Software Design and Architecture

Lab # 07

Loops, Arrays, and Functions in Java.

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Table of Contents

Loops

- In computer programming, a **loop** is a sequence of instructions that is continually repeated until a certain condition is reached.
- A **loop** statement allows us to execute a statement or group of statements multiple times

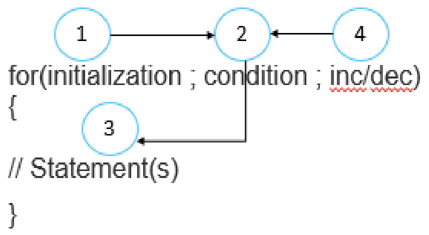
Types of Loop

1. for loop
2. while loop
3. do while loop
4. for-each loop (Enhanced For Loop)

1) for loop

- for loop is used to a statement or group of statement for a fixed number of times.
- If the number of iterations is fixed then it is recommended to use for loop.

Syntax:



```
for(initialization ; condition ; inc/dec)
{
// Statement(s)
}
```

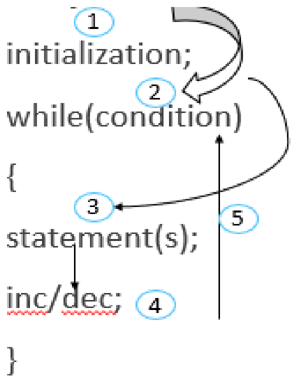
for loop Example

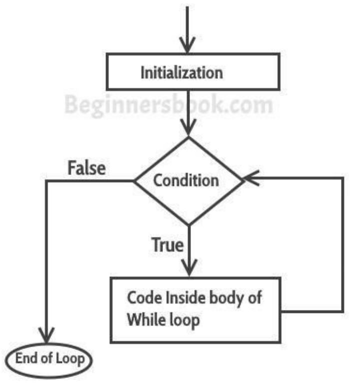
```
class ForDemo

{

public static void main(String args[])

 {

int i;

for(i=0;  i<=10 ; i++)

{     System.out.println("Kmayab Jawan Program");  }

}
```

}

2) while loop

Is used when number of iterations is not fixed.





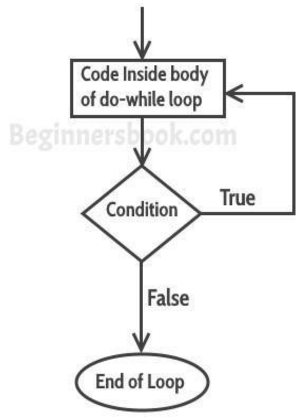
Syntax

while loop Example

```
class WhileDemo
{
public static void main(String args[])     {
int i=1;
while(i<=10)
{
System.out.println(“Kmayab Jawan Program”);
i++;
}
} }
```

do while loop

- An indefinite loop. Best used when the number of iterations is unknown.



Syntax

initialization;

do{

statement(s);

inc/dec;

}

while(condition) ;

do while loop Example

```
class DoWhileLoopExample {
public static void main(String args[]){
int i=10;     // intializaton
do
{
      System.out.println(i);
      i--  ;  //decrementation
}
while(i>1) ;
 }
}
```

Break Statement

The break statement terminates the execution of the loop when it is used inside the body of the loop.

Syntax: break;

Continue Statement

- It continues the current flow of the program and skips the remaining code at specified condition.

Syntax: continue;

```
import java.util.Scanner;
Class AddNoWhile
{     // class body starts
public static void main(String args[])
{    // main method body starts
Scanner input = new Scanner(System.in)
int n1, n2;
String choice = “Yes”; // choice declaration and initialization
while(choice.equals(“Yes”))
{   // while body starts

System.out.println(“Enter 1st no”);
n1=input.nextInt();
System.out.println(“Enter 2nd no”);
n2=input.nextInt();
System.out.println(“Sum=”+(n1+n2));
System.out.println(“Do you want to do more addition (Yes/No)”);
choice= input.next();
} // while loop body closed
System.out.println(“Thank you for using while loop”);
} // main method body closed
} // class body closed
```

Java Random Class

- Random class is part of java.util package.
- An instance of java Random class is used to generate random numbers.
- This class provides several methods to generate random numbers of type integer, double, long, float etc.

Java Random Class Methods

1) nextBoolean(): This method returns next pseudorandom which is a boolean value from random number generator sequence.

