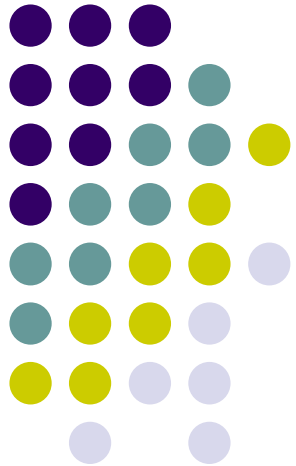
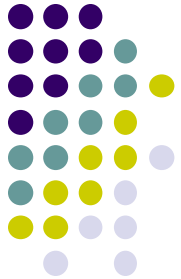
WIX1002
Fundamentals of Programming

Chapter 1

Problem Solving in Programming





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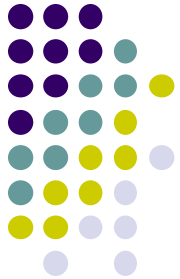
Introduction

- A computer can be define as an electronic machine, operating under the **control of instructions** stored in its own memory, that can accept data, manipulate that data and produce results that can be stored for future use.
- These set of instructions is called **program**.
- A program contains a large number of operations and a computer must be programmed to perform different tasks.
- A programming language can be divided into **machine language, assembly language and high level language**.

Introduction

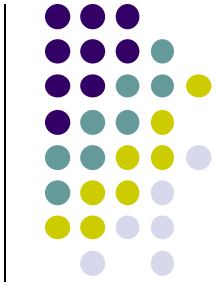
- **Machine Language**
  - It is the natural language of a particular computer.
  - It is defined by the hardware design of the computer.
  - It consist of strings of number (**0 and 1**) that construct computers to perform their operations.
  - It is **machine dependent**, particular machine language can be used only for one type of computer.
  - It is cumbersome for humans.

Introduction



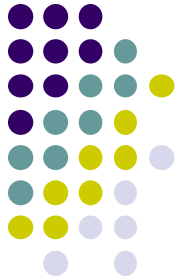
- **Assembly Language**
  - It is the English-like abbreviations languages.
  - Translator programs called **assemblers** were developed to convert assembly language programs to machine language at computer speeds.
  - It is more clearer and more easier to understand as compare to machine language.
  - However, it requires **many statements** in order to perform a simple tasks.
  - Example, **MOV AL, 88h**

Introduction



- **High Level Language**
  - It is developed to speed the programming process.
  - It was developed in which single statements could be written to accomplish substantial tasks.
  - **Compiler** is used to convert high level language programs into machine language.
  - High level languages allow programmers to write instructions that look almost like everyday English and contain commonly used mathematical notations.
  - Java is one of the High Level language.

Java



- Java is an **Object-Oriented Programming** language.
- In **OOP**, all the things around us is made up of **objects,** such as people, buildings, vehicles, and etc. Each of the object will has the ability to perform certain **actions** and these actions will has some effect on some other objects in the world. Example a people driving a car.
- Java is a well-know programming language for different applications such as console application, desktop application, distributed application, Internet application and mobile application.
- Besides, Java can be used to develop **Java applet** which can be executed in Web browser or applet viewer.

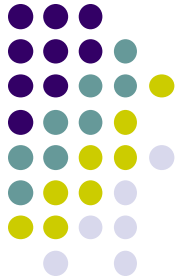
Java

- Java programs normally go through five phases to be executed. These are: **edit, compile, load, verify and execute**.
- **Phase 1 - Edit**
  - This phase consists of editing a file. This is accomplished with an editor program or **Integrated Development Environment (IDE).** Some of the popular IDE includes **NetBeans**, **Eclipse**, Jcreator and JDeveloper.
  - Java program file names end with **.java** extension. The file name must be same as the **Class name**.

