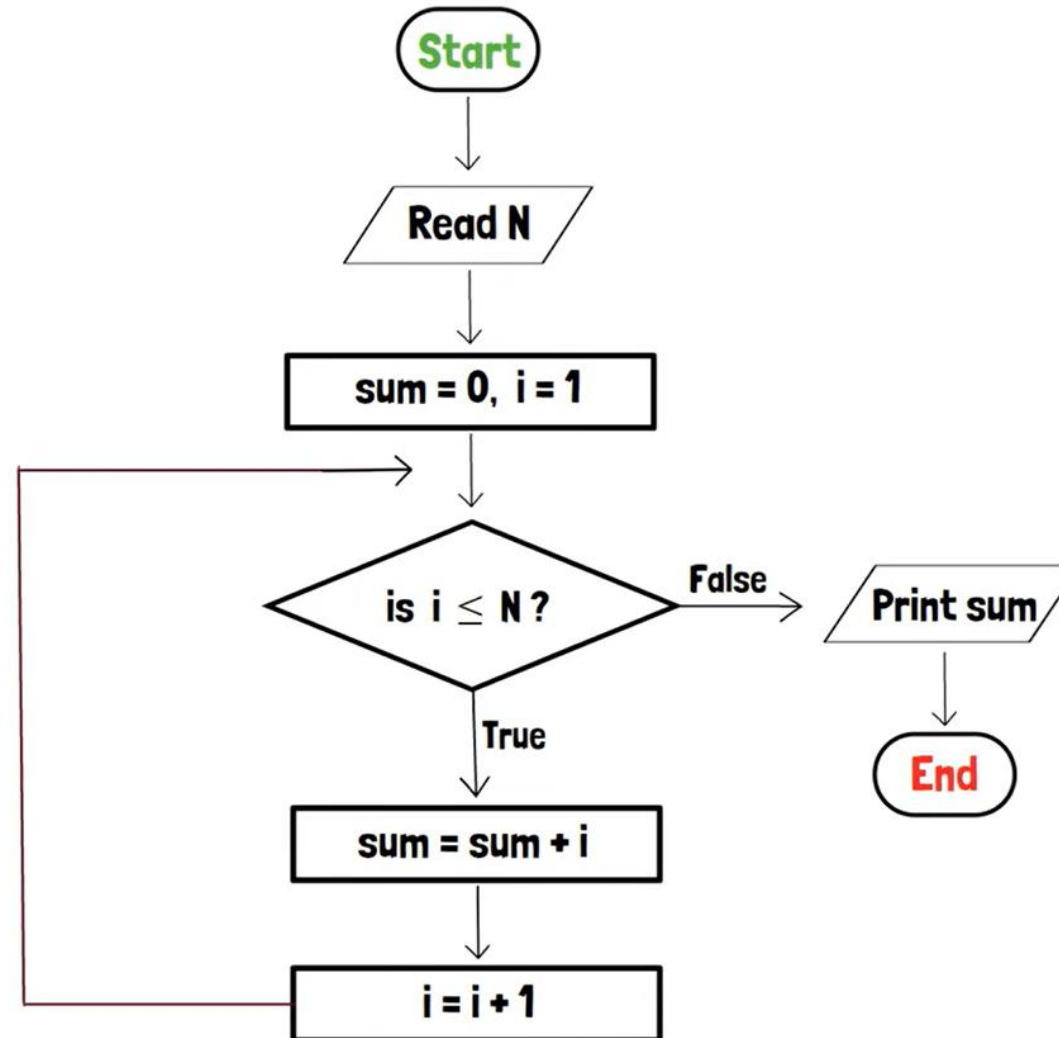
Flowchart to
check input
number is odd
or even.



