Java FullStack Development Program

Trainer : Shekher
(working professional)

Duration : 6 Months

Time : 11AM - 12:30PM

Fee : 30k (With Placement assistance)
(Live class + Class Notes + Backup videos(1 year validity) + Mock interviews + Material)

==

FullStack Development = Front-end Development + Back-end Development + Database + Cloud(AWS) + Real-time Tools.

```
  Front-end Development : HTML
                          CSS
                          Java script
                          Bootstrap
                          React JS
  Back-end Development :  Core JAVA
                          Advanced JAVA(JDBC, Servlet, JSP)
                          Spring Framework
                          Spring Boot
                          Microservices

  Database  :  Oracle
               MySQL
               MongoDB
```

```
Real-time Tools : Maven
                  JUnit
                  GitHub
                  Sonar
                  Jenkins
                  Log4J, etc..
```

Front-end :

* It is also called User Interface(UI).
* It is used for creating web pages for displaying information to the user, or to read the input from the user.
* customers/users will interact with the Front-end application.

Back-end :

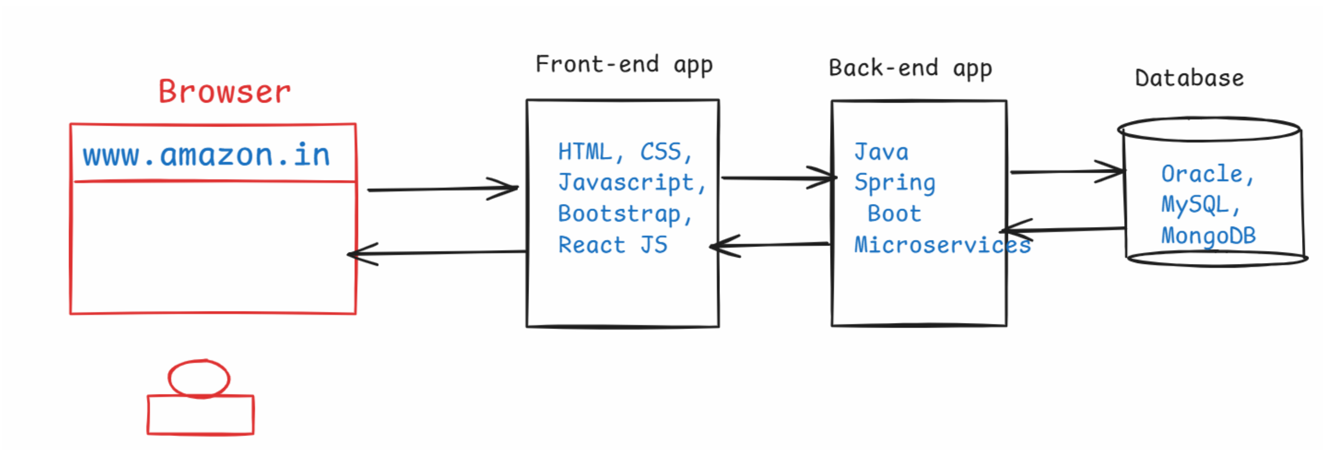
* It will accept the request from the front-end application.
* It will interact with the Database, reads the information from the Database.
* It will process the information and performs business logics and provides the response to the front-end.

Database :

* It will store the large amount of data in a structured format.

==

Core JAVA



- Java is a high-level and open source programming language.
- Java is an Object Oriented Programming language(OOP).
- It was developed by Sun Microsystems and released in 1995.
- The initial name for the programming language was Oak, later it was renamed to Java in 1995.
- Java was created by a team of 5 persons, headed by James Gosling.
- The primary goal of Java was to develop a platform-independent language, that could run on any operating system or any device.
- Java was released to the public in 1996, with a slogan "Write Once, Run Anywhere" (WORA).
- Java is widely used for developing Web applications, enterprise applications and mobile applications development(Android).
- Java is also used in IoT(Internet of Things) applications, game development and data analysis.
- Java is extensively used in the financial industry for building banking systems and trading applications, etc. .
- In 2010, Oracle Corporation has acquired Sun Microsystems company. So, from 2010, Java software maintainence and releases are handled by Oracle corporation.

Java Editions:

- Java is divided into three main editions.
  1. Java SE (Java Standard Edition)
  2. Java EE (Java Enterprise Edition)
  3. Java ME (Java Micro Edition)
- Java SE was formerly called J2SE.
- Java EE was formerly called J2EE.
- Java ME was formerly called J2ME.
- Recently, Java EE has been renamed to Jakarta EE.

Java SE:

- Java SE is the core of the Java Programming language.
- Java SE, we call it as Core JAVA.

- Java SE provides the fundmental libraries for creating general-purpose applications.
- Using Java SE, we can develop Desktop applications, also called stand-alone applications.
- Desktop applications are called single user applications, and a user has to download and install the application in their computer.
- For example, Media players, calculators, Anti-virus, IDE's, etc.

Java EE:

- Java EE was built on Java SE and it provides additional libraries for developing large-scale applications.
- Java EE provides Servlets and JSP(Java Server Page), JPA(Java Persistence API), RESTful webservices, Messaging, etc..
- With Java EE, we can develop web applications and enterprise applications.
- Both web and enterprise applications runs on a server. So, you no need to install them on your computer.
- For example, social media applications like facebook or twitter are enterprise applications, and you no need to install in your computer. You can access them from your browser.
- web applications are small applications like restaurant applications or online tutorials or hotel booking applications.
- enterprise applications are large applications like banking applications, e-commerce applications, CRM applications,etc..

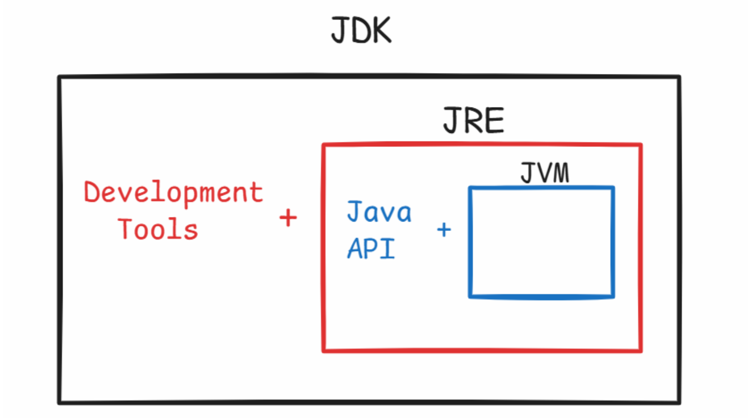
Java ME:

- Java ME is provided for developing applications for Mobile phones, embedded systems, IoT devices
- Using Java ME, you can develop applications for smart appliances, sensors, disply modules, car infotainment systems, etc.
- For a Full Stack Java Developer, Java SE and Java EE are required, but not Java ME.

JDK :

- JDK stands for Java Development Kit.
- JDK is the name of the Java Software.
- To compile and to execute the Java program in a computer, we have to install the JDK software.
- JDK software provides,
  - Development Tools, and
  - JRE

- Development tools are, compiler, debugger, profiler, etc..
- JRE stands for Java Runtime Environment.
- JRE provides,
  - Java API(Java libraries)
  - JVM
- API stands for Application Programming Interface.
- Java API provides system programs(pre-defined programs) for the programmers to develop the software applications.
- JVM stands for Java Virtual Machine
- JVM is responsible for executing the Java programs.



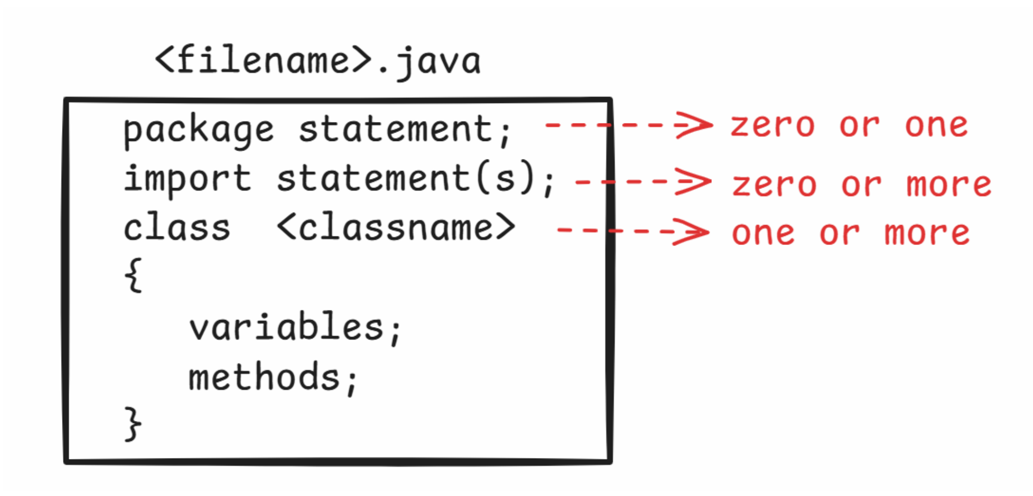
installing jdk-17:
----
1. visit https://www.oracle.com/java/technologies/javase/jdk17-archive-downloads.html
2. download Windows X64 MSI Installer.
3. A file jdk-17.0.12_Windows-X64_bin.msi is downloaded.
4. Now double click on the downloaded file, and click on Next buttons, then close button.
5. Now, jdk-17 is successfully installed.

- To verify the Java software,
  Goto C:\Program Files\Java\jdk-17

Java PATH setting:
----
1. Open Windows search and type environment
2. choose Edit system environment variables
3. click on Environment variables
4. Under system variables, choose Path variable and click Edit.
5. click on New button, and enter the value
   C:\Program Files\Java\jdk-17\bin
6. click on move up button, place it on top position.
7. click on OK buttons.

- To verify the path setting,
  open a command prompt and run the below command.
  - java --version

Basic structure of a Java program:



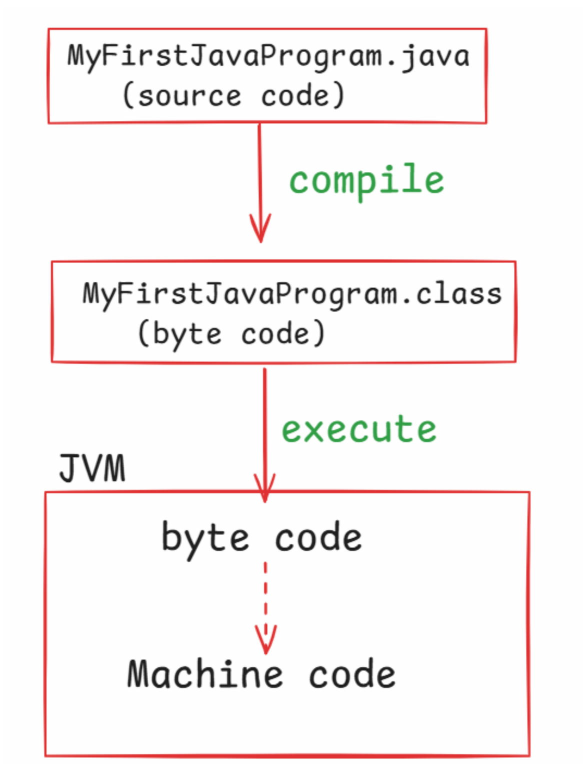
```
      <filename>.java
  package statement;  -----> zero or one
  import statement(s); ----> zero or more
  class  <classname>  -----> one or more
  {
      variables;
      methods;
  }
```

First Java program in Notepad:

```
   1. open a notepad
   2. enter the folowing code.
      class MyFirstJavaProgram
      {
         public static void main(String[] args)
         {
            System.out.println("Hello, Welcome To Java");
         }
      }
   3. Click on File menu ---> Save ---> choose D: drive ---> change
      save as type : All files --->enter file name:
      MyFirstJavaProgram.java --→ Save
   4. open command prompt
   5. change to D: drive, by typing D: then enter
   6. compile the program
      D:\>javac MyFirstJavaProgram.java
   7. execute the program.
      D:\>java MyFirstJavaProgram
   output: Hello, Welcome To Java
```

Q) If I want to execute the same program multiple times, How many times I need to compile the program?
A) Only one time.

Q) I have made some changes to the program. Do I need to compile the program again?
A) Yes, first we need to compile the program, then we have to execute it.



Identifiers:

- Identifier is a user-defined word in a program.
- In Java programs, classnames, variablenames, method names are all identifiers.
- Follow the below rules, to define an identifier.
  1. Identifier should not contain any whitespace.
  2. Identifier can contain alphabets(upper/lower), digits, underscore or dollar. Other special characters are not allowed.
  3. Identifier should not start with a digit.
  4. Don't use a keyword as an identifier.

examples:

```
      My_Class  //valid
      My Class  //invalid
      _MyClass  //valid
      $_MyClass //valid
      4MyClass  //invalid
      __MyClass //valid
      $$MyClass$$ //valid
      MyClass$4  //valid
      break=1;   //invalid
      My@Class   //invalid
```

datatypes:

- Java has provided 2 categories of data types.
  1. primitive data types.
  2. reference data types.
- primitive data types are used to store the values.
- reference data types are used to store the objects.

ex:
```
    int x = 10;  //primitive data type
    Employee e = new Employee(); //reference data type.
```

datatype	size	description	range
byte	1 byte	small integers	-128 to 127
short	2 bytes	medium-sized integers	-32768 to 32767
int	4 bytes	standard integers	-2^{31} to $2^{31} - 1$
long	8 bytes	large integers	-2^{63} to $2^{63} - 1$
float	4 bytes	small decimal numbers	-2^{128} to 2^{128}
double	8 bytes	large decimal numbers	-2^{1024} to 2^{1024}
char	2 bytes	single characters	
boolean	1 bit	boolean value	true or false

ex1:
```
  byte a = 120; //correct
  byte b = 120; //correct
  byte c = a + b; //error
```

ex2:
```
  short s1 = 25777; //correct
  short s2 = 15100; //correct
  short s3 = s1 + s2; //error
```

ex3:
```
  boolean status = true; //correct
  boolean flag = null; //error
```

ex4:
```
  float f1 = 71.56; //error
  float f2 = 71.56f; //correct
  float f3 = 71.56F; //correct
```
Note: when you store a float value, the value must be suffixed with either f or F.

How to declare a variable?

```
   datatype variablename;
   variablename = value;
       (or)
   datatype variablename = value;
ex:
   long customerId = 19445302;
   double totalDiscountApplied = 199.0;
ex:
   boolean isActive;
   isActive = true;
```

Java comments:

- comments are used to define/provide a description for the classes/variables/methods in a program.
- In Java, there are 3 types of comments.
  1. single line comment
  2. multiline comment
  3. documentation comment

-
  ```
  //single line comment
  ```

-
  ```
  /*
    multiline comment
  */
  ```

-
  ```
  /**
   * documentation comment
  */
  ```

- In real-time projects, mostly we add documentation comments. Because, they are used to prepare the project documentation.

Second Java Program:

```
/*
 * This program is to find the sum
 * of two numbers
*/
class Addition
{
  public static void main(String[] args)
  {
     int a = 20;
     int b = 30;
     int c = a + b;
     System.out.println("sum = " + c);
  }
}

> javac Addition.java
> java Addition
output:
    sum = 50
```

Q) Is the following statement valid?

```
int a = 20, int b = 30;
```

A) error

Q) Is the following statement valid?

```
System.out.println("Hello");;;
```

A) valid

Q) Is the following statement valid?

```
int a = 10, double x = 3.49;
```

A) valid

Installing Eclipse IDE:

IDE : Integrated Development Environment

- To develop the real-time Java projects, we must use IDE application.
- The popular Java IDE's are Eclipse, STS and IntelliJ
- With the help of IDE, a programmer can develop the code easily and fastly.

1. visit eclipse.org/downloads website
2. click on Download packages link
3. Download Eclipse IDE for Enterprise Java and Web Developers.
4. eclipse-jee-2024-06-R-win32-x86_64.zip file is downloaded.
5. Unzip the file.
6. A folder, eclipse-jee-2024-06-R-win32-x86_64 is created.
7. open this folder and open eclipse folder inside it.
8. You have eclipse application, and you can start the eclipse IDE, by double clicking on the eclipse application.

Note:
create a shortcut on desktop for eclipse, to quickly launch the eclipse.

First Java application on Eclipse:

1. create a workspace directory
   (Open D: drive, create a new folder 87-JFSD-Workspace)
2. start eclipse.
3. Click on Browse button, choose the workspace folder, then launch.

4. click on File menu -> New -> Project... -> Java project
   -> Next -> Project Name: Application1
   execution environment: choose Java SE-17
   Uncheck Module checkbox.
   ➔ Next -> Finish.
5. Expand Application1 -> Right click on src folder -> New
   -> class -> package : com.example

Name : Multiplication

➔ choose public static void main check box.

➔ Next -> Finish

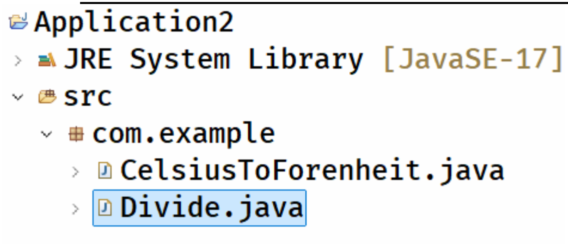
6. Write the below code.

```java
package com.example;

public class Multiplication {

 public static void main(String[] args) {

        float x1 = 0.9f;
        float x2 = 0.4F;

        float x3 = x1 * x2;
        System.out.println(" x3 = " + x3);

 }

}
```

7. Right click on Multiplication.java -> RunAs -> Java Application

output:

```
 x3 = 0.35999998
```



```
Application2
 > JRE System Library [JavaSE-17]
 v src
   v com.example
     > CelsiusToForenheit.java
     > Divide.java
```

Divide.java

```java
/**
 * This program reads two input values
 * from the user and calculates division.
 */
package com.example;

import java.util.Scanner;

public class Divide {

	public static void main(String[] args) {

		//create Scanner class object
		Scanner scan = new Scanner(System.in);
		System.out.println("Enter first number");
		int x = scan.nextInt();
		System.out.println("Enter second number");
```

```
            int y = scan.nextInt();

            int z = x / y;

            System.out.println("Division =  " + z);

            scan.close();

      }

}
```

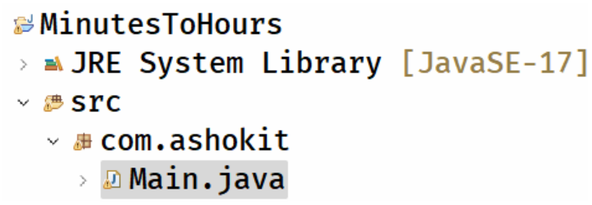
CelsiusToForenheit.java

```
/**
 * This program reads the input in celsius
 * and converts it into forenheit.
 * Hint:
 *   formula:
 *     f = (c * 9/5) + 32;
 */
package com.example;

import java.util.Scanner;

public class CelsiusToForenheit {

      public static void main(String[] args) {

            //create Scanner class object
            Scanner scan = new Scanner(System.in);
            System.out.println("Enter celsius value");
            double c = scan.nextDouble();

            //convert celsius to forenheit
            double f = (c * 9 / 5) + 32;

            System.out.println("The given celsius :  " + c);
            System.out.println("The forenheit value :  " + f);

            //optional
            scan.close();
      }

}
```

How to calculate EMI?

```
                       n
  emi = p * r *   (1 + r)         p -- principle loan amount
                  -------
                       n          r -- monthly interest rate
                  (1 + r) - 1
                                  n -- tenure in months
```

```
/**
 * This program reads the principle loan amount,
 * annual interest rate and tenure in years as input,
 * then calculates EMI, displays the output.
 */
package com.ashokit;

import java.util.Scanner;

public class Solution {

      public static void main(String[] args) {

            //create Scanner class object
            Scanner scan = new Scanner(System.in);

            System.out.println("Enter principle loan amount");
            double p = scan.nextDouble();

            System.out.println("Enter annual interest rate");
            double pa = scan.nextDouble();

            System.out.println("Enter tenure in years");
            int years = scan.nextInt();

            //convert annual interest rate to monthly interest rate
            double r = pa / 12 / 100;

            //convert tenure from years to months
            int n = years * 12;

            //calculate 1+r power n value
            double x = Math.pow( 1 + r, n );

            //calculate emi

            double emi = p * r * x / (x - 1) ;

            System.out.println("EMI = " + emi);

      }

}
```



```
MinutesToHours
 > JRE System Library [JavaSE-17]
 v src
    v com.ashokit
       > Main.java
```

```
Main.java
 --------
/**
 * This program reads minutes as input and
 * converts into hours and minutes.
 * ex:
 *     input: 135
 *     output 2 hours and 15 minutes
 */
package com.ashokit;
```