Java

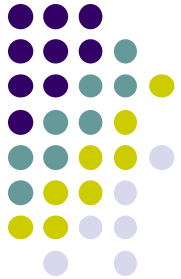
- **Phase 2 – Compile**
  - In this phase, the Java compiler translates the Java program into **byte codes**. The compiler will check whether the source code has the correct spelling and punctuation, all the data types are correct, and all the variables names are legal.
  - Java Platform (**JDK 15**) provides a compiler you can use to compile all kinds of Java programs.
  - Command use to compile java file
    - **javac filename.java**
  - **Syntax** – The **grammar rules** of the language. It tells what arrangement of words and punctuations are allowed in a Class or program definition.

Java



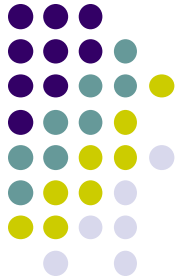
- **Phase 3 – Load**
  - The class loader will take the **.class** file containing the byte codes and transfers it to memory. Java applications are loaded into memory and executed using the Java interpreter.
  - Java interpreter is sometimes referred to as the "Java Virtual Machine" or "Java run-time system".
- **Phase 4 – Verify**
  - In this phase, the byte code verifier is used to verify the byte code before executed. It ensures byte codes do not violate security requirements.

Java

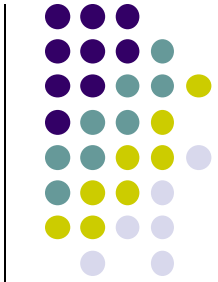


- **Phase 5 – Execute**
  - After verification, the computer will interpret the program one byte code at a time, thus performing the actions specified by the program.
  - Command use to execute java file
    - **java filename**
  - A Java Achieve (JAR) file can be created for a Java application that consists of multiple java files.
  - Command use to execute jar file
    - **java –jar filename.jar**

Problem Solving



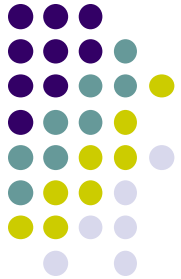
- The purpose of writing a program is to solve a problem or performing certain tasks.
- Before writing a program to solve a problem, it is essential to have a clear understanding of the problem and a carefully planned approach to solve a problem.
- Any computing problem can be solved by executing a series of actions in a **specific order**.
- A procedure for solving a problem in terms of the actions to be executed and the order in which actions are to be executed is called an **algorithm**.



Problem Solving

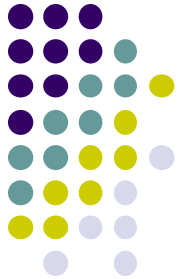
- Below are the general steps of problem solving in programming
  - First, understand the problem. Solve the problem manually with a few examples.
  - Then, devise an algorithm to solve the problem.
  - After that, write the program using the programming syntax and compile the program.
  - Correct the syntax error after the compilation. Save the program and compile again.
  - Execute the program if the program is error free.
  - Finally test the results against expected output. If the results are not correct, modify the algorithm, rewrite and recompile the program

Problem Solving



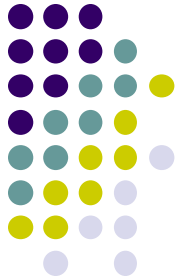
- **Strategies**
  - What do I know about the problem?
  - What is the information that I have to process in order the find the solution?
  - What does the solution look like?
  - What sort of special cases exist?
  - How will I recognize that I have found the solution?

Problem Solving



- **Syntax** – A set of rules, principles, and processes that govern the **structure of statement** in a programming language.
- **Semantic** – Describe the **meaning** of the things written while following the syntax rules of the language. Semantic describes the things happen when a program is executed.
- **Debugging** – A process of **eliminating mistakes** in the program. A mistake in a program is called a bug.