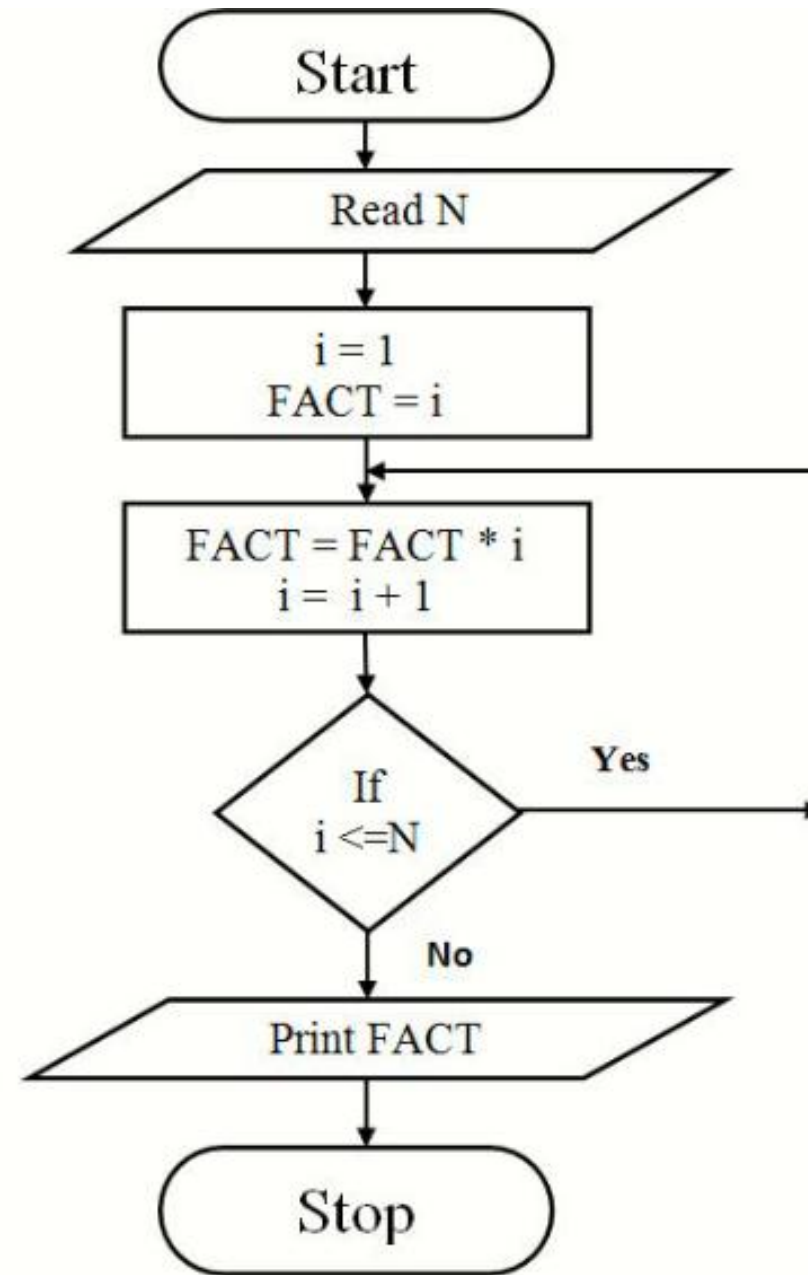
Flowchart to print Hello World 10 times



Flow chart of sum of first N natural numbers



Flow Chart to Find Factorial of a number



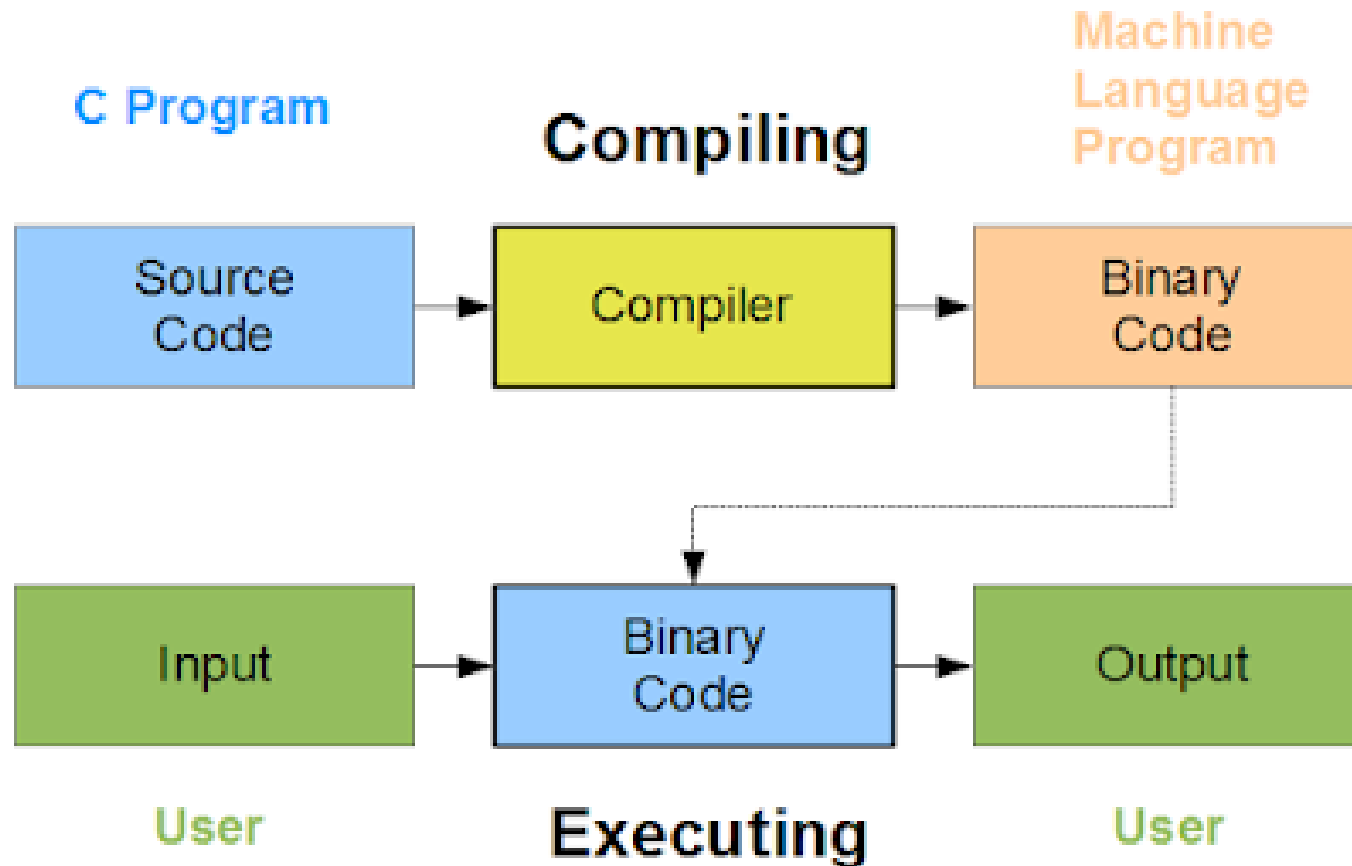
4. Coding

- Coding is the act of transforming steps in the algorithm in terms of the statement of the programming language.
- Coding is done using a programming language such as C, C++, Java, Python etc.
- It follow syntax rules the programming language.
- The code developed using a programming language is also called source code.
- Coding must eliminate all syntax and logical errors.
- It uses meaningful variable names.
- It adds comments for clarity.

5. Compilation and Execution

- Compilation is the process of translating **high level language into machine level language**.
- It is done by special software, known as **compiler**.
- During compilation, the compiler also checks for **syntax errors**. If there are syntax errors, compiler cannot compile the code.
- After successful compilation, the output is usually an **executable file** (like .exe on Windows).
- **Execution** is the process of **running a program** on a computer so that it performs the tasks written in the code and produces results.
- During execution, the program may ask for user inputs and generates outputs after processing the inputs.

Compilation and Execution



6. Debugging & Testing

- Debugging is the process of identifying, locating, and correcting errors (bugs) in a program.
- Types of Errors:
 - **Syntax errors:** Violations of language rules
 - **Runtime errors:** Errors during execution (e.g., division by zero)
 - **Logical errors:** Program runs but gives wrong output
- Testing is the process of executing a program with different inputs to verify that it produces the expected output.
 - Ensures correctness, reliability, and performance

7. Documentation

- Documentation is the written description of a program that explains how it works, how to use it, and how to maintain it.
- **Types of Documentation:**
 - **Internal Documentation:** Comments written **inside the code** to explain specific lines or sections.
 - **External Documentation:** Separate **manuals or guides** describing program functionality, design, inputs, outputs, and usage.
- **Benefits:**
 - **Aids Maintenance:** Helps programmers **update, modify, or debug** the program easily.
 - **Improves Understanding:** Makes it easier for **other programmers** or future users to understand the code.
 - **Reduces Errors:** Proper documentation minimizes **mistakes** when changes are made to the program.

Assignment #1

Write algorithms and Flowcharts for the following problems:

1. To convert temperature from Celsius to Fahrenheit [$F = (9.0/5.0 \times C) + 32$]
2. To find the smallest of two numbers
3. To display Even numbers between 1 to 50
4. Linear Search
5. Bubble Sort

*Thank
you!*