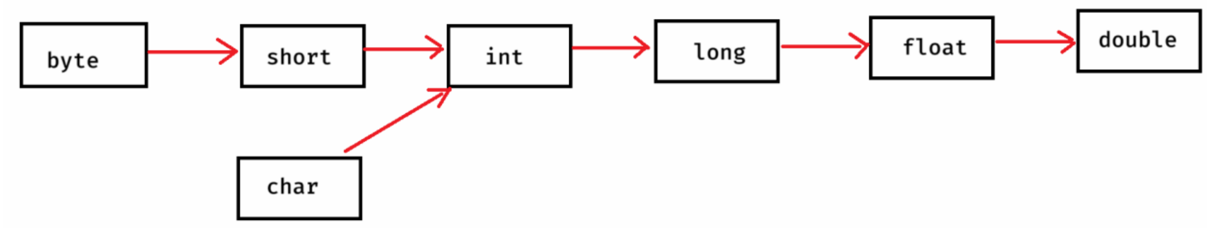
```
import java.util.Scanner;

public class Main {

	public static void main(String[] args) {
		Scanner scan = new Scanner(System.in);

		System.out.println("Enter the minutes");
		int minutes = scan.nextInt();

		//convert minutes into hours
		int hours = minutes / 60;

		//find the remaining minutes
		int remainingMinutes = minutes % 60;

		System.out.println( hours + " hours and " + remainingMinutes +
" minutes");

	}
}
```

Type casting:

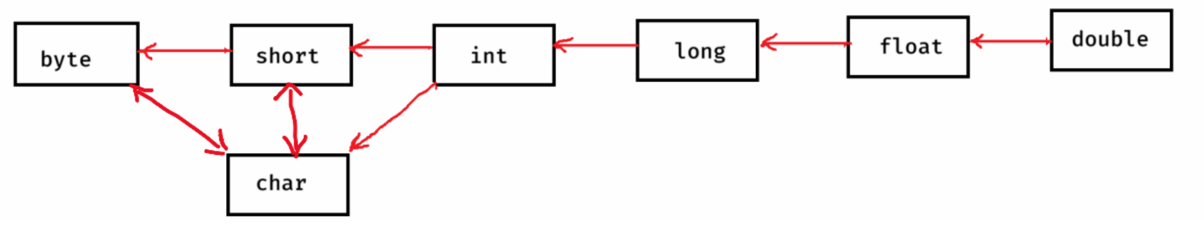
- converting a value from one data type to another data type is called type casting.
- Type casting is 2 types.
  1. implicit type casting/upcasting / widening
  2. explicit type casting/downcasting / narrowing.
- In implicit type casting, a value from lower data type will be converted to higher data type, or same data type.
- implicit type casting will be automatically done by the system.
- In explicit type casting, a value from higher data type will be converted to the lower data type.
- explicit type casting should be done explicitly by providing the target data type with the paranthesis.

ex1:
```
    int x1 = 30;
    long x2 = x1; //implicit
```
ex2:
```
    long x3 = 23879;
    int x4 = x3; //error
    int x4 = (int) x3; //explicit
```

implicit type casting:



explicit type casting:



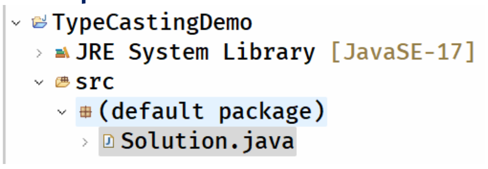
Note:

- boolean data type cannot be converted to any other data type, and also vice-versa.

examples:

```
  char ch = ‘A’;
  int i = ch; //implicit
  S.o.p(i); //output: 65

  int k = 100;
  char c = k; //error
  char c = (char) k;  //explicit
  S.o.p(c);  //output: d

  long x = 125;
  float y = x; // implicit
  S.o.p(y); //output: 125.0
```

example code:



```
TypeCastingDemo
  JRE System Library [JavaSE-17]
  src
    (default package)
      Solution.java
```

Solution.java

```
--------------
/**
 * This program demonstrates type casting.
 */
public class Solution {

	public static void main(String[] args) {

		short s =1024;
```

```
            float f = s; //implicit
            System.out.println("f = " + f);

            double d = 397.421;
            int x = (int) d; //explicit
            System.out.println("x = " + x);

            byte k = 100;
            char ch = (char) k; //explicit
            System.out.println(ch);

            char ch1 = 'A';
            byte b = (byte) ch1; //explicit
            System.out.println(b);


      }

}
```

output:

```
f = 1024.0
x = 397
d
65
```

---

operators:

-> operator is a symbol, which performs a task.
-> operators are 3 categories.
   1. unary operators
   2. binary operators
   3. ternary operator.
-> unary operator performs a task, on a single operand
-> binary operator performs a task, on two operands.
-> ternary operator performs a task. on three operands.

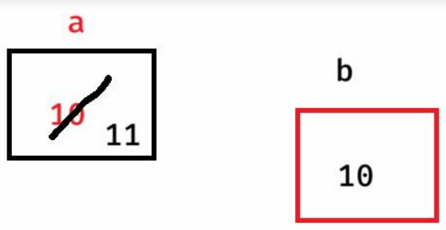
Unary operators:
 ----
   1. increment operator (++)
   2. decrement operator (--)

- increment operator increments a value by 1
- decrement operator decrements a value by 1

```
      value++  : post increment(increment but after the use)
      ++value  : pre increment (increment but before the use)

    value-- : post decrement(decrement but after the use)
    --value : pre decrement(decrement but before the use)
```

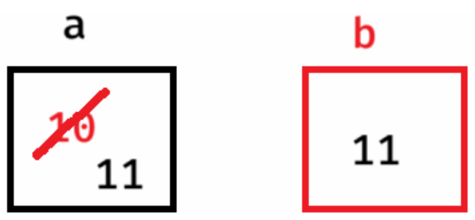
ex1:

```
int a = 10;

int b = a++;

S.o.p(b); //output: 10
s.o.p(a); //output: 11
```



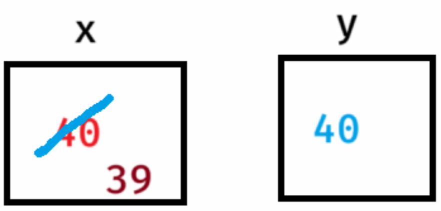
ex2:

```
int a = 10;
int b = ++a;
```



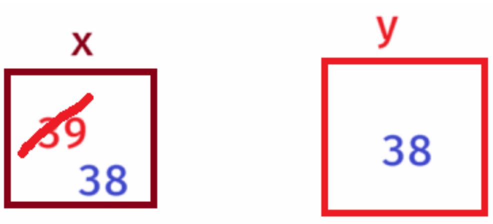
ex3:

```
int x = 40;
int y = x--;
Sop(x); //output:
Sop(y); //output:
```



ex4:

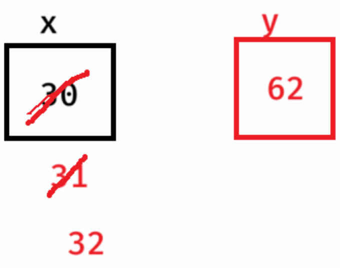
```
int x = 39;
int y = --x;
Sop(x)
Sop(y);
```



ex5:

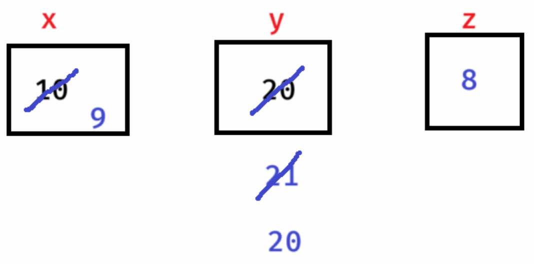
```
int x = 30;
int y = x++ + ++x;
Sop(x);
Sop(y);
```

30 + 32



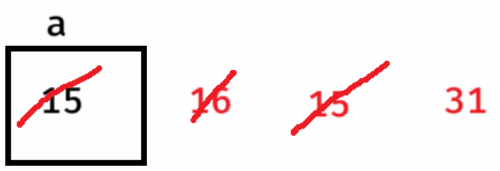
ex6:

```
int x = 10;
int y = 20;
int z = --x + y++ - y--;
         9 + 20  -  21
Sop(x);  //output: 9
Sop(y);  //output: 20
Sop(z);  //output: 8
```



ex7:

```
int a = 15;

a = a++ + a--;
    15  + 16
Sop(a); //output: 31
```



Binary operators:
===============
1. Arithmetic operators
2. relational operators
3. logical operators
4. assignment operators
5. bitwise operators

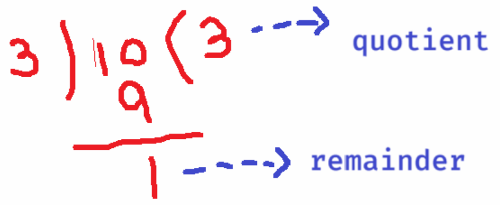
Arithmetic operators:

+	--	addition
-	--	substraction
*	--	multiplication
/	--	division
%	--	modulus

- division operator returns the quotient value and modulus operator returns the remainder value.

ex1:

```
10 / 3 = ?

       = 3

10 % 3 = ?

       = 1
```



- In Java, when you divide an integer value with another integer value then the result will also be the integer value only.

ex2

```
 10 / 3.0 = ?

      = 3.333333

 10 % 3.0 = ?          10 - ( 3.0 * 3.0)
                       = 1.0
      = 1.0

 15.5 % 3.5 = ?          15.5 - ( 3.5 * 4.0)
                         15.5 - 14.0 = 1.5
           = 1.5

  In Java, when you are finding modulus value(%), if numerator or denominator
  is a double value, then Java will calculate the result with below formula.
    a % b, is calculated as,   a - ( b * quotient )
```

```
Relational operators:
---------------------
  <    --  less than
  >    --  greater than
  <=   --  less than or equals
  >=   --  greater than or equals
  !=   --  not equals to
  ==   --  equals to
```

- relational operators returns a boolean value(either true or false).

```
ex1:
     10 < 3  // output: false

      5 > 10 > 9 //output: error
ex2:
     String str = null;
     str != null  // output: false
     str == null  // output: true
```

```
logical operators:
 ----------------
```

&&   -- and operator

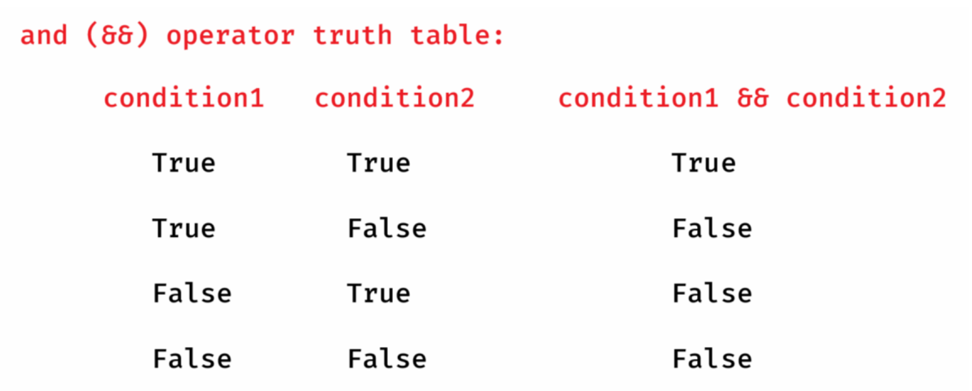
|| -- or operator

!   -- not operator

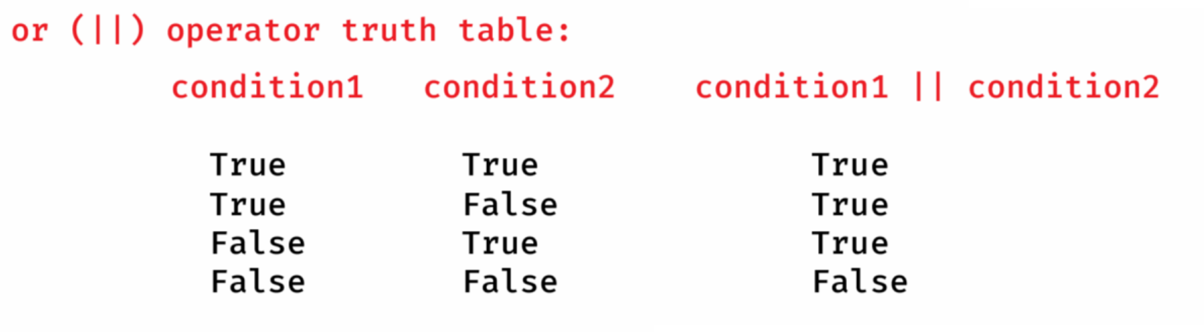
- Logical operators are used to combine the two conditions together into a single condition.
- and(&&) operator returns true, if both the conditions are true. Otherwise, returns false.

- or(||) operator returns true, if any one condition is true. Otherwise, returns false.

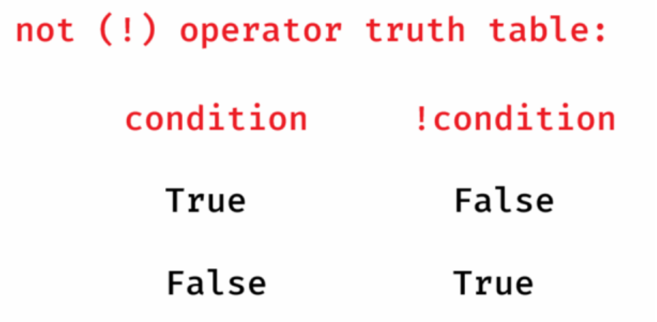
- not(!) operator is used to flip the value. If the condition is true, then it flips to false. If the condition is false then it flips to true.


and (&&) operator truth table:

condition1	condition2	condition1 && condition2
True	True	True
True	False	False
False	True	False
False	False	False


or (||) operator truth table:

condition1	condition2	condition1 || condition2
True	True	True
True	False	True
False	True	True
False	False	False


not (!) operator truth table:

condition	!condition
True	False
False	True

```
ex1:
   int x = 10;

   if( x++ >= 11 && x-- < 11)
   {
       x = x + 5;
   }
   System.out.println(x);
output:
      11
```

```
ex2:
   int a = 5;
   if( ++a > 5 || a++ > 10 )
   {
       a = a + 5;
   }
   System.out.println(a);
output:
       11
```

Note:
1. and(&&) operator executes the second condition, if the first condition is true.
2. or(||) operator executes the second condition, if the first condition is false.

```
ex3:
  int x = 1, y = 2;

  if( x++ + y++ < 5 && x-- + y-- > 4)
  {
     x++;
     y++;
  }
  System.out.println(x);
  System.out.println(y);
output:
         2
         3

ex5:
  boolean b = false;
  int k = 10;
  if ( !b || b )
  {
    k = 20;
  }
  System.out.println(k);
output:
    20
```

Assignment operators:

=	assign
+=	add then assign
-=	substract then assign
*=	multiply then assign
/=	divide then assign
%=	modulus then assign

```
ex1:
   int k = 5;
   k += 6;
   S.o.p(k);
output:
    11

ex2:
    int a = 40;
    a %= 5;
    S.o.p(a);
output:
     0

ex3:
  int c1 = 30;
  int c2 = 36;
  c1 += c2;
  S.o.p(c1);
output:
    66
```

Bitwise operators:

- Bitwise operators will work on the bits of the operands.
- Bitiwse operators are used in the development of cryptography applications, VLSI applications, Device driver applications, etc..
- Bitwise operators are not much used in the development of Web applications or the Enterprise applications.

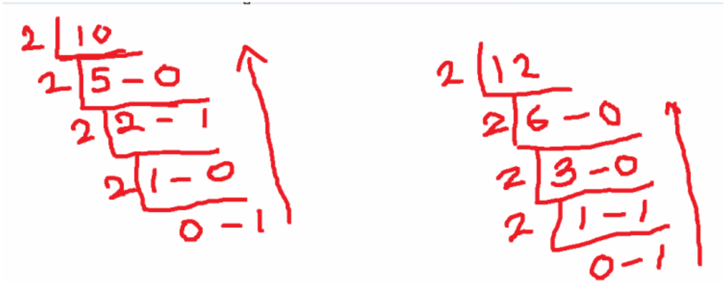
```
&    -- Bitwise AND operator
|    -- Bitwise OR operator
^    -- Bitwise XOR operator
<<   -- Left shift operator
>>   -- Right shift operator
```

Bitwise AND(&):

* This Bitwise AND operator returns result as a bit 1, if the corresponding bits of the operands are 1. Otherwise, returns 0.

ex:

```
10 & 12 = ?
        8

  10 = 1 0 1 0
  12 = 1 1 0 0
 ---------------
       1 0 0 0
 1   0   0    0

  3  2    1    0
 2  2    2    2


8 * 1 + 4 * 0 + 2 * 0 + 1 * 0
 8    +   0   +   0   +  0

= 8
```



```
ex2:
    15 & 20 = ?
              4

   15 = 0 1 1 1 1
   20 = 1 0 1 0 0
   ----------------
        0 0 1 0 0
   ----------------
```

Bitwise OR(|):

- This operator returns a bit 1, if any of the corresponding bits are 1. Otherwise returns 0.

```
 ex:
     10 | 12 = ?

     10 = 1 0 1 0
     12 = 1 1 0 0
    ---------------
          1 1 1 0
    ---------------

    1   1   1   0    = 14

    3   2    1   0
   2   2    2   2
```

Bitwise XOR(^):

----

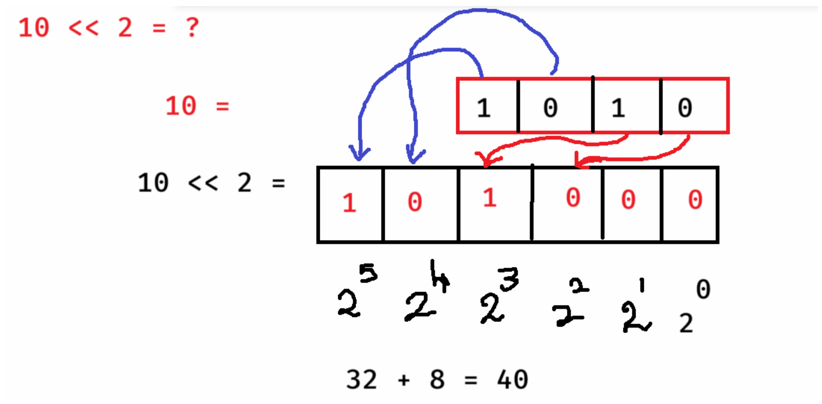
* This operator returns a bit 1, if the corresponding bits are opposite. Otherwise returns 0.

```
ex:
    10 ^ 12 = ?

   10 = 1 0 1 0
   12 = 1 1 0 0
  ---------------
        0 1 1 0    = 6
  ===============
```

Left Shift operator:
----

* This operator will shift the bits of the left operand to the left side by the given positions of right operand.
* The empty bits generated at right are filled with zero.

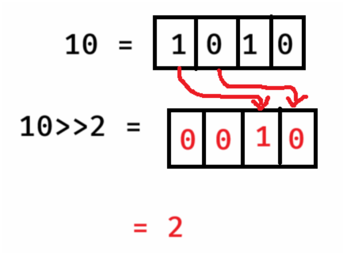
ex:



right shift operator:

- This operator will shift the bits of the left operand to the right side by the given positions of the right operand.

ex:
  10 >> 2 = ?