Problem Solving



- There are three commonly types of bugs or errors.
- **Syntax Error**
  - A grammatical mistake in the program. A mistake in the arrangement of words and punctuations.
- **Logic Error**
  - A mistake in the underlying algorithm or semantic error.
- **Run-time Error**
  - An error that happen when the program is executed

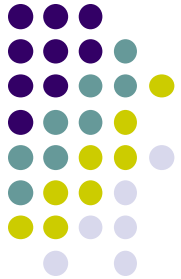
Input Process Output

- A program usually receives inputs from a user or other source (files), does some computations on the inputs (process), and returns the results of the computations (output).

Input	Process	Output
• Number 1 • Number 2 • Add, Subtract, Multiply or Divide	• Assign Variable for Number 1 • Assign Variable for Number 2 • Select Case for Calculation: Add, Subtract, Multiply or Divide • Calculate Number 1 and Number 2	• Result of Calculation

Input	Processing	Output
• Radius of circle	***Processing Items:*** area = π * radius^2 circumference = 2 * π * radius ***Algorithm:*** Step 01: Start Step 02: Input *radius* from the user Step 03: set *PI* = 3.1415 Step 04: Calculate area as: *area = PI * radius^2* Step 05: Calculate circumference as: *circumference = 2 * PI * radius* Step 06: Print *area* and *circumference* Step 07: End	• Area of circle • Circumference of circle

Pseudocode



- Pseudocode is an informal high-level description of the operating principle of a computer program or algorithm. It is simply a numbered list of instructions to perform some task.
- Best Practices
  - Write only one statement per line and each statement should express just one action.
    - Get the name of the participant.
    - Compute the total salary.
    - Display the number of students.

Pseudocode

```
Compute Final Price

1. Get the price of the item
2. Get the sales tax rate
3. Sales Tax = price of item * sales tax rate
4. Final Price = price of item + Sales Tax
```

- Indent statements that fall inside a selection or loop structure.

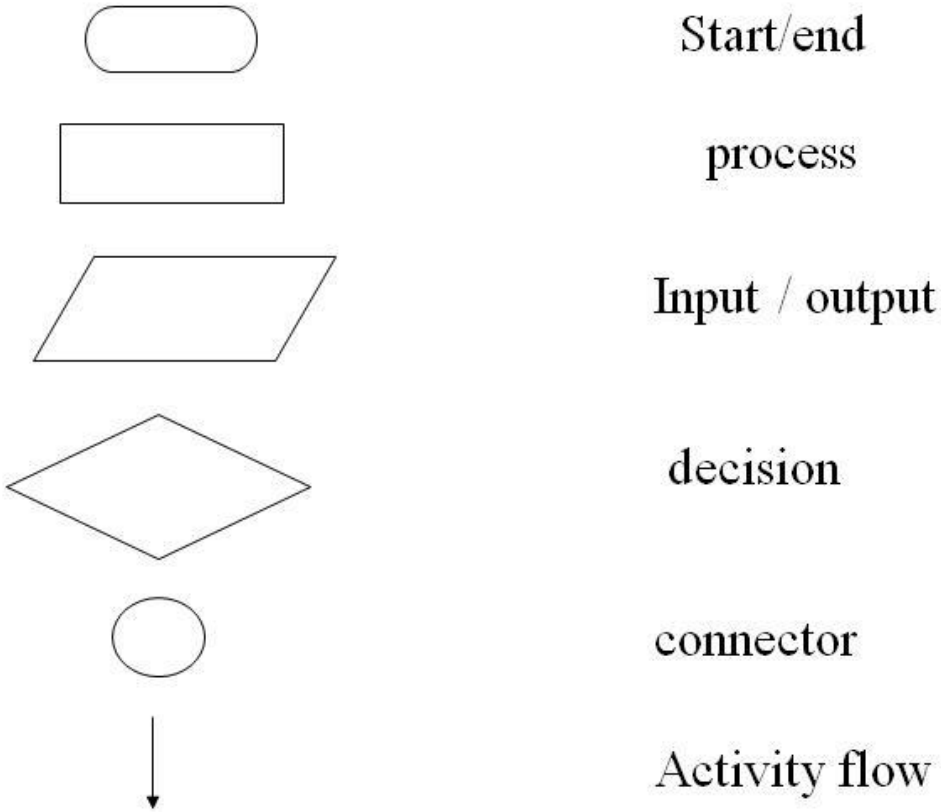
```
If the number of students are more than 40
   Create extra classes
Otherwise
   Create one class
```

```
while the water temperature is greater than 50
   add more ice
   display the new water temperature
```