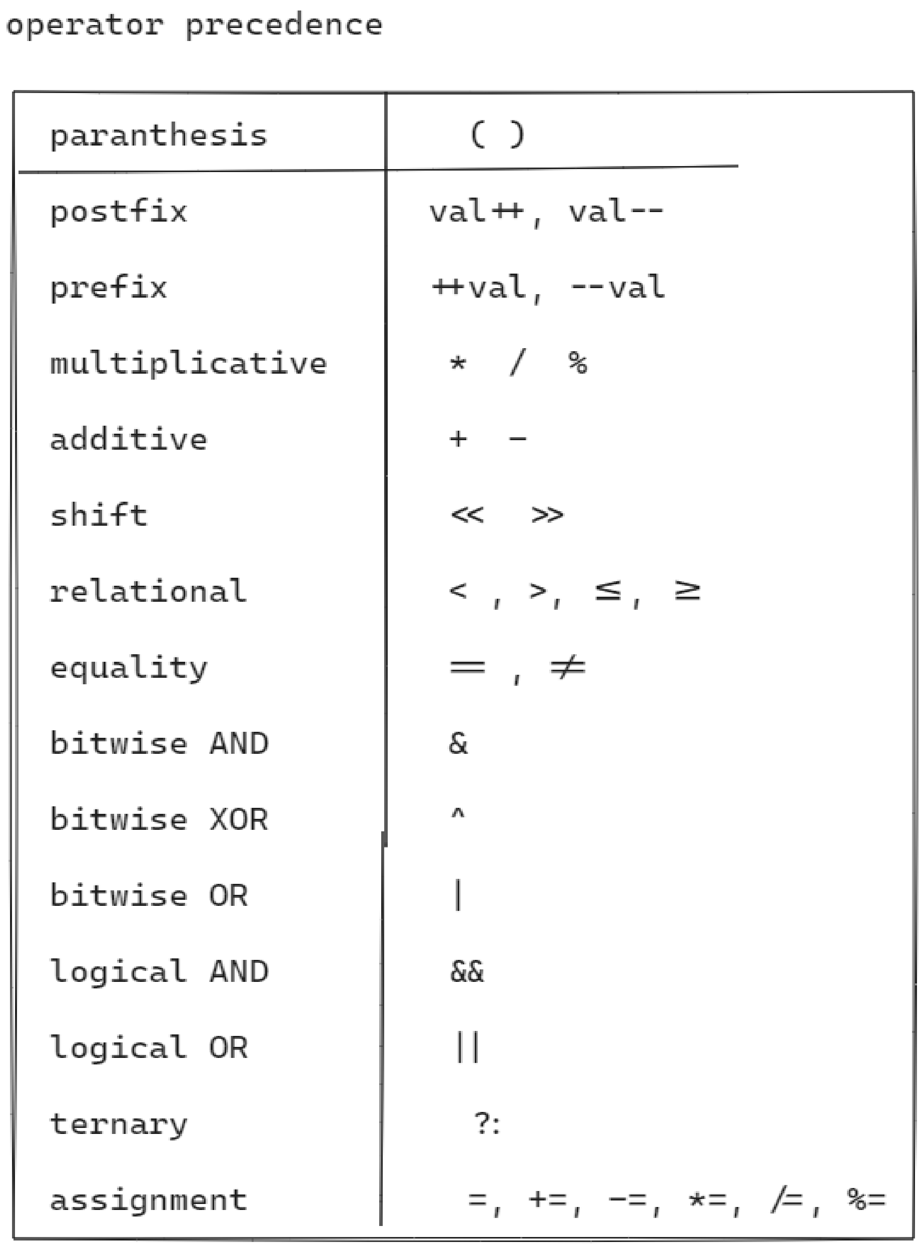
Ternary operator(? :)
----

syntax:

```
variable = condition ? value1 : value2;
```

- If the condition is true, then value1 will be returned. Otherwise, value2 will be returned.

```
ex:
   int k = 10 > 5 ? 8 : 4;
   S.o.p(k);
output: 8

ex:
  int a = 19, b = 14;
  int k = a > b ? a+b : a-b;
  S.o.p(k);
output: 33
```

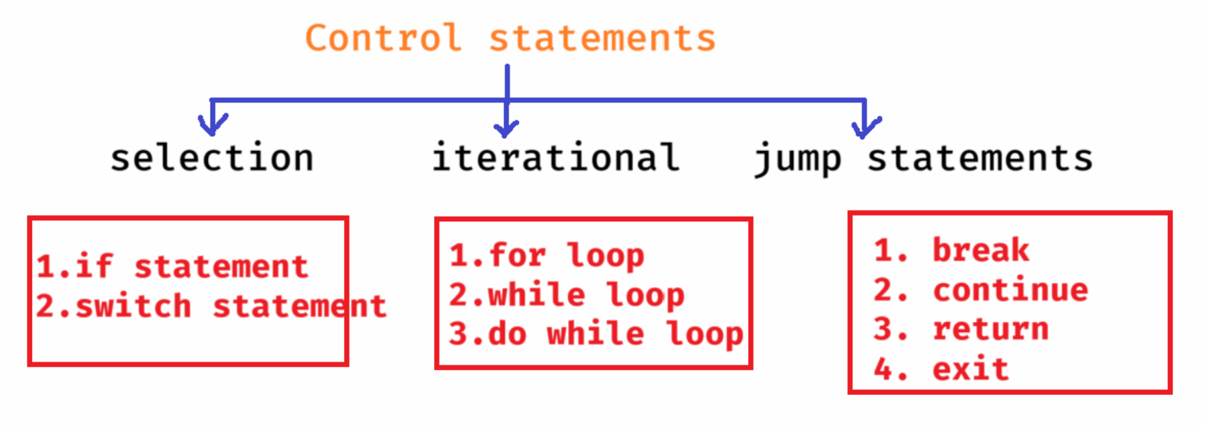


operator precedence

paranthesis	( )
postfix	val++, val--
prefix	++val, --val
multiplicative	* / %
additive	+ -
shift	<< >>
relational	< , >, ≤, ≥
equality	== , ≠
bitwise AND	&
bitwise XOR	^
bitwise OR	|
logical AND	&&
logical OR	||
ternary	?:
assignment	=, +=, -=, *=, /=, %=

```
ex1:
   int x = 3 + 4 * 9 / 6 – (2 +7);
   S.o.p(x);
output:
   int x = 3 + 4 * 9 / 6 – 9;
   int x = 3 + 36 / 6 – 9;
   int x = 3 + 6 – 9;
   int x = 9 – 9;
       x = 0;

ex2:
    int x = 6 – 7 * 8 + 9 / 5 – 6 % 3 – 7 / 2 - 3;
    S.o.p(x);
output:
    int x = 6 – 56 + 9 / 5 – 6 % 3 – 7 / 2 – 3;
        x = 6 – 56 + 1 – 6 % 3 – 7 / 2 – 3;
        x = 6 – 56 + 1 – 0 – 7 / 2 – 3;
        x = 6 – 56 + 1 – 0 – 3 – 3;
        x = -50 + 1 – 0 – 3 – 3;
        x = -49 – 0 – 3 – 3;
        x = -55
ex3:
   int x = 3 * 5 – 7 + 7 * 7 – 7 / 7 + 7 * 7 % 7;
   S.o.p(x);
output:
   56
```

```
             Control Statements
            ---------------------
  * Control statements are used to control the flow
    of execution the statements in a program.

  * Control statements are 3 types.
    1. conditional/selection control statements
    2. iterational control statements / Loop statements
    3. jump statements
```



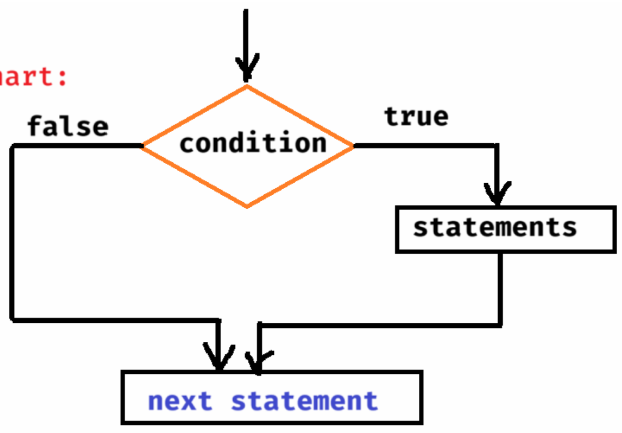
if statement

1. simple if statement
2. if else statement
3. if else ladder statement
4. nested if statement

simple if syntax:

```
if ( condition ) {
   //statements;
}
next statement;
```

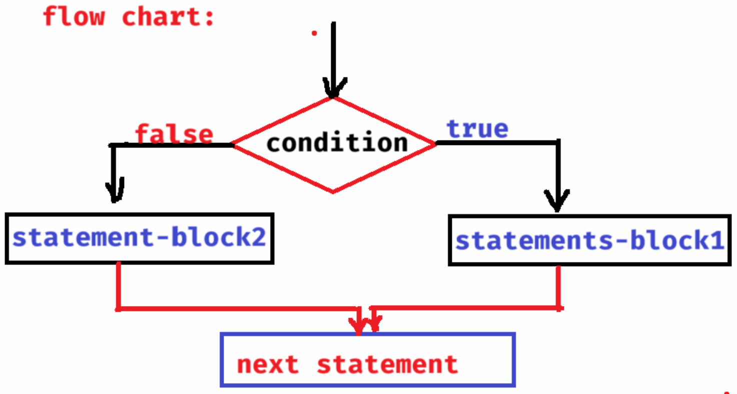
flow chart:



if else syntax:

```
if ( condition ) {
  //statements-block1
}
else {
  //statements-block2
}
```

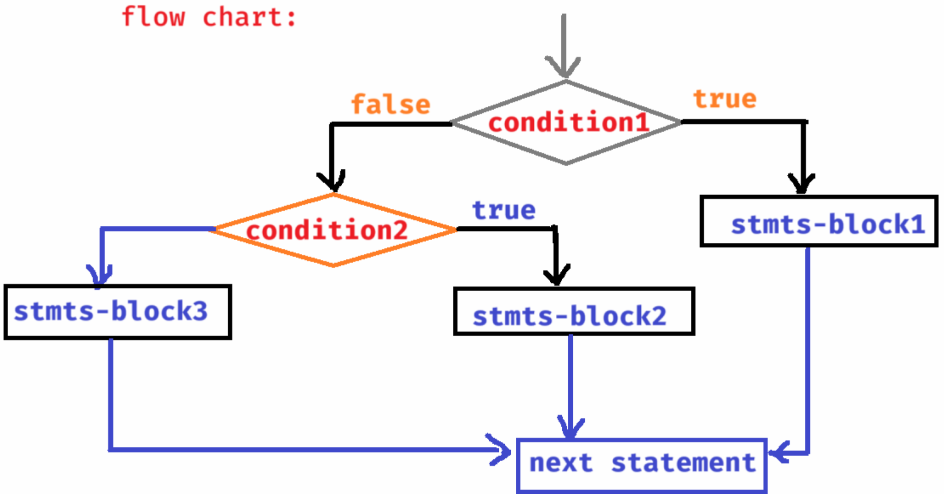
flow chart:



if else ladder syntax:

```
if ( condition1 ) {
  //statement-block1
}
else if ( condition2 ) {
  //statements-block2
}
else {
  //statement-block3
}
next statement;
```

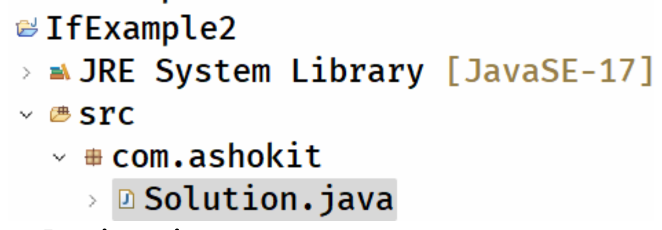
flow chart:



nested if syntax:

```
if ( condition1 ) {
  if ( condition2 ) {
     //statements-block1
  }
  else {
     //statements-block2
  }
}
else {
  //statements-block3
}
next statement;
```

```java
/*
 * This program reads two input values and then
 *  if a > b , prints a+b
 *  if a < b, prints a*b
 *  otherwise, prints a-b
 */
package com.ashokit;

import java.util.Scanner;

public class Demo {

    public static void main(String[] args) {
        Scanner scan = new Scanner(System.in);

        System.out.println("Enter first number");
        int a = scan.nextInt();

        System.out.println("Enter second number");
        int b = scan.nextInt();

        if( a > b ) {
            System.out.println(a + b);
        }
        else if ( a < b ) {
            System.out.println(a * b);
        }
        else {
            System.out.println(a - b);
        }

        scan.close();

    }

}
```

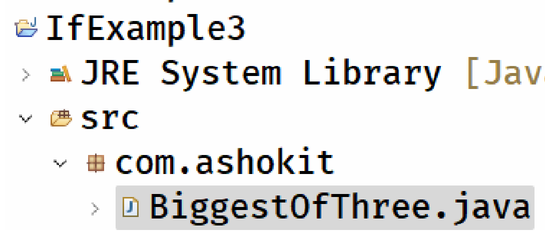


```
IfExample2
 > JRE System Library [JavaSE-17]
 v src
    v com.ashokit
       > Solution.java
```

Solution.java

```
/**
 * This program reads an integer value from the user
and
 * performs the following.
 *   -> if the given number is divisible by 3 then
displays "Zip"
 *   -> if the given number is divisible by 5 then
displays "Zap"
```

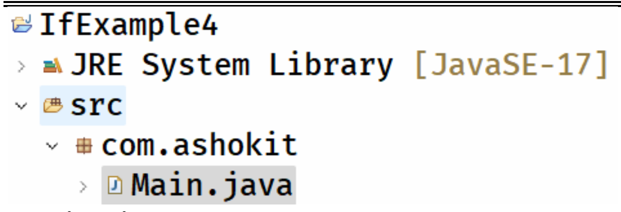
```
 *  -> if the given number is divisible by 3 and 5
then displays "Rar"
 *  -> otherwise, displays  "Jar"
 */
package com.ashokit;

import java.util.Scanner;

public class Solution {

	public static void main(String[] args) {

		Scanner scan = new Scanner(System.in);
		System.out.println("Enter a number");
		int n = scan.nextInt();

		if( n % 3 ==0 && n % 5 ==0 ) {
			System.out.println("Rar");
		}
		else if( n % 3 == 0 ) {
			System.out.println("Zip");
		}
		else if( n % 5 == 0 ) {
			System.out.println("Zap");
		}
		else {
			System.out.println("Jar");
		}

		scan.close();

	}

}
```



```
IfExample3
 > JRE System Library [JavaSE-17]
 v src
    v com.ashokit
       > BiggestOfThree.java
```

BiggestOfThree.java

```
/**
 * This program finds the biggest of
 * the 3 numbers.
 */
package com.ashokit;

import java.util.Scanner;

public class BiggestOfThree {

    public static void main(String[] args) {
        Scanner scan = new Scanner(System.in);
        System.out.println("Enter first number");
        int a = scan.nextInt();
        System.out.println("Enter second number");
        int b = scan.nextInt();
        System.out.println("Enter third number");
        int c = scan.nextInt();

        if( a > b && a > c )
            System.out.println("Biggest = " + a);

        else if( b > c )
            System.out.println("Biggest = " + b);

        else
            System.out.println("Biggest = " + c);

        scan.close();

    }

}
```



```
IfExample4
  > JRE System Library [JavaSE-17]
  v src
    v com.ashokit
      > Main.java
```

Main.java

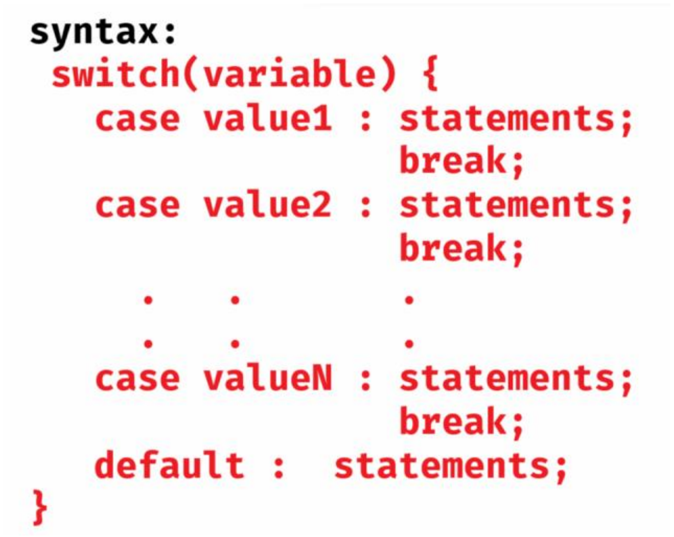
```
/**
```

```
 * Write a program to read the distance in kms as
input and
 * calculate the delivery fee as below.
 *   -> For first 3 kms, free delivery
 *   -> For next 3 kms, Rs 15 per km.
 *   -> For the remaining kms, Rs 20 per km.
 */
package com.ashokit;

import java.util.Scanner;

public class Main {

    public static void main(String[] args) {

        Scanner scan = new Scanner(System.in);
        System.out.println("Enter the distance in
kms");
        double distance = scan.nextDouble();

        double deliveryFee = 0;

        if( distance <= 3 ) {
            deliveryFee = 0;
        }
        else if( distance <= 6 ) {
            deliveryFee = (distance - 3) * 15;
        }
        else {
            deliveryFee = 3 * 15 + (distance - 6) *
20;
        }

        System.out.println("Delivery Fee = " +
deliveryFee);

        scan.close();

    }
}
```

```
Question:
 ------
  Take 3 numbers as input, and do the following.
   If last number is 7 then find the product of the two numbers.
   If middle number is 7 then find the division of the two numbers.
   If first number is 7 then find the modulus of the two numbers
   If no number is 7 then display -1.

Question:
 -------
   Take a year as input and check whether it is a leap year or not.
```

switch statement

- If you want to write multiple conditions on the same variable and the condition is equals(==) operator then instead of using if else ladder, you can use switch statement.
- With switch statement, you can make the code more readable and more understandable.



```
syntax:
 switch(variable) {
   case value1 : statements;
                 break;
   case value2 : statements;
                 break;
     .    .      .
     .    .      .
   case valueN : statements;
                 break;
   default :  statements;
 }
```

- In switch statement, the variable must be either integer type(byte/short/int/long), or char data type or String type only.
- The case values are also must be either integer type or char type or String type.
- writing the default case is optional.
- If you don’t write break in a case, then the control will execute the following cases also, until break statement occurs.

Q) can we use float/double/boolean variable in a switch statement?

A) No.

```
ex1:
  int a = 2;
  switch( a + 1 ) {
     case 1: Sop(“One”);
             break;
     case 2: Sop(“Two”);
             break;
     case 3: Sop(“Three”);
     case 4: Sop(“Four”);
     default : Sop(“Zero”);
  }
output:
     Three
     Four
     Zero
ex2:
  String signal = “blue”;
  switch(signal) {
     default : Sop(“RUN”);
     case “red” : Sop(“STOP”);
     case “yellow”: Sop(“WAIT”);
     case “green”: Sop(“START”);
  }
output:
   RUN
   STOP
   WAIT
   START

EX3:
   char ch = ‘w’;
   switch(ch) {
      case ‘a’:
      case ‘e’:
      case ‘i’:
      case ‘o’:
      case ‘u’: Sop(“Vowel”);
                break;
      default : Sop(“Consonant”);
   }
   output:
     Consonant
```

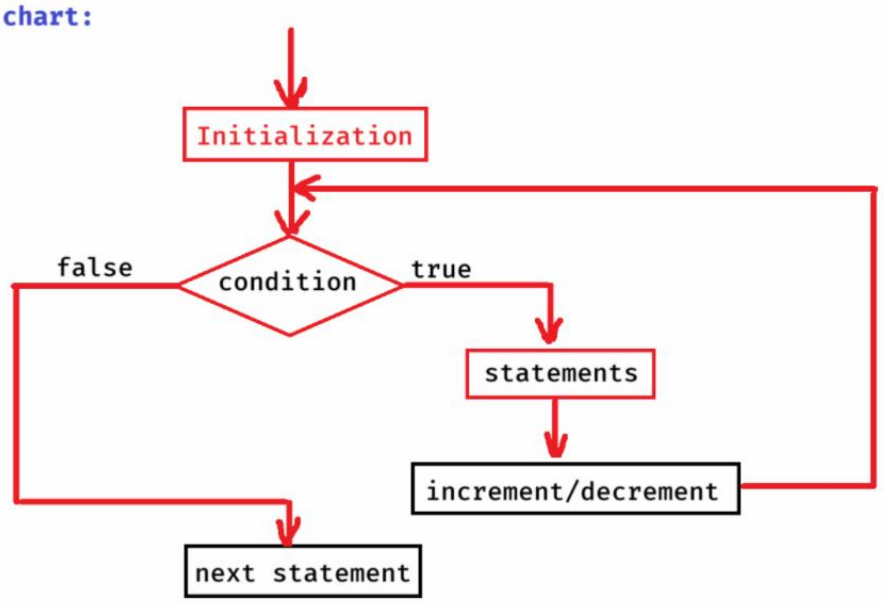
for loop :

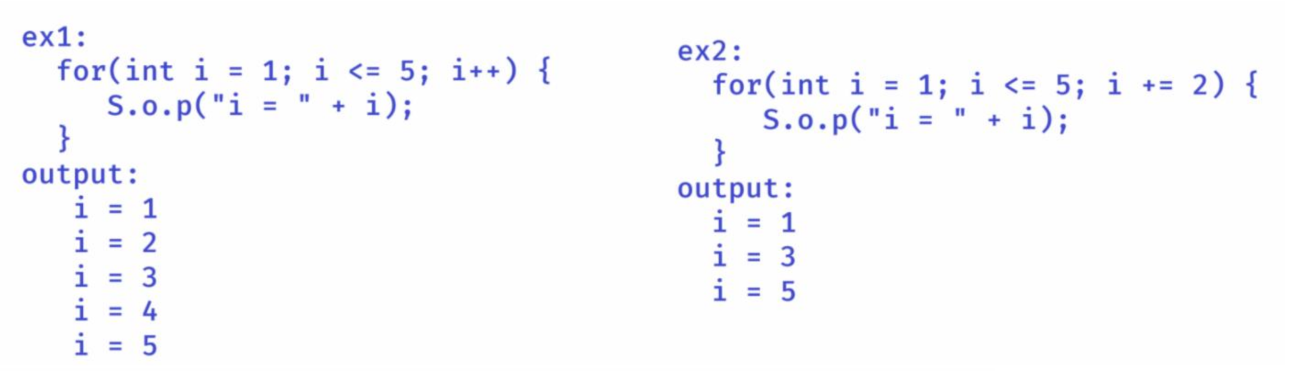
- If you want to execute some statements in a program repeatedly for multiple times based on some condition, then you need a loop.
- If you know how many times you need to repeat the loop, then use for loop.

```
syntax:

for( initialization; condition; increment/decrement ) {
      statements;
}
next statement;
```

```
* When control enters into for statement, first it executes initialization.
* Next the control checks the condition.
* If it is true, then the control will execute the statements in the for
loop body.
* Next the control executes the increment/decrement. After that, the control
goes back to the condition.
* The above two steps are executed repeatedly until, the given condition
becomes false.
* If false, the control goes to the next statement after the for loop.
```

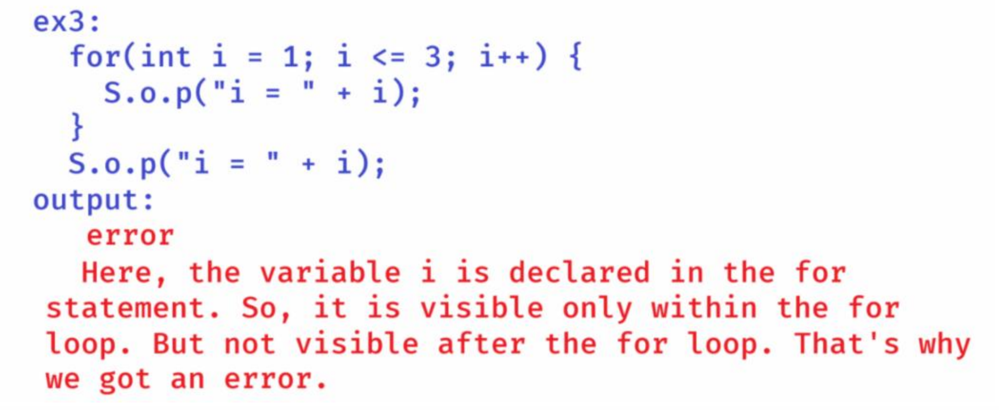
flow chart:



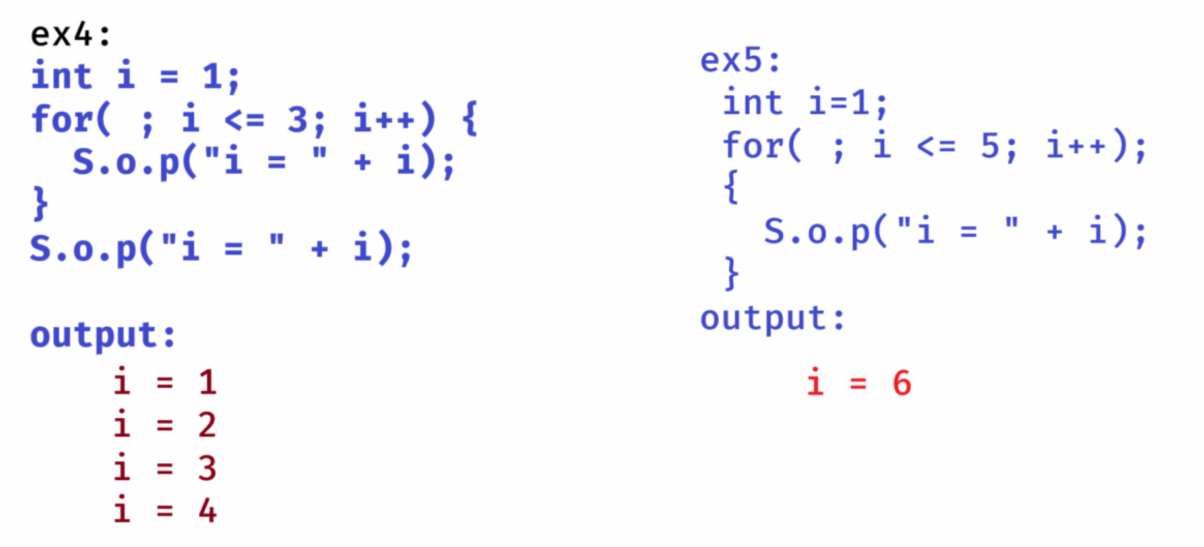


```
ex1:
  for(int i = 1; i <= 5; i++) {
     S.o.p("i = " + i);
  }
output:
   i = 1
   i = 2
   i = 3
   i = 4
   i = 5
```

```
ex2:
  for(int i = 1; i <= 5; i += 2) {
     S.o.p("i = " + i);
  }
output:
  i = 1
  i = 3
  i = 5
```



```
ex3:
  for(int i = 1; i <= 3; i++) {
    S.o.p("i = " + i);
  }
  S.o.p("i = " + i);
output:
   error
   Here, the variable i is declared in the for
 statement. So, it is visible only within the for
 loop. But not visible after the for loop. That's why
 we got an error.
```



```
ex4:
int i = 1;
for( ; i <= 3; i++) {
  S.o.p("i = " + i);
}
S.o.p("i = " + i);

output:
    i = 1
    i = 2
    i = 3
    i = 4
```

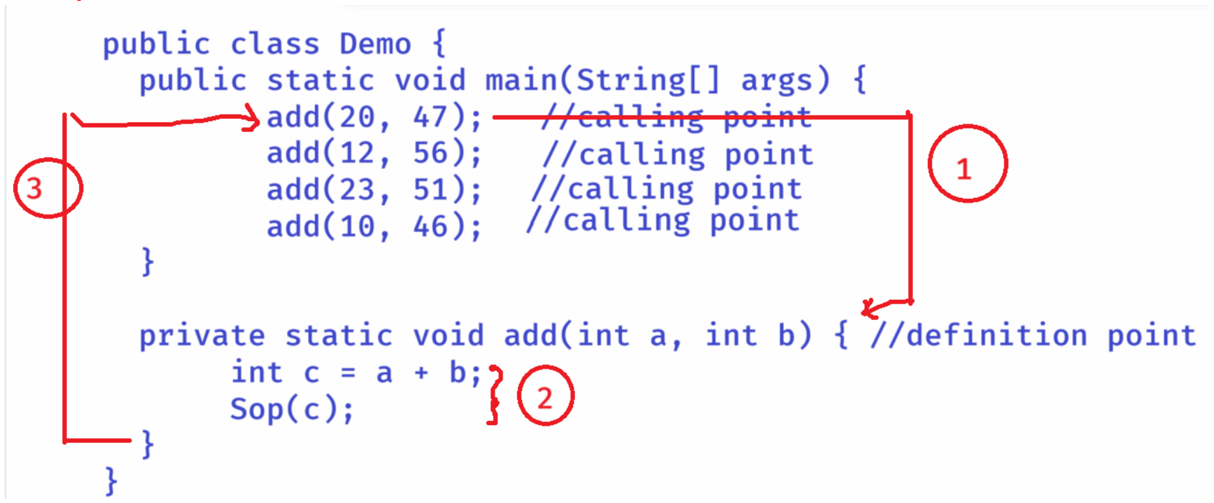
```
ex5:
 int i=1;
 for( ; i <= 5; i++);
 {
   S.o.p("i = " + i);
 }
output:

     i = 6
```

- Suppose, if you write the logic in a main method then when you run the program, JVM calls the main method and the logic in the main will be executed and then the program is terminated.
- If you want to execute the same logic again, then you have to run the program again.
- To make the logic as reusable, it is better to define the logic in another method. So, that you can call that method many times.

- The basic syntax of write a method is,
```
returntype  methodname(argument1, argument2, ..)
{
   //logic
}
```
ex:
```
    void add(int x, int y)
    {
       //logic
    }
```
Here, void is the return type and its meaning is, there is no value to return from this method.

ex:
```
     int multiply(int a, int b)
     {
        //logic
     }
```
Here, int is the return type and its meaning is, the method should return an integer value.

example:



```
public class Demo {
  public static void main(String[] args) {
         add(20, 47);   //calling point
         add(12, 56);   //calling point
         add(23, 51);   //calling point
         add(10, 46);   //calling point
  }

  private static void add(int a, int b) { //definition point
       int c = a + b;
       Sop(c);
  }
}
```

1. when you call a method, the control jumps from calling point to the definition point.
2. The logic defined in that method will be executed.
3. After execution, the control will be sent back to the calling point.

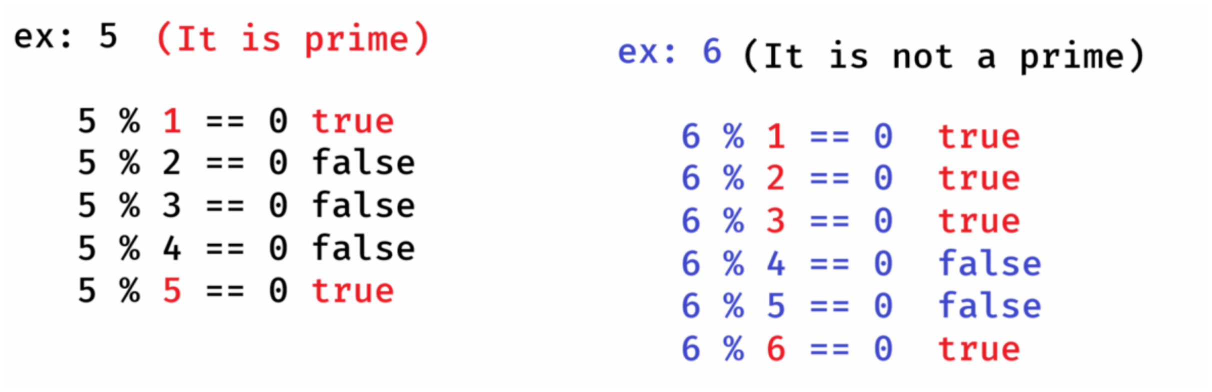
```
/*
 * This program reads n value from the user
 * and calculates the sum of n Natural numbers.
 * ex:
 *    if n = 5,
 *       1 + 2 + 3 + 4 + 5 = 15 //output
 */
package com.ashokit;
```

```java
import java.util.Scanner;

public class Sum {

    public static void main(String[] args) {

        Scanner scanner = new Scanner(System.in);
        System.out.println("Please enter n value to
calculate sum of n Natural numbers");
        int n = scanner.nextInt();
        findSum(n); //calling point
    }

    private static void findSum(int n) {
//definition point
        int sum = 0;

        for(int i = 1; i <= n; i++) {
            sum = sum + i;
        }
        System.out.println("SUM = " + sum);
    }
}
```

Prime number :

- **A natural number (>=1), which contains only 2 factors(1 and itself) is called as a prime number.**

ex:



```
ex: 5  (It is prime)                 ex: 6 (It is not a prime)

   5 % 1 == 0 true                      6 % 1 == 0  true
   5 % 2 == 0 false                     6 % 2 == 0  true
   5 % 3 == 0 false                     6 % 3 == 0  true
   5 % 4 == 0 false                     6 % 4 == 0  false
   5 % 5 == 0 true                      6 % 5 == 0  false
                                        6 % 6 == 0  true
```

```
Logic:
        n = 5
        count = 0
        for(int i = 1; i <= n; i++) {
           if( n % i == 0)
                count++;
        }
        if(count == 2)
           Sop("prime number");
        else
           Sop("prime number");
```

problem with the above logic:

* if n value is large, then the loop will repeat more times. So, it will decrease the performance of the program.

Logic2:

```
    n = 5;
    flag = false;
    for(int i = 2; i <= n/2; i++) {
       if(n % i == 0) {
         flag = true;
         break;
       }
    }
    if(flag == true)
       Sop("Not a prime number");
    else
       Sop("Prime number");
```

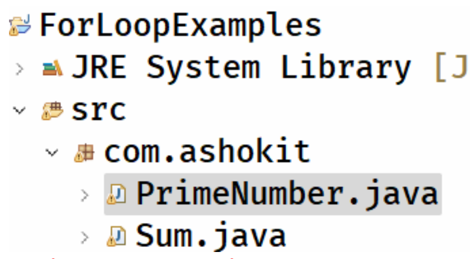
problem with this logic:

* This logic is reducing the iterations by approximately 50%. But still if the n value is large, then the loop will repeat more times. So, it will decrease the performance of the program.

Logic3:

```
n = 37;
flag = false;
for(int i = 2; i <= Math.sqrt(n); i++) {
  if(n % i == 0) {
    flag = true;
    break;
  }
}
if(flag == true)
  Sop("Not a prime number");
else
  Sop("Prime number");
```

- This is best logic to check for a prime number. Because it reduces lot of loop iterations, and improves the performance.



```
ForLoopExamples
 > JRE System Library [JavaSE-17]
 v src
   v com.ashokit
     > PrimeNumber.java
     > Sum.java
```

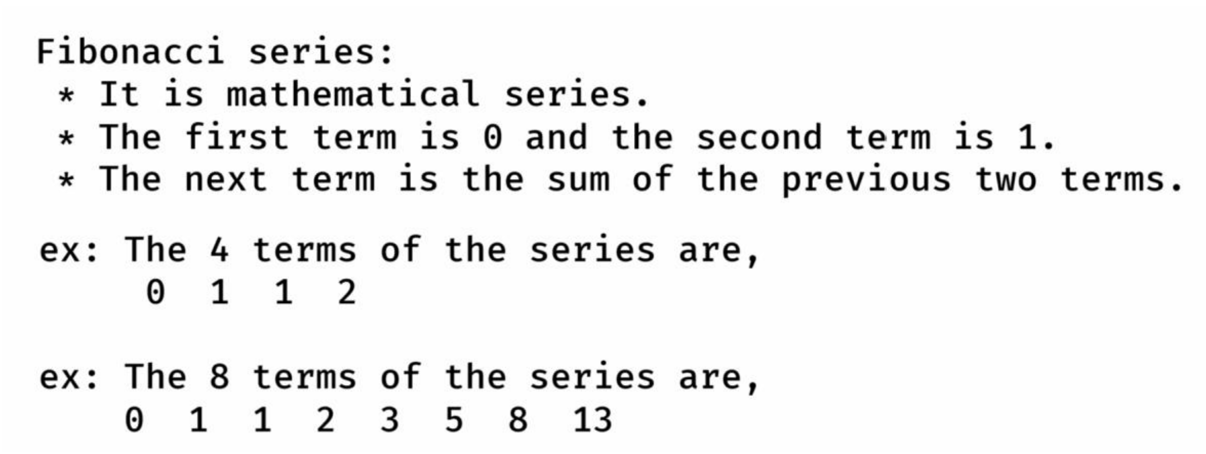
PrimeNumber.java

```
package com.ashokit;

import java.util.Scanner;

public class PrimeNumber {

    public static void main(String[] args) {

        Scanner scanner = new Scanner(System.in);
        System.out.println("Enter a number to check
it is prime or not");
        int n = scanner.nextInt();
        checkPrime(n);
    }

    private static void checkPrime(int n) {

        boolean flag = false;

        for(int i = 2; i <= Math.sqrt(n); i++) {
            if(n % i == 0) {
                flag = true;
                break;
            }
        }
        if(flag == true)
            System.out.println("It is not a prime
number");
        else
            System.out.println("It is a prime
number");
    }

}
```

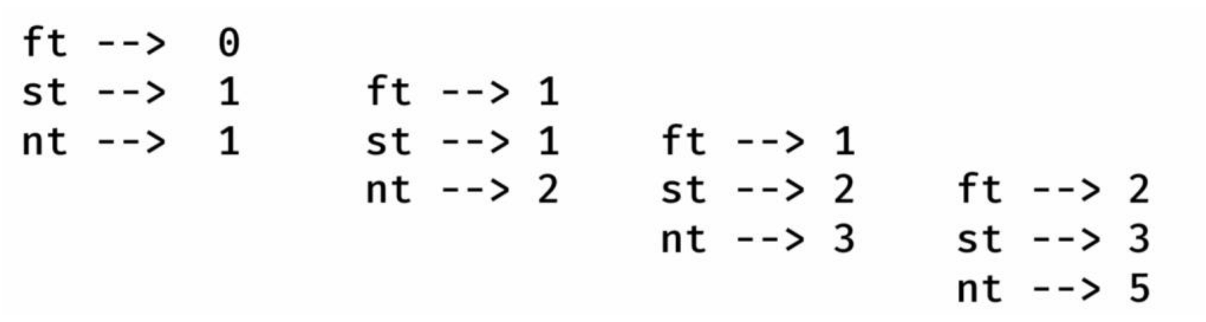
```
perfect number :
  If sum of the factors of a number, excluding
the given number is equal to the given number
then it is a perfect number.

ex:
  number = 6
  factors : 1, 2, 3
  sum of the factors: 6
   So, 6 is a perfect number
```

PerfectNumber.java

```java
package com.ashokit;

import java.util.Scanner;

public class PerfectNumber {

	public static void main(String[] args) {
		Scanner scanner = new Scanner(System.in);
		System.out.println("Enter a number to check whether it is 
perfect or not");
		int n = scanner.nextInt();
		checkPerfect(n);
		scanner.close();
	}

	private static void checkPerfect(int n) {
		int sum = 0;
		for(int i = 1; i <= n/2; i++) {
			if( n % i == 0 )
				sum = sum + i;
		}
		if( sum == n)
			System.out.println("It is perfect number");
		else
			System.out.println("It is not a perfect number");
	}
}
```



```
Fibonacci series:
 * It is mathematical series.
 * The first term is 0 and the second term is 1.
 * The next term is the sum of the previous two terms.

ex: The 4 terms of the series are,
     0  1  1  2

ex: The 8 terms of the series are,
    0  1  1  2  3  5  8  13
```



```
ft -->  0
st -->  1      ft --> 1
nt -->  1      st --> 1     ft --> 1
               nt --> 2     st --> 2     ft --> 2
                            nt --> 3     st --> 3
                                         nt --> 5
```

FibonacciSeries.java

```java
package com.ashokit;

import java.util.Scanner;

public class FibonacciSeries {

	public static void main(String[] args) {
		Scanner scanner = new Scanner(System.in);
		System.out.println("Enter n value to print fibonacci 
series");
		int n = scanner.nextInt();
		printFibonacci(n);
		scanner.close();
	}

	private static void printFibonacci(int n) {
		int firstTerm = 0;
		int secondTerm = 1;
		for(int i = 1; i <= n; i++) {
			System.out.print(firstTerm + "    ");
			int nextTerm = firstTerm + secondTerm;
			firstTerm = secondTerm;
			secondTerm = nextTerm;
		}
	}
}
```

Q) write a program to find the factorial of a given number?
Q) write a program to print the multiplication table of a given number?