Flow Chart

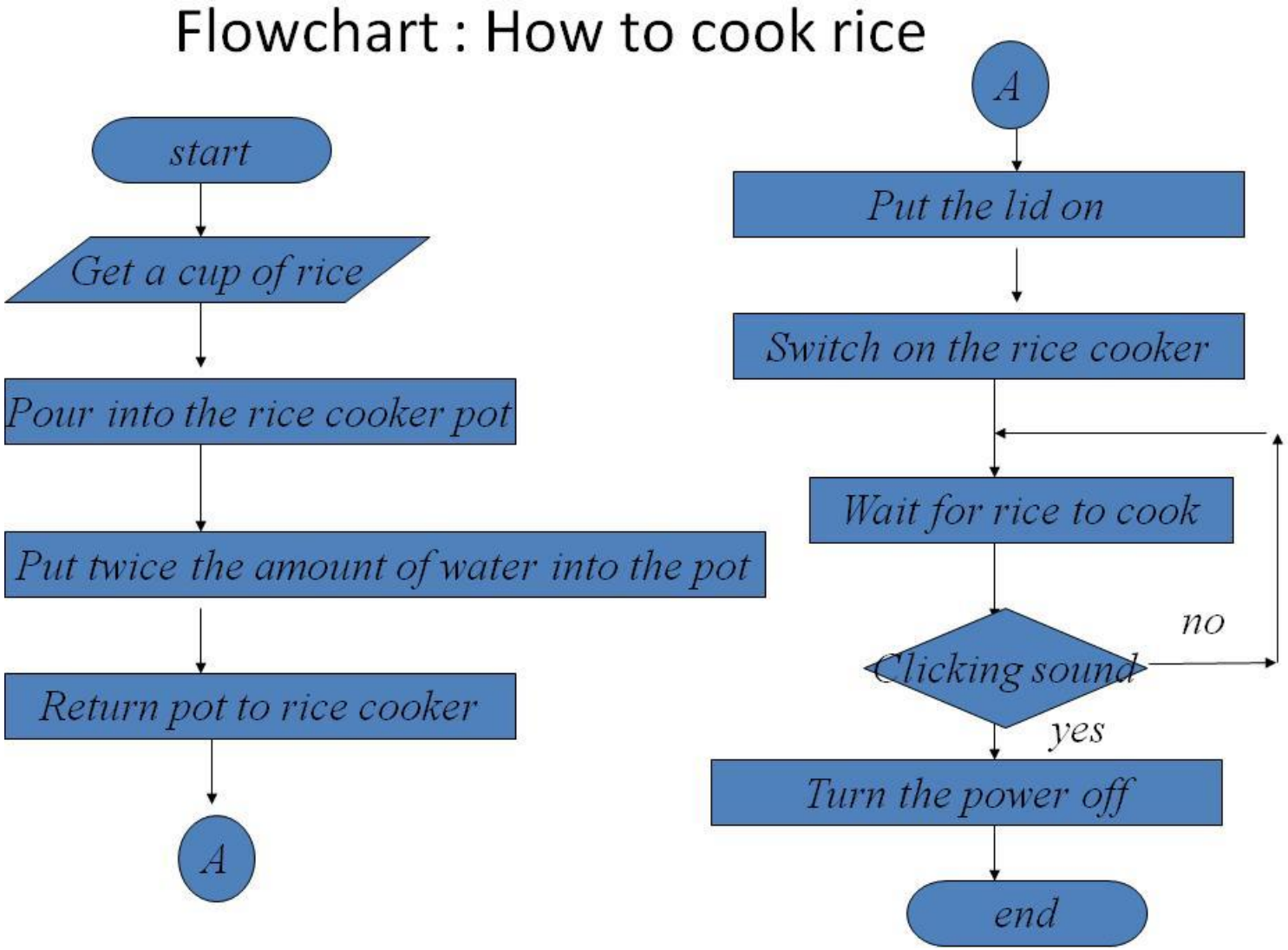
- A flowchart is a type of diagram that represents an algorithm or process.
- A flow chart shows the steps as boxes of various kinds, and their order by connecting them with arrows.
- It is used in analysing, designing, documenting or managing a process or program.

Flow Chart

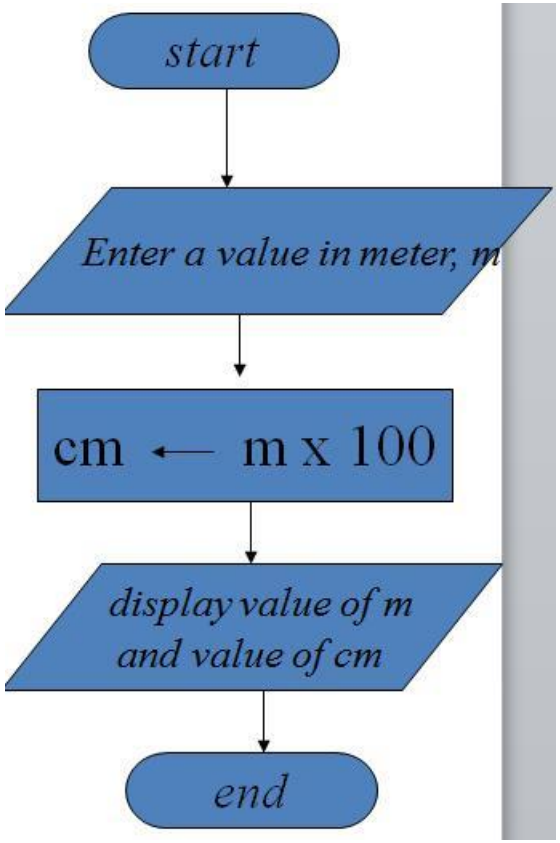


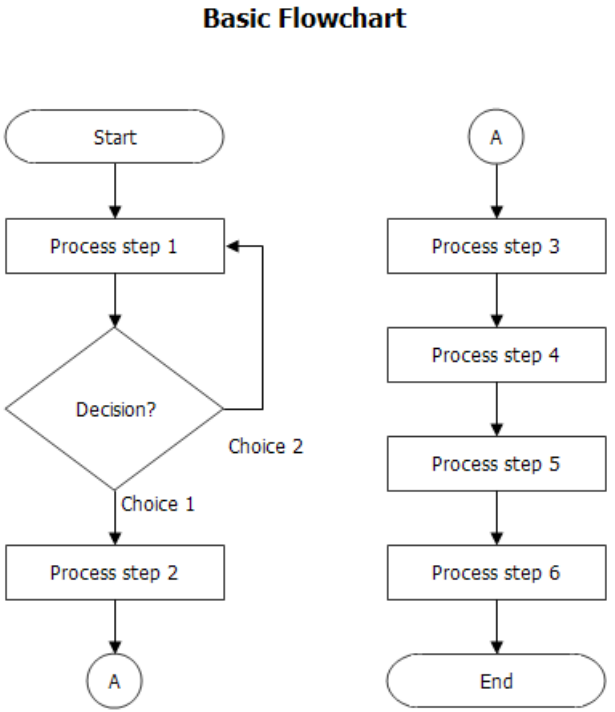
Flow Chart Notation

Flow Chart

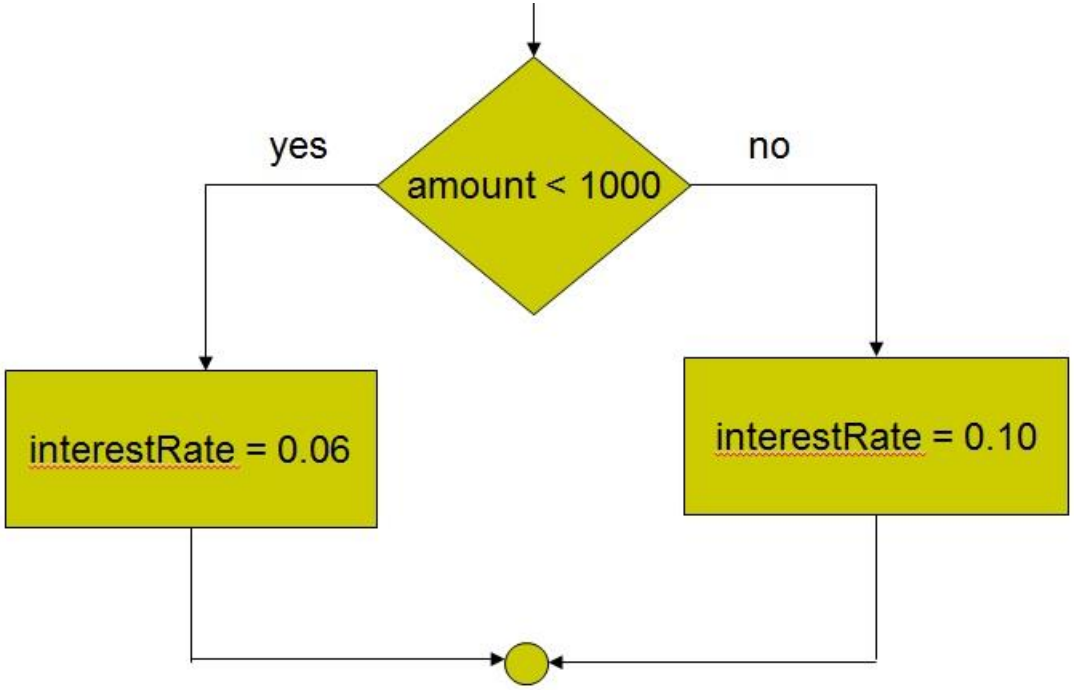

Flowchart : How to cook rice
start
Get a cup of rice
Pour into the rice cooker pot
Put twice the amount of water into the pot
Return pot to rice cooker
A
A
Put the lid on
Switch on the rice cooker
Wait for rice to cook
Clicking sound
no
yes
Turn the power off
end

Flow Chart


start
Enter a value in meter, m
cm ← m x 100
display value of m
and value of cm
end