Nested for loop:

- If you write a for loop inside another for loop then it is called a nested for loop.
- For each iteration of the outer for loop, the inner for loop will be completely executed.

ex:

```
for(int i=1; i<=2; i++) {

  for(int j=1; j<=2; j++) {

      Sop(j);

  }

}
```

output:

```
1

2

1

2
```

ex:

```
for(int i=1; i<=3; i++) {

   for(int j=1; j<=i; j++) {

      S.o.print(j + “ “);

   }

   S.o.println();

}
```

output:

```
1

1 2

1 2 3
```

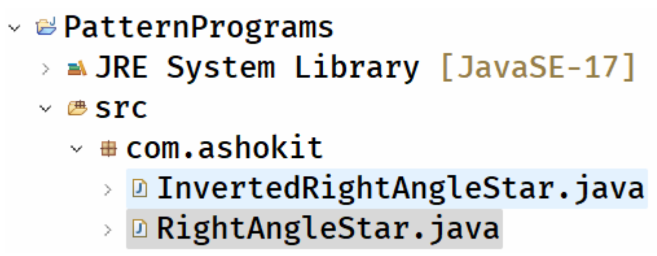
Pattern programs:

- while writing the pattern programs, follow the below steps.
- 1. we always use nested for loops to print the pattern
  2. we repeat the outer loop for rows/lines.
- 3. we repeat the inner loop for columns, by somehow finding
-    the relationship between rows and columns.
- 4. we always print star(*) in the inner loop.

ex: print the below right angle triangle star(*) pattern.

if n = 5, then output should be

```
*
* *
* * *
* * * *
* * * * *
```



```
PatternPrograms
  JRE System Library [JavaSE-17]
  src
    com.ashokit
      InvertedRightAngleStar.java
      RightAngleStar.java
```

RightAngleStar.java

```
package com.ashokit;

import java.util.Scanner;

public class RightAngleStar {

	public static void main(String[] args) {
		Scanner scanner = new Scanner(System.in);
		System.out.println("Enter n value to print Right angle star 
pattern");
		int n = scanner.nextInt();
		showPattern(n);
		scanner.close();
	}

	private static void showPattern(int n) {
		//rows
		for(int i = 1; i <= n; i++) {
			//columns
			for(int j = 1; j <= i; j++) {
				System.out.print("*" + " ");
			}
			System.out.println();

		}
	}
 }
```

InvertedRightAngleStar.java

```
/**
 * This program should display inverted right angle star
 * pattern for the given number of rows.
 * example:
 *      n = 5
 *  output:
 *          * * * * *
 *          * * * *
 *          * * *
 *          * *
 *          *
 */
package com.ashokit;

import java.util.Scanner;

public class InvertedRightAngleStar {

	public static void main(String[] args) {
		Scanner scanner = new Scanner(System.in);
		System.out.println("Enter n value to print Inverted Right angle 
star pattern");
		int n = scanner.nextInt();
		showPattern(n);
		scanner.close();
	}

	private static void showPattern(int n) {
		// rows
		for (int i = 1; i <= n; i++) {
			// columns
			for (int j = 1; j <= n - i + 1; j++) {
				System.out.print("*" + " ");
			}
			System.out.println();

		}

	}

}
```

LeftAngleStar.java

```
/**
 * This program should print Left Angle Star pattern for
 * the given number of rows.
 * example:
 *       n = 5
 *   output:
 *                 *
 *               * *
 *             * * *
 *           * * * *
 *         * * * * *
 */
```

```
package com.ashokit;
import java.util.Scanner;
public class LeftAngleStar {
	public static void main(String[] args) {

		Scanner scanner = new Scanner(System.in);
		System.out.println("Enter n value to print Left angle star
pattern");
		int n = scanner.nextInt();
		showPattern(n);
		scanner.close();
	}

	private static void showPattern(int n) {
		//rows
		for(int i = 1; i <= n; i++) {

			//inner loop1 : spaces
			for(int k = 1; k <= 2 * ( n - i ); k++) {
				System.out.print(" ");
			}
			//inner loop2 : stars
			for(int j = 1; j <= i; j++) {
				System.out.print("*" + " ");
			}
			System.out.println();

		}

	}
}
```

InvertedLeftAngleStar.java

```
/**
 * This program should print inverted left angle star
 * pattern for the given number of rows.
 * example:
 *      n = 5
 *    output:
 *        * * * * *
 *          * * * *
 *            * * *
 *              * *
 *                *
 */
package com.ashokit;

import java.util.Scanner;

public class InvertedLeftAngleStar {

	public static void main(String[] args) {
		Scanner scanner = new Scanner(System.in);
		System.out.println("Enter n value to print Inverted Left angle
star pattern");
		int n = scanner.nextInt();
		showPattern(n);
		scanner.close();
	}

	private static void showPattern(int n) {
		// rows
		for (int i = 1; i <= n; i++) {

			//inner loop1 : spaces
			for(int k = 1; k <= 2 * (i - 1); k++) {
				System.out.print(" ");
			}

			// inner loop2 : stars
			for (int j = 1; j <= n - i + 1; j++) {
				System.out.print("*" + " ");
			}
			System.out.println();

		}

	}
}
```

PyramidPattern.java

```
/**
 * This program prints a pyramid pattern for the given
 * number of rows.
 * example:
 *   if  n = 5,
 *   output:
 *                  *
 *                * * *
 *              * * * * *
 *            * * * * * * *
 *          * * * * * * * * *
 */
package com.ashokit;

import java.util.Scanner;

public class PyramidPattern {

	public static void main(String[] args) {
		Scanner scanner = new Scanner(System.in);
		System.out.println("Enter n value to print Pyramid star
pattern");
		int n = scanner.nextInt();
		showPattern(n);
		scanner.close();
	}

	private static void showPattern(int n) {
		// rows
		for (int i = 1; i <= n; i++) {

			//inner loop1 : spaces
			for(int k = 1; k <= 2 * (n - i); k++) {
					System.out.print(" ");
				}

				// inner loop2 : stars
				for (int j = 1; j <= 2 * i - 1; j++) {
					System.out.print("*" + " ");
				}
				System.out.println();

			}

		}
}
```

PascalTriangle.java

```
/**
 * This program should print a pascal triangle for the
 * given number of rows.
 * example:
 *    if  n = 5
 *   output:
 *            1
 *           1 1
 *          1 2 1
 *         1 3 3 1
 *        1 4 6 4 1
 */
package com.ashokit;

import java.util.Scanner;

public class PascalTriangle {

	public static void main(String[] args) {

		Scanner scanner = new Scanner(System.in);
		System.out.println("Enter n value to print the pascal
triangle");
		int n = scanner.nextInt();
		showPattern(n);
		scanner.close();
	}

	private static void showPattern(int n) {

		//rows
		for(int i = 0; i <= n - 1; i++) {
			//spaces
			for(int k = 0; k <= n - i - 1; k++) {
				System.out.print(" ");
			}

			//terms of the pascal triangle
			for(int j = 0; j <= i; j++) {
				int t = factorial(i) / (factorial(j) * factorial(i-
j));

				System.out.print(t + " ");
```

```
                }
                System.out.println();
            }

        }

        private static int factorial(int x) {

            int fact = 1;

            for(int i=1; i<=x; i++)
            {
                fact = fact * i;
            }
            return fact;
        }
}
```

```
/**
 * write a program to display the below character pattern.
 * example:
 *    if n = 5,
 *    output:
 *         A
 *         A B
 *         A B C
 *         A B C D
 *         A B C D E
 */
package com.ashokit;

import java.util.Scanner;

public class CharacterPattern {

        public static void main(String[] args) {
            Scanner scanner = new Scanner(System.in);
            System.out.println("Enter n value to print Right angle character 
pattern");
            int n = scanner.nextInt();
            showPattern(n);
            scanner.close();
        }

        private static void showPattern(int n) {
            //rows
            for(int i = 1; i <= n; i++) {
                //columns
                for(char ch = 'A'; ch <= 65 + i - 1; ch++) {
                    System.out.print(ch + " ");
                }
                System.out.println();

            }

        }


}
```

---

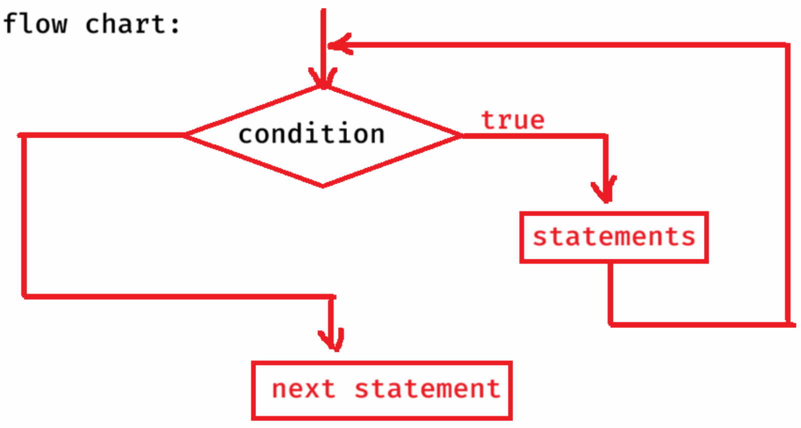
while loop

---

syntax:

```
while(condition) {
    statements;
}
next statement;
```

flow chart:



```java
/**
 * write a program to find the sum of the digits of
 * a given number.
 * ex:
 *   if n = 149
 *   output: 14
 */
package com.ashokit;

import java.util.Scanner;

public class SumOfDigits {

     public static void main(String[] args) {
          Scanner scanner = new Scanner(System.in);
          System.out.println("Enter a number to find the sum
of its digits");
          int n = scanner.nextInt();
          findSumOfDigits(n);
          scanner.close();

     }

     private static void findSumOfDigits(int n) {
          int sum = 0;
          while( n != 0 ) {
               int d = n % 10;
               sum = sum + d;
               n = n / 10;
          }
          System.out.println("Sum = " + sum);
     }

}
```

Armstrong number:

- If the sum of n^{th} power of each digit of a number is equal to the same number then it is called an Armstrong number.

ex:

number = 153

$1^3 + 5^3 + 3^3 = 153$

So, 153 is an Armstrong number.

ex:

number = 1634

$1^4 + 6^4 + 3^4 + 4^4 = 1634$

So, 1634 is an Armstrong number

. First findout/count how many digits are there in the given number.

. After that find the nth power of each digit and add it to the sum variable.

. finally check is the sum is matching with the given number or not. If yes, then the number is armstrong. Otherwise, not an armstrong number.

Armstrong.java

```java
/*
 * Write a program to check whether a given number is
 * an Armstrong number or not
 */
package com.ashokit;

import java.util.Scanner;

public class Armstrong {

	public static void main(String[] args) {

		Scanner scanner = new Scanner(System.in);
		System.out.println("Enter a number to verity is it
an Armstrong number or not");
		int n = scanner.nextInt();
		boolean flag = checkArmstrong(n);
		if(flag == true)
			System.out.println("It is an Armstrong
number");
		else
			System.out.println("It is not an Armstrong
number");
```

```
            scanner.close();

      }

      private static boolean checkArmstrong(int n) {
            int sum = 0;
            int temp1 = n;
            int temp2 = n;
            int count = 0;

            //This while loop counts the num of digits
            while(temp1 != 0) {
                  int d = temp1 % 10;
                  count++;
                  temp1 = temp1 / 10;
            }

            //This while loop finds the sum
            while(temp2 != 0) {
                  int d = temp2 % 10;
                  sum = sum + (int)Math.pow(d, count);
                  temp2 = temp2 / 10;
            }
            if( sum == n )
                  return true;
            else
                  return false;
      }

}
```

Strong number:

- If sum of the factorials of each digit of a number is equal to the same number then it is a strong number.

```
ex:   n = 145

       1! + 4! + 5! = 145

      So, 145 is a strong number
```

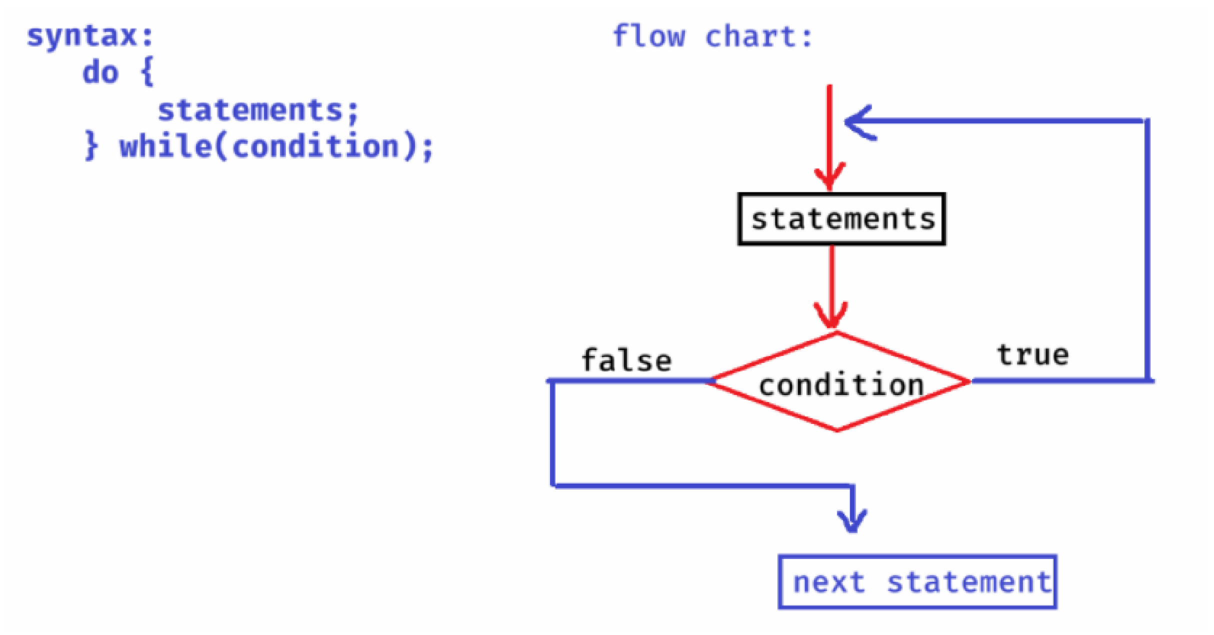
Palindrome Number:

- If reverse of a number is equal to the same number then we call it as a palindrome number.

```
  ex:   number = 145
        reverse = 541
        Not a palindrome
  ex:
      number = 12321
      reverse = 12321
      Yes, it’s a palindrome.
Palindrome.java
```

```java
/**
 * This program checks whether a given number is
 * palindrome or not
 */
package com.ashokit;

import java.util.Scanner;

public class Palindrome {

	public static void main(String[] args) {

		Scanner scanner = new Scanner(System.in);
		System.out.println("Enter a number to check is it palindrome or 
not");
		int n = scanner.nextInt();
		boolean flag = isPalindrome(n);
		if(flag == true)
			System.out.println("Yes, it is a palindrome number");
		else
			System.out.println("No, it is not a palindrome number");
		scanner.close();

	}

	private static boolean isPalindrome(int n) {
		int temp = n;
		int rev = 0;

		while( n != 0) {
			int d = n % 10;
			rev = rev * 10 + d;
			n = n / 10;
		}

		if(rev == temp)
			return true;
		else
			return false;
	}

}
```

do while loop:


syntax:
```
    do {
         statements;
    } while(condition);
```
flow chart:

Guess.java

```java
/**
 * This program will accept a number b/w 0 to 9 from the
 * user and also generates a random number b/w 0 to 9.
 * If both are matched, then Guess is correct. Otherwise,
 * Guess is wrong.
 */
package com.ashokit;

import java.util.Random;
import java.util.Scanner;

public class Guess {

	public static void main(String[] args) {

		Scanner scanner = new Scanner(System.in);
		int n = -1;
		do {
			System.out.println("Enter a number between 0 to 9");
			n = scanner.nextInt();
		} while( n < 0 || n > 9);

		Random r = new Random();
		int k = r.nextInt(10); // generates a random number b/w 0 to 9
		if(n == k) {
			System.out.println("Your number : " + n);
			System.out.println("System number : " + k);
			System.out.println("Guess is correct!");
		}
		else {
			System.out.println("Your number : " + n);
			System.out.println("System number : " + k);
			System.out.println("Guess is wrong!!");
		}

		scanner.close();
```

```
      }

}
```

1) write a program to print all the prime numbers between 1 to 100.
2) write a program to print all the armstrong numbers between 1 to 1000

break & continue statements:

- break statement is used to move the control to out of the loop or switch statement.

ex:

```
    for(int i=1; i<=3; i++)
    {
       if( i * 2 > 2)
         break;
       Sop(i);
    }
 output: 1
```

ex:

```
    for(int i=1; i<=3; i++)
    {
     for(int j=1; j<=3; j++)
     {
         if(i+j > 3)
           break;
         Sop(j);
     }
    }
 output:
       1
       2
       1
```

=============

PinCheck.java

```java
/**
 * This program is to read atm pin from the user.
 * It provides 3 attempts. If 3 attempts are not correct then displays locked.
 * If matched in <= 3 attempts, then display pin valid, then breaks the loop.
 */
package com.ashokit;

import java.util.Scanner;

public class PinCheck {

	public static void main(String[] args) {

		Scanner scanner = new Scanner(System.in);
		int correctPin = 1234;
		int attempt=1;
		for (  ; attempt <= 3; attempt++) {
			System.out.println("Enter ATM pin : ");
			int enteredPin = scanner.nextInt();
			if (enteredPin == correctPin) {
				System.out.println("Pin is valid. Welcome to ATM");
				break;
			} else {
				System.out.println("Pin is incorrect! Remaining attempts : " +
(3 - attempt));
			}
		}

		if (attempt > 3)
			System.out.println("Your card is locked for 24 hours");

	}

}
```

- **continue statement is used to move the control for the next iteration of the loop, by skipping the execution of the remaining staements of the loop, after the continue statement.**

ex:

```
   for(int i=1; i<=5; i++) {
        if( i * i < 6)
             continue;
        Sop(i);
   }
```

output:

```
      3
      4
      5
```

Solution.java

```
/*
 * This program finds the sum of 5 positive integers
 * entered by the user.
 * if negitive integer is entered, then continue statement
will
 * repeat the loop for next iteration.
 */
package com.ashokit;

import java.util.Scanner;

public class Solution {

	public static void main(String[] args) {

		Scanner scanner = new Scanner(System.in);
		int sum = 0;
```

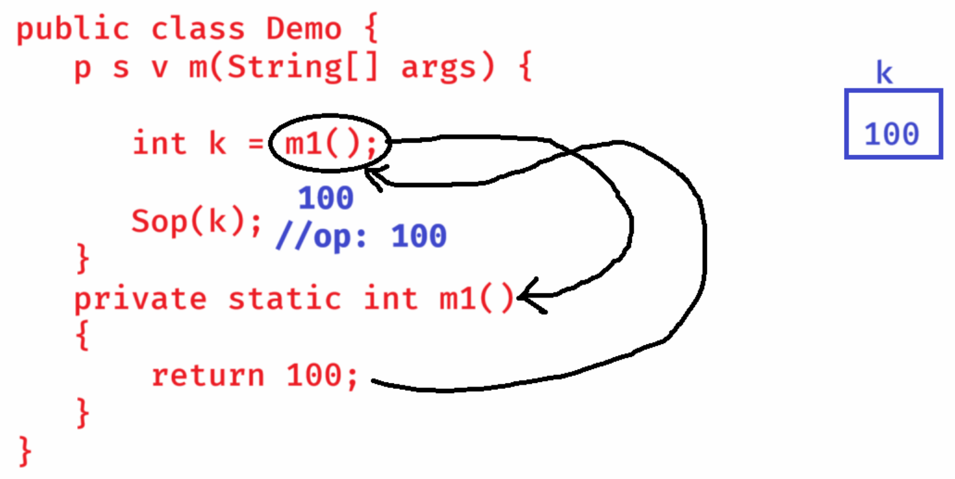
```
        int count = 0;

        while(true) {   //infinite loop
            System.out.println("Enter a positive integer");
            int n = scanner.nextInt();
            if( n < 0)
                continue;

            sum = sum + n;
            count++;
            if(count == 5)
                break;

        }

        System.out.println("sum = " + sum);

    }

}
```

---

return and exit statements:

- **return statement is used to return/move the control from the method definition to the method calling point.**
- **If a method returns any value, then the method calling point will be replaced with the returned value.**

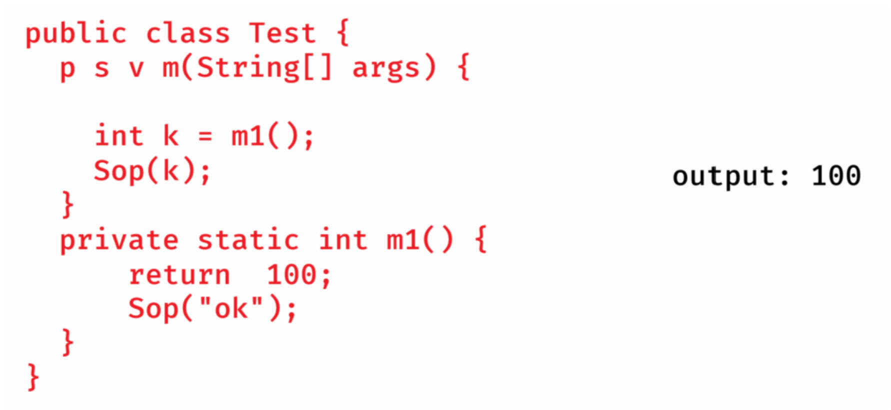
ex:



```
public class Demo {
    p s v m(String[] args) {

        int k = m1();
                 100
        Sop(k);  //op: 100
    }
    private static int m1()
    {
        return 100;
    }
}
```

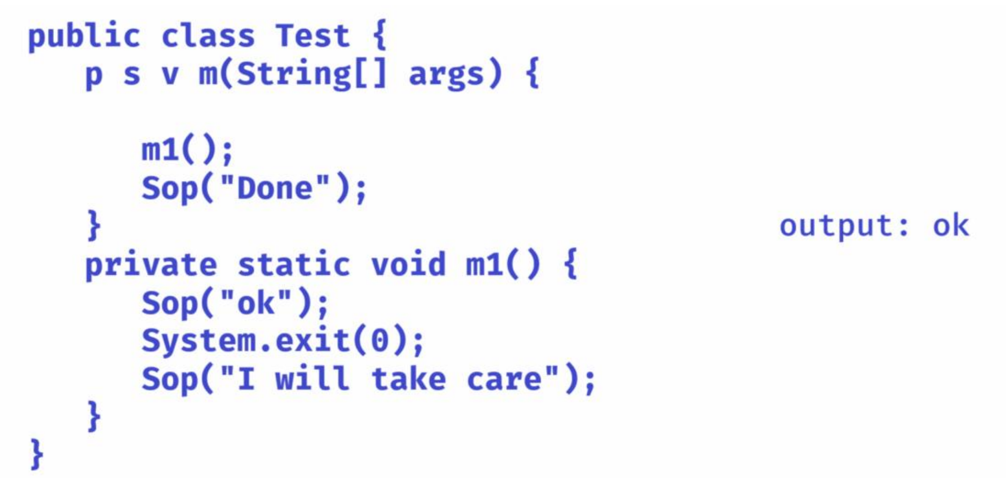
- **If return statement is executed, the next statements after the return will not be executed.**

ex:



```
public class Test {
  p s v m(String[] args) {

    int k = m1();
    Sop(k);                                output: 100
  }
  private static int m1() {
      return  100;
      Sop("ok");
  }
}
```

- exit statement will terminate the currently running JVM immediately.
- After exit statement, no statements of the program will be executed.



```
public class Test {
   p s v m(String[] args) {

      m1();
      Sop("Done");
   }                                    output: ok
   private static void m1() {
      Sop("ok");
      System.exit(0);
      Sop("I will take care");
   }
}
```

Arrays

- Suppose, an application has multiple values and to hold them, multiple variables are created.
- The issues are,
  1. If too many variables are created, then code complexity will be increased.
  2. The memory for the variables are allocated randomly at different places. So, retrieving/fetching the value of a variable requires entire memory search by the JVM. So, the performance of an application will be decreased.
- The solution for the above problems is arrays.
- An array is a single variable but it can store multiple values, in continuous memory locations.
- So, the number of variables are decreased and the performance will be increased.

array declaration, creation and initialization:

```
datatype[]  arrayname;  // array declaration
    (or)
datatype arrayname[]; //array declaration

arrayname = new datatype[size];  //array creation
```

. we can combine array declaration and creation together.