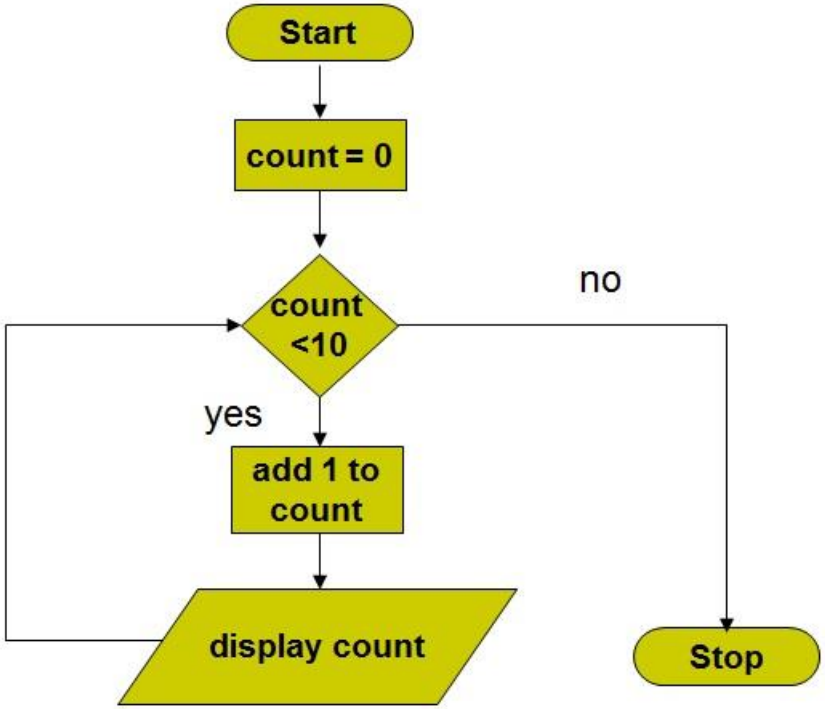

Basic Flowchart
Start
Process step 1
Decision?
Choice 2
Choice 1
Process step 2
A
A
Process step 3
Process step 4
Process step 5
Process step 6
End

Flow Chart



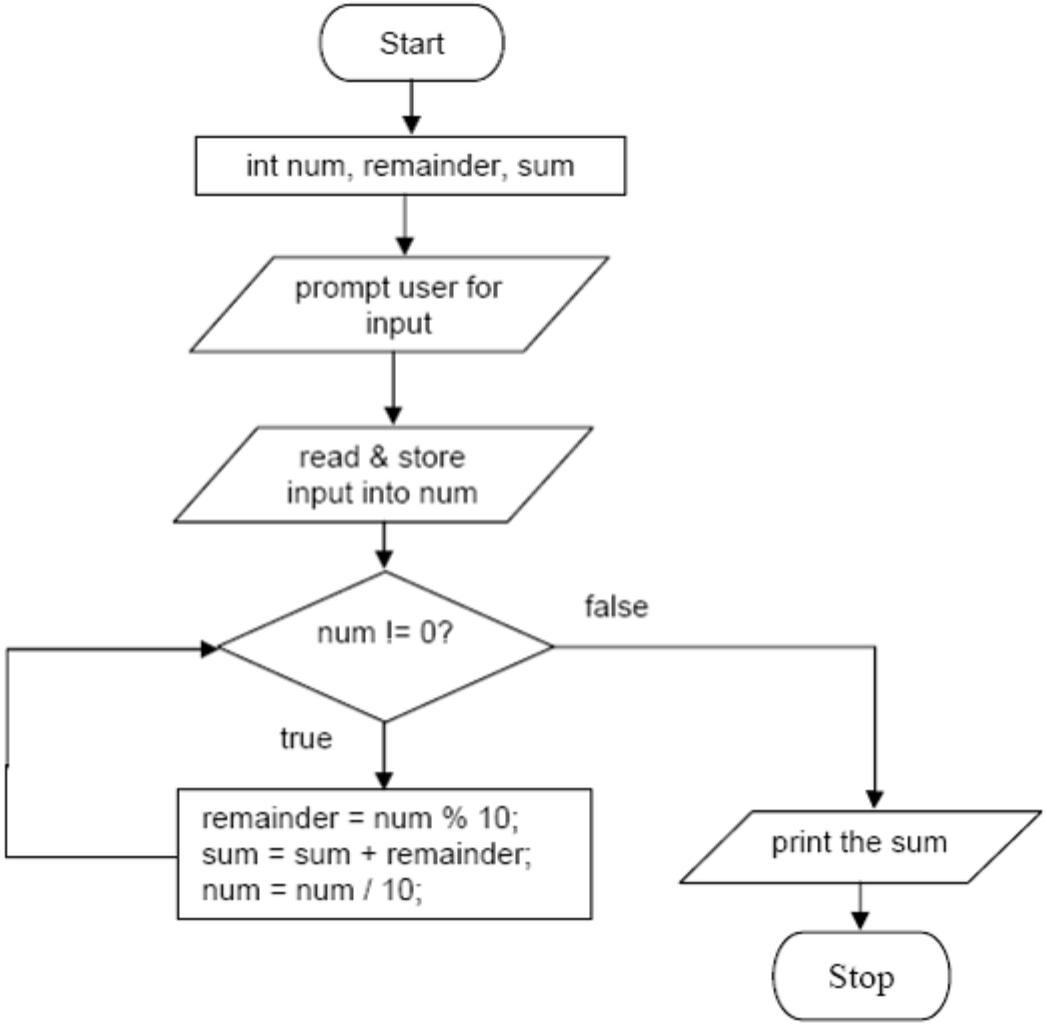
Selection Structure

Flow Chart



Repetition Structure

Flow Chart

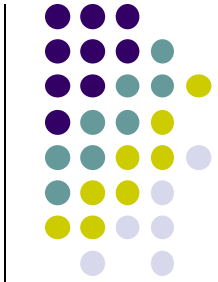

Start
int num, remainder, sum
prompt user for input
read & store input into num
num != 0?
false
true
remainder = num % 10;
sum = sum + remainder;
num = num / 10;
print the sum
Stop

Sample Java Program

```
public class FirstProgram
{
   public static void main(String[] args)
   {
      System.out.println("Welcome to Java!");
   }
}
```

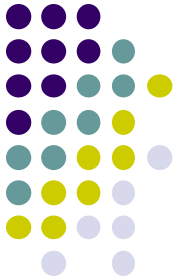
* File Name: **FirstProgram.java**

Sample Java Program

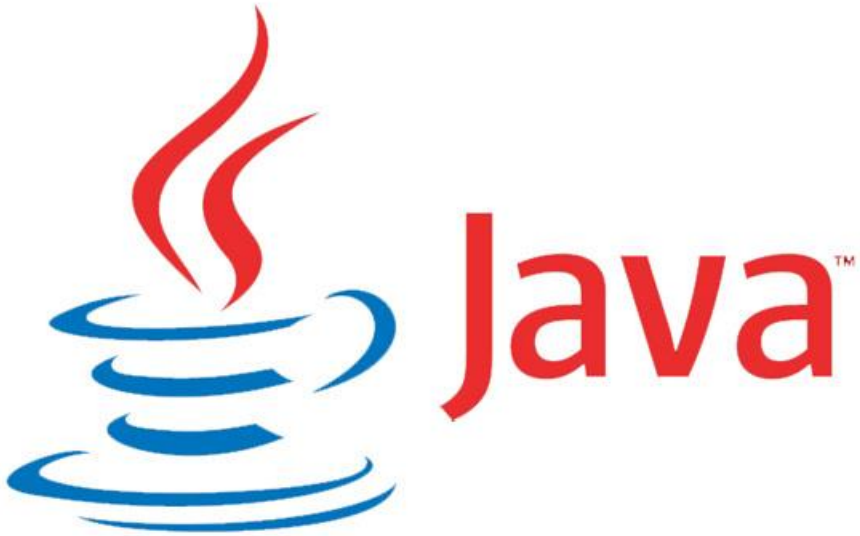


- Every program in Java consists of **at least one class definition.** The class name of the program is **FirstProgram**.
- A left brace { - begins the body of every class definition. A right brace } - ends each class definition.
- The class contains a method named **main**. When the program is run, the **main** method is invoked which means the statements in the **main** method are executed.
- The **void** indicates that this method will perform a task and will not return any information when the task is completed.
- The statement in the sample program display the output **Welcome to Java!**

Sample Java Program



- In Java:
  - A program is made up of one or more **classes**
  - A class contains one or more **methods**
  - A method contains program **statements**
- Java is **case sensitive**. The uppercase letters and lowercase letters must be enter correctly.
- Class are the fundamental building blocks of Java program. Each program begin with a **class definition**.
- Every **Java application** contains a **main method**. The instructions in the main method are executed when the application starts. main method must always be **static**.
- Each Java statements must end with a semicolon (;)


Java™