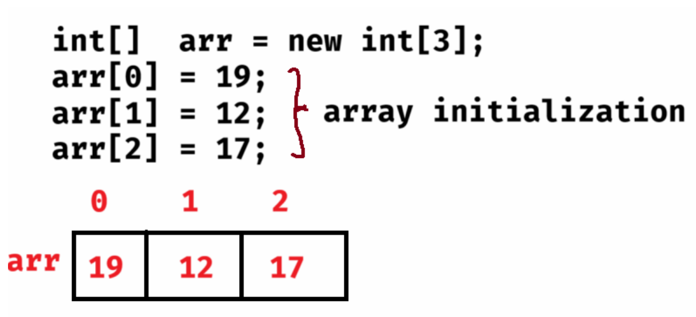
```
datatype[]  arrayname = new datatype[size];
```

ex:

```
 int[]  tkt_numbers = new int[200];
 float[] prices_in_this_week = new float[7];
 char[]  vowels = new char[5];
```

ex:

```
 int[] arr = new int[3];
```



```
int[]  arr = new int[3];
arr[0] = 19;  }
arr[1] = 12;  } array initialization
arr[2] = 17;  }
```

- we can also combine array declarion, creation and initialization in a single statement.

ex:

```
int[] arr = new int[] { 19, 12, 17};
       (or)
int[] arr = { 19, 12, 17};
```

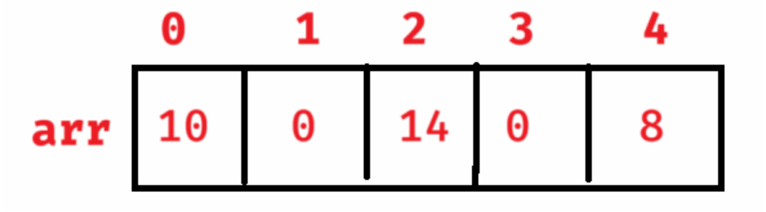
length attribute:

- length attribute can be used to find the size of an array.

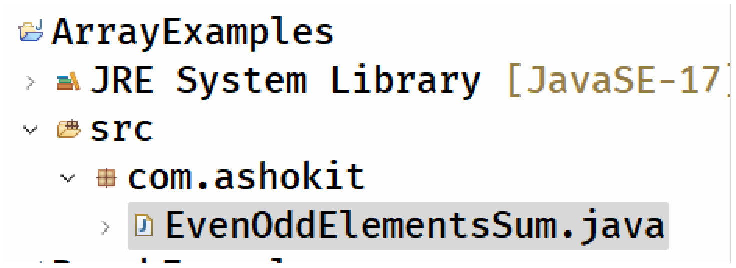
ex1:

```
  int[] arr = new int[3];
  arr[0]=10;
  arr[1]=20;
  arr[2]=30;
  System.out.println( arr.length ); //output: 3
```

```
ex2:
  int[] arr = new int[5];
  arr[0] = 10;
  arr[2] = 14;
  arr[4] = 8;
  System.out.println(arr.length); //output: 5
  System.out.println(arr[1]); //output: 0
  System.out.println(arr[3]); //output: 0
```



limitations of an array:
 ----
1. Once an array is created with a size, it is fixed. We can’t increase/decrease the size.
2. If an array is created with more than required size then memory will be wasted. If created with less than required size then we will get shortage of memory.
3. An array can only store homogeneous elements(same type).
4. We don’t have pre-defined methods to perform insert/delete/update/search/sort operations. It is called lack of pre-defined methods.



EvenOddElementsSum.java

```java
/**
 * This program finds sum of even and odd elements
 * of an array separately.
 * It should read the size and the elements of an array
 * from the user.
 */
package com.ashokit;

import java.util.Scanner;

public class EvenOddElementsSum {
	public static void main(String[] args) {

		Scanner scanner = new Scanner(System.in);
		System.out.println("Enter the size of an array");
		int size = scanner.nextInt();

		//create an array
		int arr[] = new int[size];

		//store elements
		for(int i = 0; i < size; i++) {
			System.out.println("Enter element for index : "
+ i);
			arr[i] = scanner.nextInt();
		}

		findEvenOddSum(arr);
		scanner.close();
	}

	private static void findEvenOddSum(int[] arr) {

		int evenSum = 0, oddSum = 0;

		for(int i = 0; i < arr.length; i++) {
			if (arr[i] % 2 == 0)
				evenSum = evenSum + arr[i];
			else
				oddSum = oddSum + arr[i];
		}

		System.out.println("sum of even elements :   " +
evenSum);
		System.out.println("sum of odd elements : " +
oddSum);

	}

}
```

MaxConsecutiveElement.java

```
package com.ashokit;

public class MaxConsecutiveElement {

	public static void main(String[] args) {

		int[] arr = { 1, 1, 3, 3, 3, 3, 2, 2, 4, 2, 2, 2};
```

```java
		findMaxConsecutiveElement(arr);
	}

	private static void findMaxConsecutiveElement(int[] arr)
{

		int maxi = 0, count = 1, element = 0;

		for(int i = 0; i < arr.length - 1; i++) {

			if (arr[i] == arr[i+1]) {
				count++;
			}
			else {
				count = 1;
			}

			if(count > maxi) {
				maxi = count;
				element = arr[i];
			}

		}

		System.out.println("The element : " + element + "
has repeated consecutively for : "+maxi + " times");

	}

}
```

LinearSearch.java

```java
/*
 * This program will search for the given element
 * in an array, using linear search.
 * linear search : comparing the given element with
 *                 each element of the array sequentially.
 */
package com.ashokit;

import java.util.Scanner;

public class LinearSearch {

	public static void main(String[] args) {

		Scanner scanner = new Scanner(System.in);
		System.out.println("Enter the size of an array");
		int size = scanner.nextInt();
		if(size < 1) {
			System.out.println("Invalid array size!");
			System.exit(0);
		}

		//create an array
		int arr[] = new int[size];

		//store the elements
		for(int i = 0; i < size; i++) {
			System.out.println("Enter element for index : "
+ i);
			arr[i] = scanner.nextInt();
		}

		System.out.println("Enter search element");
		int searchElement = scanner.nextInt();

		boolean flag = linearSearch(arr, searchElement);
		if (flag == true)
			System.out.println("Element found");
		else
			System.out.println("Element not found");
		scanner.close();

	}

	private static boolean linearSearch(int[] arr, int
searchElement) {

		for(int i = 0; i < arr.length; i++) {
			if ( arr[i] == searchElement )
				return true;
		}

		return false;
	}

}
```

Solution.java

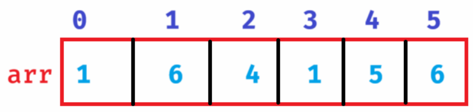
```
/*
 * write a program to search for an element in the given array
 * using binary search.
 *
 * binary search:
 *	1. array elements must be in ascending order.
```

```java
 *      2. find the low and high index of the array
 *      3. find the mid index as (low + high) /2
 *      4. if searching element is equal to arr[mid], then element
 *         is found, andbreak the loop.
 *      5. if searching element > arr[mid], then low = mid + 1
 *      6. if searching element < arr[mid], then high = mid - 1
 *      7. repeat the steps 3 to 6, until low <= high
 *      8. if low > high, then element is not found.
 */

import java.util.Arrays;
import java.util.Scanner;

public class Solution {

	public static void main(String[] args) {

		Scanner scan = new Scanner(System.in);
		System.out.println("Enter the size of an array");
		int size = scan.nextInt();

		if( size < 1 ) {
			System.out.println("size invalid. Try again....");
			System.exit(1);
		}

		//create an array
		int[]  arr = new int[size];

		for(int i = 0; i < size; i++ ) {
		  System.out.println("Enter the element for index :"+ i);
		  arr[i] = scan.nextInt();
		}

		System.out.println("Enter searching element");
		int searchingElement = scan.nextInt();

		binarySearch(arr, searchingElement);
	    scan.close();

	}

	private static void binarySearch(int[] arr, int searchingElement) {

		//sort the array
		Arrays.sort(arr);

		int low = 0;
		int high = arr.length - 1;

		boolean flag = false;

		while(low <= high) {

			int mid = (low + high) / 2;

			if(arr[mid] == searchingElement) {
				System.out.println("element is found at index: " + mid);
				flag = true;
				break;
			}
			else if(arr[mid] > searchingElement)
				high = mid - 1;
			else
```

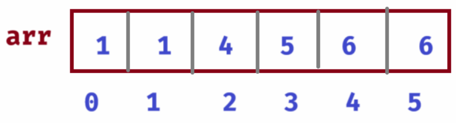
```
                low = mid + 1;
            }

            if(flag == false) {
                System.out.println("element is not found");
            }

    }

}
```

remove the duplicate elements from the array:

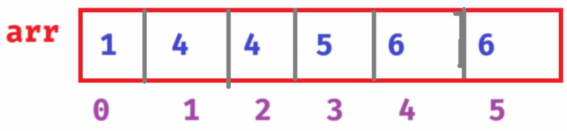
```
int[] arr = { 1, 6, 4, 1, 5, 6 };
I want to remove duplicate elements?
```



* To remove the duplicates, first array elements must be sorted.
Arrays.sort(arr);

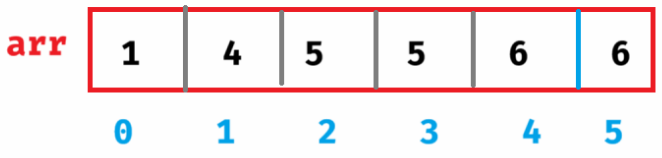


```
i = 0, j = 1        arr[i] == arr[j]
                    yes: increment j

i = 0, j = 2        arr[i] == arr[j]
                    no :
                         increment i
                         copy arr[j] to  arr[i]

                       i = 1
                       arr[1] = arr[2]
```

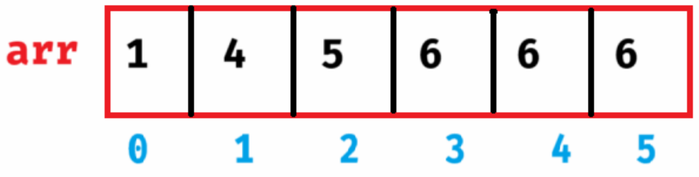


```
i = 1, j = 2        arr[i]==arr[j]
                    yes: increment j
```

```
i=1, j=3        arr[i] == arr[j]
                No:
                     increment i
                     copy arr[j] to arr[i]

                      i=2
                     arr[2] = arr[3]
```



```
i = 2, j = 3          arr[i] == arr[j]
                      Yes: increment j

i=2, j = 4            arr[i] == arr[j]
                      No:
                           increment i
                           copy arr[j] to arr[i]

                           i=3
                           arr[3] = arr[4]
```



```
i=3, j=4          arr[i] == arr[j]
                  yes: increment j

i=3, j=5          arr[i] == arr[j]
                  Yes: increment j

 i=3, j=6          j is crossing the last index
                   Loop is stopped.
```

Now display the elements only from 0 to i

```
  1  4  5  6
```

RemoveDuplicates.java

```java
/*
 * This program will remove the duplicate elements
 *  and prints only unique elements of the array.
 */
package com.ashokit;

import java.util.Arrays;

public class RemoveDuplicates {

	public static void main(String[] args) {

		int arr[] = { 2, 5, 3, 2, 3, 4, 1 };
		removeDuplicates(arr);
	}

	private static void removeDuplicates(int[] arr) {
		int i = 0;

		System.out.println("Original array elements  : ");
		for(int x = 0; x < arr.length; x++) {
			System.out.print(arr[x] + "  ");
		}

		System.out.println();

		System.out.println("+*+".repeat(20));

		//sort the array
		Arrays.sort(arr);

		for (int j = 1; j < arr.length; j++) {
			if (arr[i] == arr[j])
				continue;
			else {
				i++;
				arr[i] = arr[j];
			}
		}

		//display
		System.out.println("After removing duplicate elements : ");
		for (int k = 0; k <= i; k++ ) {
			System.out.print(arr[k] + "  ");
		}

	}

}
```

for each loop:

- In Java, we have two types of for loops.
  1. for loop/numerical for loop

2. for each loop / enhanced for loop

- for each loop can be used only with arrays and collections.

syntax:
```
   for(datatype variable : array/collection)
   {
        statements;
   }
```

ex:
```
   char[]  ch = { 'a', 'e', 'i', 'o', 'u' };

   for(char c : ch) {

     S.o.p(c);

   }
```

======================

ArraysUnion.java

```
/**
 * This program finds the union of 2 arrays.
 * ex:
 *   int[] a = {2, 5, 1, 4};
 *   int[] b = {1, 3, 5}
 * output:
 *      { 2, 5, 1, 4, 3 }
 */
package com.ashokit;

import java.util.LinkedHashSet;

public class ArraysUnion {

      public static void main(String[] args) {

            int[] a = { 2, 5, 1, 4 };
            int[] b = { 1, 3, 5 };
            int[] c = findUnion(a, b);

            System.out.println("The result of union operation");
            for(int k : c) {
                  System.out.print(k + "   ");
            }


      }

      private static int[] findUnion(int[] a, int[] b) {

            LinkedHashSet<Integer>  lhs = new LinkedHashSet<>();

            //add first array elements to the LinkedHashSet
            for(int x : a) {
```

```
                        lhs.add(x);
                }

                //add second array elements to the LinkedHashSet
                for(int x : b) {
                        lhs.add(x);
                }

                int[]  c = new int[lhs.size()];

                int i = 0;
                //copy the elements from lhs object to new array
                for(int x : lhs) {
                        c[i] = x;
                        i++;
                }

                return c;
        }

}
```

ArraysIntersection.java

```
/**
 * This program finds the intersection of 2 arrays.
 * ex:
 *   a[ ] = { 3, 0, 6, 7, 5}
 *   b[ ] = { 2, 9, 0, 7, 4}
 *  output:
 *      0  7
 */
package com.ashokit;

import java.util.LinkedHashSet;

public class ArraysIntersection {

        public static void main(String[] args) {

                int[]  arr1 = { 2, 7, 0, 1, 4};
                int[]  arr2 = { 3, 0, 5, 4, 7, 2};
                findIntersection(arr1, arr2);
        }

        private static void findIntersection(int[] arr1, int[] arr2) {

                LinkedHashSet<Integer>  lhs = new LinkedHashSet<Integer>();

                //add first array elements to the lhs
                for(int x : arr1) {
                        lhs.add(x);
                }

                //read the elements from second array and
                //check is it exist in lhs

                for(int k : arr2) {
                        if(lhs.contains(k)) {
                                System.out.print(k + "    ");
                        }
                }

        }

}
```

Bubble sort:

- In bubble sort, we have to compare the two adjacent elements.
- if the first element is greater than second element then we should swap them.
- In each pass, one largest element will be bubbled to the end of the array.
- If array has n elements, then elements can be sorted in n-1 passes.
- Suppose, if n = 5, then the elements indexes to compare are,

```
  pass1 : 0,1  1,2  2,3  3,4
  pass2 : 0,1  1,2  2,3
  pass3 : 0,1  1,2
  pass4 : 0,1
example:
   [3, 8, 1, 5, 0]
pass1:
    [3, 8, 1, 5, 0]
    [3, 1, 8, 5, 0]
    [3, 1, 5, 8, 0]
    [3, 1, 5, 0, 8]  8 is bubbled.

pass2:
    [1, 3, 5, 0, 8]
    [1, 3, 5, 0, 8]
    [1, 3, 0, 5, 8]  5 is bubbled

pass3:
    [1, 3, 0, 5, 8]
    [1, 0, 3, 5, 8]  3 is bubbled.

pass4:
    [0, 1, 3, 5, 8]  1 is bubbled.
```

recursion:

- recursion means, calling a method again from the body of the same method.
- recursion must know, when it should stop. Otherwise, it becomes infinite, at some point of time, JVM throws StackOverflowError.

FactorialReursion.java

```
package com.ashokit;

import java.util.Scanner;

public class FactorialRecursion {
	public static void main(String[] args) {

		Scanner scanner = new Scanner(System.in);
		System.out.println("Enter a number");
		int n = scanner.nextInt();

		int result = factorial(n);
		System.out.println("Factorial = "  + result);
		scanner.close();

	}

	private static int factorial(int n) {

		if( n == 0 || n == 1)
			return 1;
		else
			return  n * factorial(n - 1);
	}

}
```

FibonacciRecursion.java

```
/**
 * This program will print the fibonacci series of
 * n terms, with recursion.
 */
package com.ashokit;

import java.util.Scanner;

public class FibonacciRecursion {

	public static void main(String[] args) {

		//connect Scanner to the keyboard input
		Scanner scanner = new Scanner(System.in);
		System.out.println("Enter n value to print fibonacci terms");
		int n = scanner.nextInt();

		for(int i = 0; i < n; i++) {
			int k = fibonacci(i);
			System.out.print(k + "  ");
		}

		scanner.close();
	}

	private static int fibonacci(int i) {
		if (i == 0)
			return 0;
		if (i == 1)
			return 1;
```

```
            return fibonacci(i-1) + fibonacci(i-2);

        }

}
```

MergeSort.java

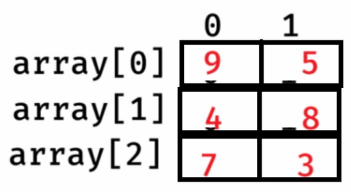
```
package com.ashokit;

public class MergeSort {

    public static void main(String[] args) {

        int[] arr = { 3, 0, 9, 5, 2, 11 };


        System.out.println("Original array:");
        printArray(arr);

        mergeSort(arr, 0, arr.length - 1);

        System.out.println("Sorted array:");
        printArray(arr);
    }

    // Main mergeSort method
    private static void mergeSort(int[] array, int left, int
right) {
        if (left < right) {
            // Find the middle point
            int mid = (left + right) / 2;

            // Sort the first and second halves
            mergeSort(array, left, mid);
            mergeSort(array, mid + 1, right);

            // Merge the sorted halves
            merge(array, left, mid, right);
        }
    }

    // Merge two subarrays
    private static void merge(int[] array, int left, int mid,
int right) {
        // Sizes of subarrays
        int n1 = mid - left + 1;
        int n2 = right - mid;
        // Create temp arrays
        int[] L = new int[n1];
        int[] R = new int[n2];

        // Copy data
        for (int i = 0; i < n1; i++)
            L[i] = array[left + i];
        for (int j = 0; j < n2; j++)
            R[j] = array[mid + 1 + j];

        // Merge temp arrays
        int i = 0, j = 0;
        int k = left;
        while (i < n1 && j < n2) {
            if (L[i] <= R[j]) {
                array[k++] = L[i++];
            } else {
                array[k++] = R[j++];
            }
        }

        // Copy remaining elements
        while (i < n1) {
            array[k++] = L[i++];
        }

        while (j < n2) {
            array[k++] = R[j++];
        }
    }

    // Utility to print array
    private static void printArray(int[] arr) {
        for (int val : arr)
            System.out.print(val + " ");
        System.out.println();
    }


}
```

Two Dimensional array:

```
  datatype[][]  arrayname = new datatype[rows][cols];
                (or)
  datatype  arrayname[][] = new datatype[rows][cols];
                (or)
  datatype[]  arrayname[] = new datatype[rows][cols];
```

ex:

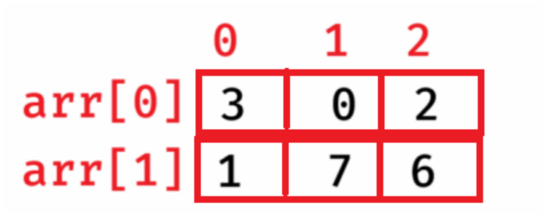
```
int[][]  array = new int[3][2];
```



```
array[0][0] = 9;  array[0][1] = 5;
array[1][0] = 4;  array[1][1] = 8;
array[2][0] = 7;   array[2][1] = 3;
```

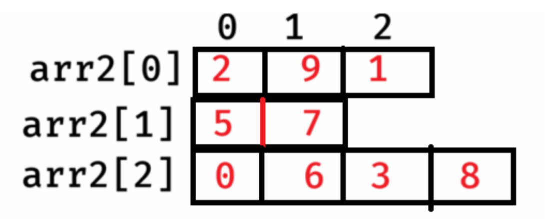
static initialization:

```
int[][] arr = { {3, 0, 2}, {1, 7, 6} };
```



```
int[][]  arr2 = { {2, 9, 1}, {5, 7}, {0, 6, 3, 8} };
```

* Here, each row of the array has different size. So, it is called a Jogged Array.



DiagonalSum.java

```
/**
 * This program will find the sum of left and
 * right diagonals of the 2D array.
 */
package com.ashokit;

import java.util.Scanner;

public class DiagonalSum {

      private static void findDiagonalSum(int[][] arr) {

            int leftSum = 0;
            int rightSum = 0;

            for (int i = 0; i < arr.length; i++) {
                  for (int j = 0; j < arr[i].length; j++) {
                        if (i == j)
                              leftSum = leftSum + arr[i][j];
                        if (i + j == arr.length - 1)
                        rightSum = rightSum + arr[i][j];
                    }
                }

                System.out.println("\u001B[31m" + "Left diagonal sum = " +
leftSum);
                System.out.println("\u001B[35m" + "Right diagonal sum = " +
rightSum);
        }

        public static void main(String[] args) {

                Scanner scanner = new Scanner(System.in);

                System.out.println("Enter the rows");
                int rows = scanner.nextInt();

                System.out.println("Enter the cols");
                int cols = scanner.nextInt();

                //create an array
                int[][] arr = new int[rows][cols];

                if (rows == cols) {

                        //read the elements
                        for (int i = 0;  i < rows; i++) {
                                for (int j = 0; j < cols; j++) {
                                        System.out.println("Enter element for : " + i
+ ", " + j);

                                        arr[i][j] = scanner.nextInt();
                                }
                        }

                        findDiagonalSum(arr);
                }
                else {
                        System.out.println("It's rectangular matrix. So, diagonal
doesn't exist!");
                }
                scanner.close();

        }


}
```

```
//MatrixMultiplication.java
```

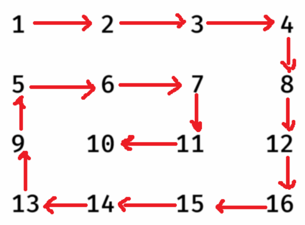
```
package com.ashokit;

public class MatrixMultiplication {

        public static void main(String[] args) {

                int[][]  a = { {2, 5}, {1, 0}, {5, 3} };    // size 3 * 2
                int[][]  b = { {1, 9}, {2, 4} };  // size 2 * 2
                multiply(a, b);
```

```
    }

    private static void multiply(int[][] a, int[][] b) {
        int r1 = a.length;
        int c1 = a[0].length;

        int r2 = b.length;
        int c2 = b[0].length;

        if (c1 == r2) {
            int[][] c = new int[r1][c2];

            for (int i = 0; i < r1; i++)
            {
                for (int j = 0; j < c2; j++)
                {
                    int x = 0;
                    for (int k = 0; k < c1; k++)
                    {
                        x = x + a[i][k] * b[k][j];
                    }
                    c[i][j] = x;
                }
            }

            for(int i = 0; i < r1; i++) {
                for (int j = 0; j < c2; j++) {
                    System.out.print(c[i][j] + "    ");
                }
                System.out.println();
            }
        }
        else
        {
            System.out.println("multiplication not possible");
        }

    }

}
```

---

printing the elements in spiral manner.

ex:



output: 1 2 3 4 8 12 16 15 14 13 9 5 6 7 11 10

Loop1: To print elements from left to right

Loop2: To print elements from top to bottom

Loop3: To print elements from right to left

Loop4: To print elements from bottom to top.

SpiralMatrix.java

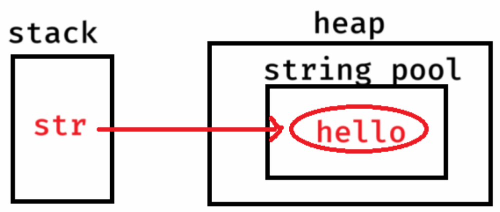
```java
package com.ashokit;

import java.util.ArrayList;

public class SpiralMatrix {

	public static void main(String[] args) {

		int[][] mat = { {1, 2, 3, 4}, {5, 6, 7, 8}, {9, 10, 11, 12},
{13, 14, 15, 16} };
		printSpiral(mat);
	}

	private static void printSpiral(int[][] mat) {

		ArrayList<Integer> al = new ArrayList<>();
		int rows = mat.length; //no. of rows
		int cols = mat[0].length; //no. of cols

		int left = 0, right = cols - 1;
		int top = 0, bottom = rows - 1;

		while (top <= bottom && left <= right) {
			//moving from left to right
			for(int i=left; i<=right; i++) {
				al.add(mat[top][i]);
			}
			top++;

			//moving from top to bottom
			for(int i=top; i <=bottom; i++) {
				al.add(mat[i][right]);
			}
			right--;

			//moving from right to left
			if (top <= bottom) {
				for (int i=right; i >= left; i--) {
					al.add(mat[bottom][i]);
				}
				bottom--;
			}

			//moving from bottom to top
			if(left <= right) {
				for (int i=bottom; i>=top; i--) {
					al.add(mat[i][left]);
				}
				left++;
			}
		}

		System.out.println(al);
```

```
        }
}
```

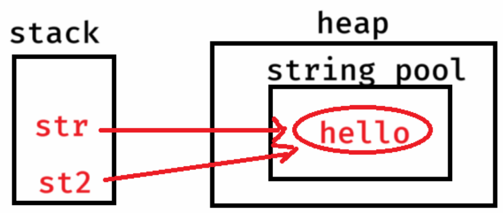
String operations

- String is not a primtive data type. It is a class in java.lang package.
- There are 2 ways of creating a string object.
  1. String str = “hello”; //string literal
  2. String str = new String(“hello”); //using new keyword
- In Heap, a special memory area is available called string pool.
- When a String object is created using literal, then JVM will check for the object in string pool. If exist, then it will point the variable to the same object.
- if doesn’t exist then JVM creates a new object in the string pool, and then will point the variable to that object.

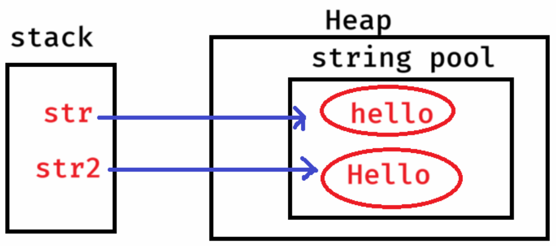
```
ex1:
  String str = "hello";
```



```
ex1:
  String str = "hello";
  String st2 = "hello";
```

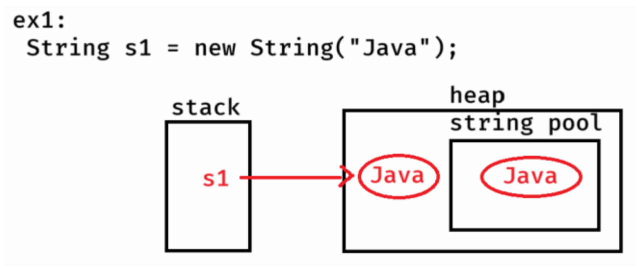


```
ex1:
  String str = "hello";
  String str2 = "Hello";
```

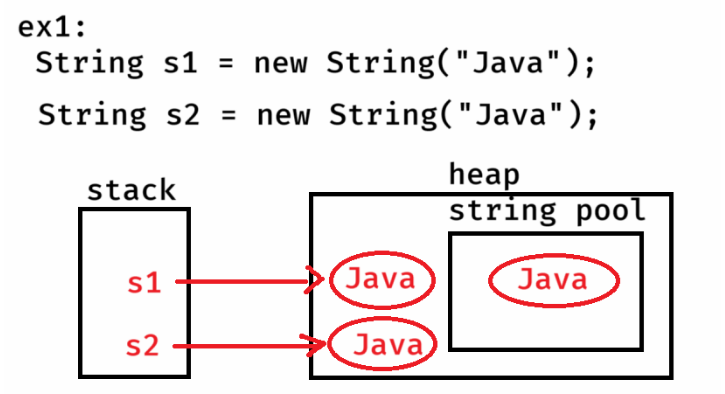


- When new keyword is used, if the string object exist in the string pool, then a new string object will be created in the heap and points the variable to the object in heap.

- **If the object doesn't exist in string pool, then a new object is created in string pool and also in the heap.**



```
ex1:
 String s1 = new String("Java");
```



```
ex1:
 String s1 = new String("Java");
 String s2 = new String("Java");
```

Q) How many objects are created for the below code?

```
    String str1 = new String("Ashokit");
    String str2 = str1;
```

Ans: 2 objects

Q) How many objects are created for the below code?

```
    String m1 = new String("Hibernate");
    String m2 = new String("JPA");
```

Ans: 4 objects

Q) How many objects are created for the below code?

```
    String str1 = "dell";
    String str2 = null;
```

Ans: 1 object.

Q) How many objects are created for the below code?

```
    String str1 = "apple";
    String str2 = "null";
```

Ans: 2 objects.

Q) How many objects are created for the below code?

```
    String str = new String();
```

Ans: 1 object.

Q) How many objects are created for the below code?

```
     String str = new String(null);
```

Ans: throws NullPointerException

find the length of a string:

length : It is an attribute

length() : It is a method

ex:

```
  String str = “ashokit”;
  Sop(str.length);  //output: error
  Sop(str.length()); //output: 7
```

ex:

```
 String[]  strArr = { “Clara”, “Joseph”, “Mary” };
 Sop(strArr.length);    //output: 3
 Sop(strArr.length()); //output: error
 Sop(strArr[1].length);  //output: error
 Sop(strArr[1].length()); //output: 6
```

ex:

```
 String str = null;
 Sop(str.length); //output: compile-time error
 Sop(str.length());  //output: NullPointerException
```

strings comparision:

1. == operator
2. equals() method
3. equalsIgnoreCase() method
4. compareTo() method

- == operator compares whether the two reference variables are pointing to the same object in the memory or not.
- If yes, then returns true. Otherwise, returns false.

ex1:

```
 String s1 = “hello”;
 String s2 = new String(“hello”);
 Sop(s1 == s2);  //output: false
```

ex2:

```
String str1 = new String("Java");
String str2 = str1;
Sop(str1 == str2);  //output: true
```

ex3:

```
String t1 = "sky";
String t2 = "Sky";
Sop(t1 == t2);  //output: false
```

- equals() method compares the content in the string objects. If they are same then returns true. Otherwise, returns false.

ex1:

```
String s1 = "dell";
String s2 = new String("dell");
Sop(s1 == s2);  //output: false
Sop(s1.equals(s2)); //output: true
```

ex2:

```
String str1 = new String("lenovo");
String str2 = new String("Lenovo");
Sop(str1 == str2);     //output: false
Sop(str1.equals(str2)); //output: false
```

- equalsIgnoreCase() method compares the content of the two strings, by ignoring the case. If they are same then returns true. Otherwise, returns false.

ex:

```
String username = "admin";
Sop(username.equalsIgnoreCase("Admin")); //output: true
```

- compareTo() method compares the content of the two strings. If they are same then returns 0.
- If the first string is less than second string, then returns -ve integer.

* If the first string is greater than second string then returns +ve integer.

ex1:

```
String s1 = “Admin”;

String s2 = “admin”;

Sop(s1.compareTo(s2)); //output: -32

Sop(s2.compareTo(s1)); //output: +32
```

ex2:

```
String s1 = new String(“Java”);

String s2 = new String(“Java”);

Sop(s1.compareTo(s2)); //output: 0
```

---

substring method:

- substring is a some part/portion of a string.
- substring(begin, end) : returns a string from begin to end-1 index.
- substring(begin) : returns a string from begin to end of the string.

ex1:

```
String str = “The sky is blue”;

String str2 = str.substring(4, 10);

Sop(str2); //output: sky is

String str3 = str.substring(4);

Sop(str3); //output: sky is blue

String str4 = str.substring(4, 17); //exception: IndexOutOfBoundsException
```

---

charAt & indexOf methods:

- charAt() returns the character at the specified index.
- indexOf() returns the index of the specified character.

ex:

```
String str = “The cat sat”;

Sop(str.charAt(5)); //output: a

Sop(str.charAt(15)); //exception: IndexOutOfBoundsException
```

ex:

```
  String str = “The cat sat”;

  Sop(str.indexOf(‘t’)); //output: 6

  Sop(str.lastIndexOf(‘t’)); //output: 10
```

ex:

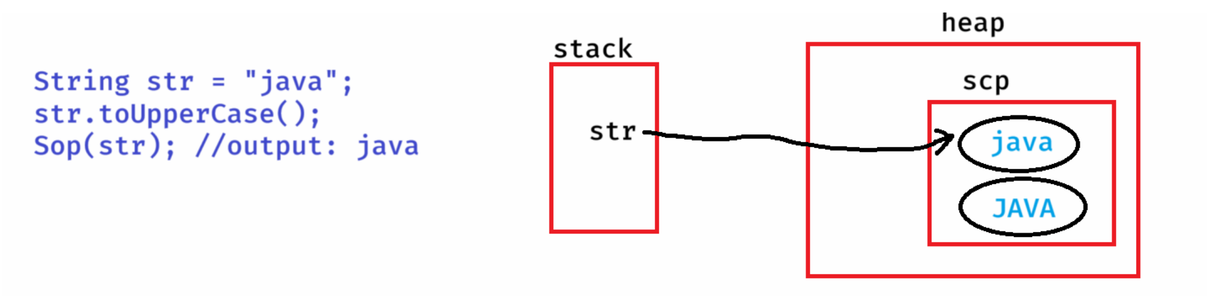
```
  String str = “The cat sat on mat”;

  Sop(str.indexOf(‘t’, 7)); //output: 10

  Sop(str.indexOf(‘k’)); //output: -1

  Sop(str.indexOf(“at”)); //output: 5
```

---

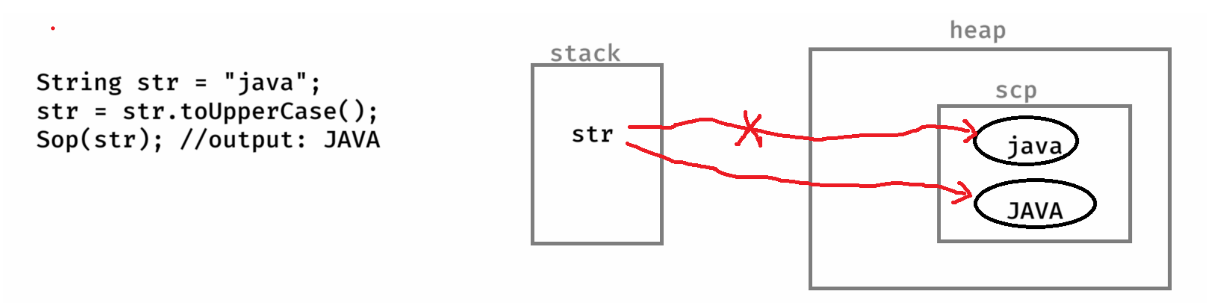
toLowerCase and toUpperCase methods:

- In Java, string objects are immutable objects.
- immutable object means, an object which does not allow to modify its data.
- mutable object means, an object which allows to modify its data.
- when you call toLowerCase/toUpperCase methods, JVM creates a new object for the string value, because existing object doesn’t allow to modify the data.

ex:



```
String str = "java";
str.toUpperCase();
Sop(str); //output: java
```



```
String str = "java";
str = str.toUpperCase();
Sop(str); //output: JAVA
```

ex:

```
  String str = “ASHOKit”;

  str.toLowerCase();

  Sop(str); //output: ASHOKit
```

```
ex:

   String str = “dell”;

   Sop(str.toUpperCase()); //output: DELL

   Sop(str);  //output: dell
```

replace() method:

- It replaces the each substring of a string with a replacement string.
  replace(substring, replacement)

```
ex1: String str1 = “The cat sat on mat”;
     str1.replace(“cat”, “dog”);
     S.o.p(str1);
output: The cat sat on mat

ex2: String str1 = “The cat sat on mat”;
     str1 = str1.replace(“cat”, “dog”);
     S.o.p(str1);
 output: The dog sat on mat
```

replaceAll():

replaces each substring of a string that matches the specified regular expression with a given replacement string.

        replaceAll(String regex, String replacement)

```
 ex1:
    String str = “My contact number : 123-456-7890”;
    String result = str.replaceAll(“\\d”, “#”);
    S.o.println(str);
    S.o.println(result);
output:My contact number : 123-456-7890
       My contact number : ###-###-####
```

  Note: \\d pattern matches to any digit(0-9)

```
 ex2:
    String str = “Spring is a framework”;
    String result = str.replaceAll(“\\s”, “_”);
    S.o.println(result);
output: Spring_is_a_framework
```

  Note: \\s pattern matches to a space.

```
ex3:
    String str = “Java  is a  Programming   language”;
    String result = str.replaceAll(“\\s+”, “ “);
    S.o.println(result);
output: Java is a Programming language
```

  Note: \\s+ pattern matches one or more spaces

```
ex4:
    String str = “Java#@is$great!&”;
    String result = str.replaceAll(“[^a-zA-Z0-9]”, “”);
    S.o.println(result);
```

```
output: Javaisgreat
Note: [^a-zA-Z0-9] pattern matches to except letters and digits.

ex5:
    String str = “Ashokit Solutions”;
    String result = str.replaceAll(“[aeiouAEIOU]”, “”);
    S.o.println(result);
output: shkt Sltns

ex6:
   String creditCard=”1234-5678-9012-3456”;
   String result = creditCard.replaceAll(“[^-](?=.{4})”, “X”);
   S.o.println(result);
output: XXXX-XXXX-XXXX-3456
Note: (?=.{4}) pattern checks if there are 4 characters following the
current character or not.

 ex7:
    String str = “<h1>Hello, <b>Shekher</b>!</h1>”;
    String result = str.replaceAll(“<[a-zA-Z0-9/]>”, “”);
    S.o.println(result);
output: Hello, Shekher!
```

---

split() method:

- It will divide a string into an array of substrings based on a given delimiter.

```
ex1:
    String str1 = “JSP is a technology”;
    String[] str2 = str1.split(“ “);
    for(String s : str2)
       S.o.println(s);
output:
      JSP
      is
      a
      technology
ex2:
   String str = “apple,banana,orange,grapes”;
   String[] fruits = str.split(“,”);
   for(String fruit : fruits) {
       S.o.println(fruit);
   }
output:
       apple
       banana
       orange
       grapes
ex3:
  String str = “The cat sat on mat”;
  String[] str2 = str.split(“t”);
  for(String s : str2)
  {
     S.o.p(s);
  }
```

```
output:
    The ca
     sa
     on ma
```

join() method:

- It will combine multiple strings together into a single string.
- It is a static method, so we can call it with classname.

```
  ex1:
     String[] names = { “Spring”, “Boot”, “Microservices” };
     String joinedString = String.join(“ “, names);
     S.o.println(joinedString);
output: Spring Boot Microservices

 ex2:
    String[] technologies = { “JDBC”, “Servlet”, “JSP” };
    String joinedString = String.join(“ and “, technologies);
    S.o.println(joinedString);
output: JDBC and Servlet and JSP
```

---

trim():

- It removes white space characters, before start of the first non-white space character and after the end of last non-white space character.

```
ex1:
   String username = “ guest”;
   S.o.p(username.equals(“guest”)); //output: false
   S.o.p(username.trim().equals(“guest”)); output: true
ex2:
   String username = “ashok it”;
   S.o.p(username.equals(“ashokit”)); //output: false
   S.o.p(username.trim().equals(“ashokit”)); // output: false
```

isEmpty() and isBlank() :

- isEmpty() method finds the length of a string and if it is zero then returns true, otherwise returns false.
- isBlank() method finds the length of a string, after trim and if it is zero then returns true, otherwise returns false.

```
ex1:
   String str1 = “”;
   S.o.p(str1.isEmpty()); //true
   S.o.p(str1.isBlank()); //true
ex2:
   String str1 = “ “;
   S.o.p(str1.isEmpty()); //false
   S.o.p(str1.isBlank()); //true
ex3:
   String str1 = “Hello”;
   S.o.p(str1.isEmpty()); //false
   S.o.p(str1.isBlank()); //false
```

```
startsWith() and endsWith():
 --------------------------
ex: String str1 = “ashokit@gmail.com”;
    S.o.println(str1.startsWith(“gmail”)); //false
    S.o.println(str1.endsWith(“gmail”));   //false
ex:
    String str1 = “ASHOKIT@gmail.com”;
    S.o.println(str1.startsWith(“ashok”)); //false
    S.o.println(str1.toLowerCase().startsWith(“ashok”)); //true
ex:
    String str1 = “ashokit@gmail.com”;
    str1.toUpperCase();
    S.o.println(str1.endsWith(“GMAIL.COM”)); //false
ex:
    String str1 = “ashokit@gmail.com”;
    str1 = str1.toUpperCase();
    S.o.println(str1.endsWith(“GMAIL.COM”)); // true
```

---

intern():

This method will return the object from the string pool.
When this method is called, the variable will point to the object
in the string pool.

ex:

```
        String s1 = "hello";
        String s2 = new String("hello");

        System.out.println(s1 == s2); //false

        s2 = s2.intern();
        System.out.println(s1 == s2); //true
```

valueOf():

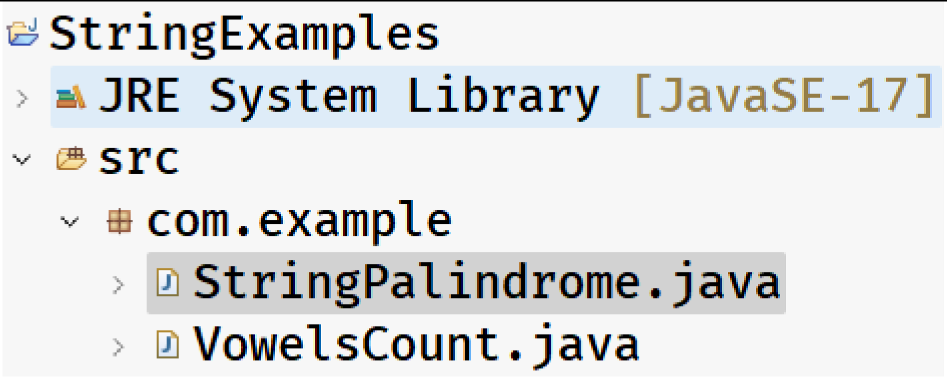
- This method converts a value from any primitive data type to string type.
- It is a static method, so we have to call this method with the classname.

ex:

```
 int x = 100;
 int y = 200;
 String str = String.valueOf(x) + String.valueOf(y);

 System.out.println(str); //output: 100200

 String str2 = String.valueOf(true) + String.valueOf(false) +
                    String.valueOf(0.0) + String.valueOf(1234);

 System.out.println(str2); //truefalse0.01234
```

```
toCharArray():
         . converts a string into a character array.
   ex:
       String str = “Java”;
       char[]  ch = str.toCharArray();
```

```
concat():
       It will concat a given string to the existing string.
ex:  String str = “Core ”;
     str.concat(“Java”);
     Sop(str); //output:Core
     str = str.concat(“Java”);
     Sop(str); //output: Core Java
```


StringExamples
JRE System Library [JavaSE-17]
src
com.example
StringPalindrome.java
VowelsCount.java

StringPalindrome.java

```
/*
 * This program checks whether a given string is
 * palindrome or not.
 * ex:
 *   str = "madam"
 *   reverse = "madam"
 *   It is palindrome
 * ex:
 *   str = "malayalam"
 *   reverse = "malayalam"
 *   It is palindrome
 * ex:
 *   str = "dell"
 *   reverse = "lled"
 *   It is not a palindrome
 */
package com.example;

import java.util.Scanner;

public class StringPalindrome {

   private static boolean isPalindrome(String str) {

        //convert the string to lowercasae
        str = str.toLowerCase();

        //convert the string to char[]
        char[] ch = str.toCharArray();

        boolean flag = true;

        for (int i = 0, j = ch.length - 1;  i <= j; i++, j--)
        {
             if (ch[i] != ch[j])
             {
                  flag = false;
                  break;
             }
        }
        return flag;
   }

   public static void main(String[] args) {

        Scanner scanner = new Scanner(System.in);
```

```java
        System.out.println("Enter a string");
        String str = scanner.nextLine();

        boolean flag = isPalindrome(str);

        if(flag == true)
            System.out.println("It is a palindrome");
        else
            System.out.println("It is not a palindrome");
        scanner.close();
    }

}
```

VowelsCount.java

```java
/*
 * This program is to count the vowels and
 * consonants in a given string.
 * example:
 *   str = "Lilliput@River2"
 *   output:
 *    vowels count : 5
 *    consonants count : 8
 */
package com.example;

import java.util.Scanner;

public class VowelsCount {

    public static void main(String[] args) {

        Scanner scanner = new Scanner(System.in);
        System.out.println("Enter a string");
        String str = scanner.nextLine();
        countVowels(str);
        scanner.close();
    }

    private static void countVowels(String str) {
        // TODO Auto-generated method stub

        // convert the string to lowercase
        str = str.toLowerCase();

        // convert the string to char[]
        char[] ch = str.toCharArray();

        int vowelsCount = 0;
        int consonantsCount = 0;

        // loop
        for (int i = 0; i < ch.length; i++) {
            if (Character.isLetter(ch[i])) {
                switch(ch[i]) {
                case 'a':
                case 'e':
                case 'i':
                case 'o':
                case 'u':
                    vowelsCount++;
                    break;
                default:
                    consonantsCount++;
                }
            }
        }

        System.out.println("vowels count = " +
vowelsCount);
        System.out.println("consonants count = " +
consonantsCount);

    }

}
```

```java
/**
 * This program is to check whether the
 * given two strings are anagrams or not.
 * example:
 *    str1 = "state"
 *    str2 = "taste"
 *    output: Anagrams
 *    str1 = "Java"
 *    str2 = "Python"
 *    output: Not Anagrams
 */
package com.example;

import java.util.Arrays;
import java.util.Scanner;

public class Anagrams {

    public static void main(String[] args) {

        Scanner scanner = new Scanner(System.in);

        System.out.println("Enter first string");
        String str1 = scanner.nextLine();

        System.out.println("Enter second string");
        String str2 = scanner.nextLine();

        boolean flag = checkAnagrams(str1, str2);

        if (flag == true)
            System.out.println("Yes, the strings are
anagrams");
        else
            System.out.println("No, the strings are
not anagrams");

        scanner.close();

    }
    private static boolean checkAnagrams(String str1,
String str2) {

        if( str1.length() != str2.length() )
        {
            return false;
        }

        //convert the strings to lowercase
        str1 = str1.toLowerCase();
        str2 = str2.toLowerCase();

        //convert the strings to char[]
        char[] ch1 = str1.toCharArray();
        char[] ch2 = str2.toCharArray();

        //sort them
        Arrays.sort(ch1);
        Arrays.sort(ch2);

        boolean flag = true;

        for (int i = 0; i < ch1.length; i++) {
            if (ch1[i] != ch2[i]) {
                flag = false;
                break;
            }
        }

        return flag;
    }

}
```

Frequency.java

```java
/**

 * This program finds the frequency of each character

 * in a given string.

 * example:
```

```
 *  str = "MiSSisiPi"
 *  output:
 *         i - 4
 *         m - 1
 *         p - 1
 *         s - 3
 */
package com.example;

import java.util.Arrays;
import java.util.Scanner;

public class Frequency {

	public static void main(String[] args) {

		Scanner scanner = new Scanner(System.in);
		System.out.println("Enter a string");
		String str = scanner.nextLine();
		frequency(str);
		scanner.close();

	}

	private static void frequency(String str) {
		// TODO Auto-generated method stub
		str = str.toLowerCase();
		char[] ch = str.toCharArray();
		Arrays.sort(ch);

		for(int i = 0; i < ch.length; i++) {
```

```
                int count = 0;
                for(int j = i; j < ch.length; j++) {
                    if(ch[i] == ch[j])
                    {
                        count++;
                        i = j;
                    }
                    else
                    {
                        break;
                    }
                }
                System.out.println(ch[i] + " - " + count);
            }

        }

}
```

FirstNonRepeatingCharacter.java

```
/**
 * This program will print the first non-repeating
 * character of a string.
 * example:
 *   str = "swiss"
 *   output: w
 */
package com.example;

import java.util.Scanner;

public class FirstNonRepeatingCharacter {

    public static void main(String[] args) {
        Scanner scanner = new Scanner(System.in);
        System.out.println("Enter a string");
        String str = scanner.nextLine();
        nonRepeatingChar(str);
        scanner.close();

    }

    private static void nonRepeatingChar(String str)
{
        // TODO Auto-generated method stub
        char[] ch = str.toCharArray();

        for(int i = 0; i < ch.length; i++)
        {
            int count = 0;
            for (int j = i; j < ch.length; j++)
            {
                if(ch[i] == ch[j]) {
                    count++;
                    i = j;
                }
            }
            if(count == 1) {
                System.out.println("The first non-
repeating char : " + ch[i]);
                break;
            }
        }

    }

}
```

StringBuffer class

- String, StringBuffer and StringBuilder are the independent classes from java.lang package and these classes are use to perform string operations.
- StringBuffer class object is a mutable and a thread-safe object.
- StringBuffer class object can be created only with new keyword.

```
ex:
  StringBuffer sb = “hello”; // error
  StringBuffer sb = new StringBuffer(“hello”); //correct
```

- when a StringBuffer object is created, the JVM checks for the exisiting object in the SCP for the string value. If already exists, then creates a new object in Heap and makes the variable to point to the object in heap.
- If not exist, then creates a new object in SCP, then a new object in Heap, then makes the variable pointing to the heap object.
- While creating a StringBuffer object, JVM allocates a 16 characters buffer for the existing value in the StringBuffer object.
- For example:
- StringBuffer sb =new StringBuffer(“hello”);
- length of the StringBuffer object: 5
- capacity of the StringBuffer object: 5 + 16 = 21
- If the length of the StringBuffer object crosses the capacity, then the capacity will be resized with the formula, oldcapacity * 2 + 2
- Suppose, if 17 more characters are appended to the above StringBuffer object, then
  length : 22
  capacity: 21 * 2 + 2 = 44

How a StringBuffer object is thread-safe?

- StringBuffer is a mutable object, but it doesn’t allow multiple threads exactly at the same time to make the changes.
- If first thread is allowed to make the changes, then second thread has to wait.
- So, a StringBuffer object is a thread safe object.

comparing StringBuffer objects:

```
ex:
  StringBuffer sb1 = new StringBuffer(“Java”);
  StringBuffer sb2 = new StringBuffer(“Java”);
  S.o.println( sb1.equals(sb2) ); //output: false
```

Note: equals() method in StringBuffer also works like == operator.

- If you want to compare the StringBuffer objects, you have to convert the StringBuffer objects into String objects again.

```
ex:
   String s1 = sb1.toString();
   String s2 = sb2.toString();
   S.o.p( s1.equals(s2)); // output: true
```

some key methods of StringBuffer class:

1. append(): appends the given value to the existing object.
   ex:
   ```
   String s1 = new String("Core ");
   s1.concat("Java");
   S.o.println(s1); // output:Core

   StringBuffer sb = new StringBuffer("Core ");
   sb.append("Java");
   S.o.println(sb); // output:Core Java
   ```

2. insert(index, String): inserts the given string at the given index.
   ex:
   ```
      StringBuffer sb1 = new StringBuffer("The sat on mat");
      sb1.insert(4, "dog ");
      S.o.println(sb1); // output:The dog sat on mat
   ```
   ex:
   ```
   StringBuffer sb2 = new StringBuffer("The cost is :  rupees");
   sb2.insert(14, 100);
   S.o.println(sb2);
   ```
   output:The cost is : 100 rupees

3. delete(start, end):Removes the characters from start to end-1.
   ex:
   ```
   StringBuffer sb1 = new StringBuffer("The sky is blue");
   sb1.delete(0, 4);
   S.o.println(sb1); // output:sky is blue
   ```

   ex:
   ```
   StringBuffer sb2 = new StringBuffer("hello");
   sb2.delete(2, 9);
   S.o.println(sb2); // output:he
   ```

   ex:
   ```
   StringBuffer sb3 = new StringBuffer("Lilliput");
   sb3.delete(5, 3); // StringIndexOutOfBoundsException
   sb3.delete(5, 8);
   S.o.println(sb3); // output:Lilli
   ```

4. replace(start, end, str) : replaces the content between start to end – 1 with the given string.
   ex:
   ```
   StringBuffer sb1 = new StringBuffer("The sky is blue");
   sb1.replace(11, 15, "black");
   S.o.println(sb1); //output:The sky is black
   ```

```
5. reverse() : reverse the characters of a given string value.
   ex:
     StringBuffer sb1 = new StringBuffer(“level”);
     if(sb1.reverse().equals(“level”))
         S.o.p(“palindrome”);
     else
         S.o.p(“not a palindrome”);
    output: not a palindrome

    ex:
     StringBuffer sb1 = new StringBuffer(“level”);
     if(sb1.reverse().toString().equals(“level”))
         S.o.p(“palindrome”);
     else
         S.o.p(“not a palindrome”);
    output: palindrome

    ex:
      StringBuffer sb2 = new StringBuffer(“Madam”);
      if(sb2.reverse().toString().toLowerCase().equals(“madam”))
          Sop(“palindrome”);
      else
          Sop(“not a palindrome”);
   output: palindrome

    ex:
       StringBuffer sb3 = new StringBuffer(“Liril”);
       sb3.reverse();
       String s1 = sb3.toString();
       s1.toLowerCase();
       if(s1.equals(“liril”))
          S.o.p(“palindrome”);
       else
          S.o.p(“not a palindrome”);
   output:
       not a palindrome
```

Compression.java

```
/**
 * This program prints the string compression.
 * example:
 *   str = "aabccdeaa"
 *  output: a2b1c2d1e1a2
 */
package com.example;
```

```java
import java.util.Scanner;

public class Compression {

    public static void main(String[] args) {
        Scanner scanner = new Scanner(System.in);
        System.out.println("Enter a string");
        String str = scanner.nextLine();
        compress(str);
        scanner.close();

    }

    private static void compress(String str) {
        StringBuffer buffer = new StringBuffer();
        int count = 1;
        for (int i = 0; i < str.length(); i++) {
            if ( i + 1 < str.length() &&
str.charAt(i) == str.charAt(i+1)) {
                count++;
            }
            else {

    buffer.append(str.charAt(i)).append(count);
                count = 1;
            }
        }
        System.out.println(buffer);

    }

}
```

StringBuilder class:

- StringBuilder is a class provided in java.lang package.
- StringBuilder class also performs operations on string values.
- StringBuilder is a mutable and not a thread-safe object.
- In Multithreaded applications, if StringBuilder object is shared with multiple threads and if the threads are modifying the value exactly at the same time then unexpected results will be produced.
- So, StringBuilder is recommended to use in Single thread applications.

- StringBuilder object can also be created with new keyword only.

ex:
```
  StringBuilder builder = “apple”; // error
  StringBuilder builder = new StringBuilder(“apple”); //correct
```

- Since, StringBuilder is also a mutable object, additional space for 16 characters will be allocated, to allow the changes to the value.

- StringBuilder class also contains the same methods like StringBuffer class, but StringBuffer class methods are synchronized methods and StringBuilder class methods are not synchronized.

Q) what is the difference between String and StringBuffer?
Ans: String is immutable object, StringBuffer is mutable object.

Q) what is the difference between String and StringBuilder?
Ans: String is immutable and thread-safe object. StringBuilder is mutable and not a thread-safe object.

Q) what is the difference between StringBuffer and StringBuilder?
Ans: StringBuffer is mutable and thread-safe object. StringBuilder is mutable but not a thread-safe object.

Q) why Java is called Robust language?
Ans: 1. A language can be called as a Robust langugage, based on two parameters.

   i) The language should provide Garbage Collection mechanism.
   ii) The language should provide Error handling support.

2. In Java, we have automatic garbage collection mechanism and also exception handling. So, Java can be called as a Robust language.

Q) why Java is called a secured language?
Ans: 1. When a Java program is compiled, we get byte code.
2. When byte code is loaded into JVM, there is a byte code verifier in JVM, who checks whether this byte code is original or tampered by some one in the middle.
3. If tampered, then exceptions/error will be thrown.
4. So, a hacker can’t hack the Java Byte code. So, we call as a secured language.

Q) why Java is called multithreaded language?
Ans: Java allows multiple tasks to execute parallelly within a single application, by creating multiple threads. So, Java is called mulithreaded language.

Q) Why Java is called distributed language?
Ans: Java provides built-in support for developing applications, where different parts of the application run on a different computer in a network and they are all connected together, and provides the services to the end-users/customers. So, Java is called distributed language.

Object Oriented Programming System(oops)

---

why OOP?

- To develop a software application, a programmer/developer has to choose one of the two programming models(paradigms).
- 1. procedure oriented programming model
- 2. object oriented programming model.
- Procedure oriented programming languages are a good fit for developing System-level applications.
- examples:
-     operating systems
-     database engines
-     microcontrollers
-     device drivers, etc..
- But, Procedure oriented programming languages are not a good fit for developing web and enterprise applications.
- Reasons?
- 1. No built-in support for protocols like HTTP, FTp, SMTP etc..
- 2. No built-in support for Database access
- 3. No built-in support for multithreading
- 4. No built-in support for error handling
- 5. No real-world mappings(like customer, products, employees, etc..)
- 6. No Garbage collection support, etc..
- So, Object oriented programming languagues were introduced to develop the web and enterprise applications.

OOP principles:

- OOP principles are provided to make a web/enterprise application as maintainable, reusable, scalable, secured etc..

- OOP principles are four.
- 1. Encapsulation
- 2. Abstraction
- 3. Inheritance
- 4. Polymorphism

Encapsulation:

- Encapsulation means, combine the data and related functionalities together at one place as a single unit.
- Don't allow other components from assinging invalid data.
- So, to implement this principle, you should create a class with private variables and public setter/getter methods.

Abstraction:

- Abstraction means, it process of providing the essential data and hiding the un-essential data from the user of the system.
- A general example of abstraction is,
- i) you are a user of a TV Remote
- ii) The essential data provided to the user, the buttons to perform actions like switch on/off, volume incr/decr, etc..

  iii) The un-essential data hidden is like, how signals are sent from remote to TV and how they are processed by the TV.
  iv) This is called Abstraction.
- To implement this Abstract principle, you should use abstract classes and interfaces of Java programming.

Inheritance:

- Inheritance means, creating new types/classes by inheriting from already existing types/classes.
- The newly created classes are called child classes and already exisiting classes are called parent classses.
- To implement this inheritance principle, you should use the keywords like "extends" and "implements" of Java.

Polymorphism:

- Polymorphism means, providing many forms to perform one action or one action should exihibit multiple behaviours.
- For example, one action is opening a bank account and many forms to perform this action are, through Adhaar Card, or through PAN Card, or through VoterId, etc.. This is polymorphism.

- Overloading and overriding are the two mechanisms provide by Java to implement polymorphism.
- Note:
- Polymorphsim is a combination of two Greek words poly means "Many" and morphism means "forms".

class and object:

- In terms OOP, everything in the real-world is considered as an object.
- The objects are divided into different groups based on their attributes/properties and/or behavior.
- Now I should create a template/blueprint/plan with the properties and behaviour, for each group of objects.
- For example, In e-commerce application, we have different groups of objects like customers, products, orders, payments, employees, etc…. So, for each group of objects, we should create a template to reprent their properties and behaviour.
- These templates/blueprints/plans are called as classes.
- class is a keyword in Java, which is derived from another word called “classification”.
- definition of a class:
-     A class is a template which contains variables to represent the properties and methods to represent the behaviours of a certain group of objects.
-     A class is a blueprint with a collection of variables and methods, to represent a group of objects.
-     A class is a container with data members and methods, to represent a certain group of objects.
- syntax of a class:
- -----------------

```
   <access specifier> <access modifier>  class  <classname>
   {
       variables;
       methods;
   }
```

- example:

```
   class Person {
         String name;
         int age;

         void eating() {
            // code
         }
         void talking() {
             // code
         }
    }
```

- definition of an object:
-         It is an instance of a class.

- syntax:
```
    ClassName  objectName = new  ClassName();
```
ex:
```
    Person  p1 = new  Person();
      1      2     3     4
```

1. It is the type of the variable. When you create a class, then it automatically becomes as a datatype(user-defined).
2. It is the reference variable, which stores the address of the object.
3. It is a memory allocation operator. It uses the class/bluepring to allocate the memory space in heap.
4. constructor call

All together:

. Java uses Person as a blueprint for allocating the memory space, initializes the object, and stores the address of that object into a reference variable called p1.