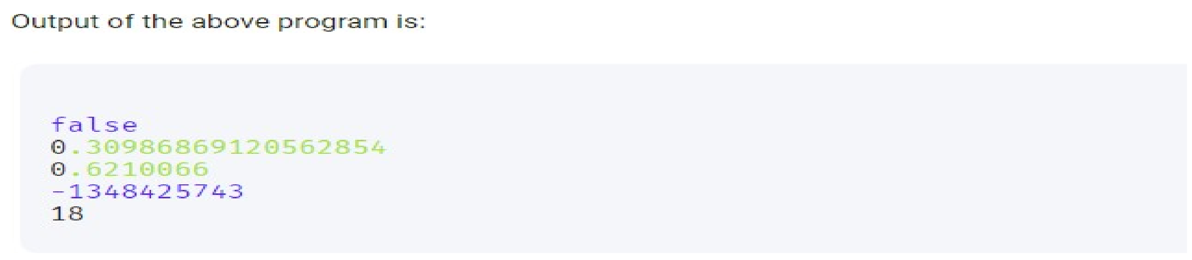
2) nextDouble(): This method returns next pseudorandom which is double value between 0.0 and 1.0.

3) nextFloat(): This method returns next pseudorandom which is float value between 0.0 and 1.0.

4) nextInt(): This method returns next int value from random number generator sequence.

5) nextInt(int n): This method return a pseudorandom which is int value between 0 and specified value from random number generator sequence.

Java Random Example



Output of the above program is:

```
false
0.30986869120562854
0.6210066
-1348425743
18
```

Random Numbers

import java.util.Random;

Random rand = new Random();

int num = rand.nextInt(6)+1;

Here 6 means it will generate numbers from 0 to 5 means it will generate 6 numbers.

Game of Random Numbers

```
import java.util.Random;
import java.util.Scanner;
public class Game
{     // Class body starts
Public static void main(String args[])
{     // main method body starts
int num, guess, count=0;
Scanner input = new Scanner(System.in);
Random rand = new Random();
num = rand.nextInt(100)+1;
System.out.println(“Number Generated, try to guess it”);
while(true)
{
count++;
System.out.println(“Enter your guess: ”);
guess = input.nextInt();
if(guess>num)
{
System.out.println(“Your number is high, please try again”);
}
else if(guess<num)
{
System.out.println("Your number is low, please try again");
}
else
{
break;
}
}      // while loop body closed
System.out.println("You found the guess in" + count+ "Attempts");
if(count<5)
{
System.out.println("Excellent");
}
if(count>5)
{
System.out.println("Good");
}
} // Main method body closed
} // class body closed
```

Array

Same name which store multiple values. It is a collection of similar type of elements that have contiguous memory location.

Array is:

1. Linear data structure (consecutive location)
2. Static data structure (fixed size)
3. Homogeneous data will be stored.

Syntax of one-dimensional array in C++

Datatype arrayName[size];

Example:

int array[5];

Datatype arrayName[] = new Datatype[size];

Example:

int marks[]   = new int[5];

```
                    OR
int[]  marks = new int[5];
                    OR
int marks[];      // declaration
marks = new int[5];     //initialization
```

Initialization of Array

```
int    marks[]  =    new int[5]       // 5 is array length or size
marks[0]  = 80 ;          // [0] is array index and 80 is array element
marks[1]  = 90 ;
marks[2]  = 70  ;
marks[3]  = 60  ;
marks[4]  = 30 ;
```

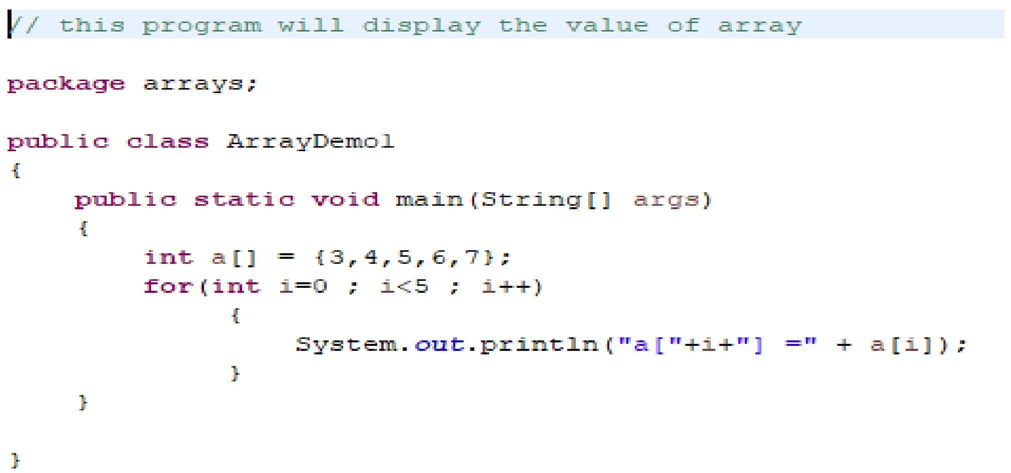
Declaration, instantiation and initialization of java array

```
int marks[]   =  {80, 90, 70, 60, 30};
```

Declare array length constant

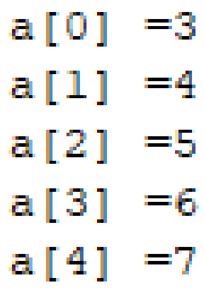
Example

```
final int ARRAY_LENGTH = 10 ;
int[]     array  = new int[ARRAY_LENGTH];
```



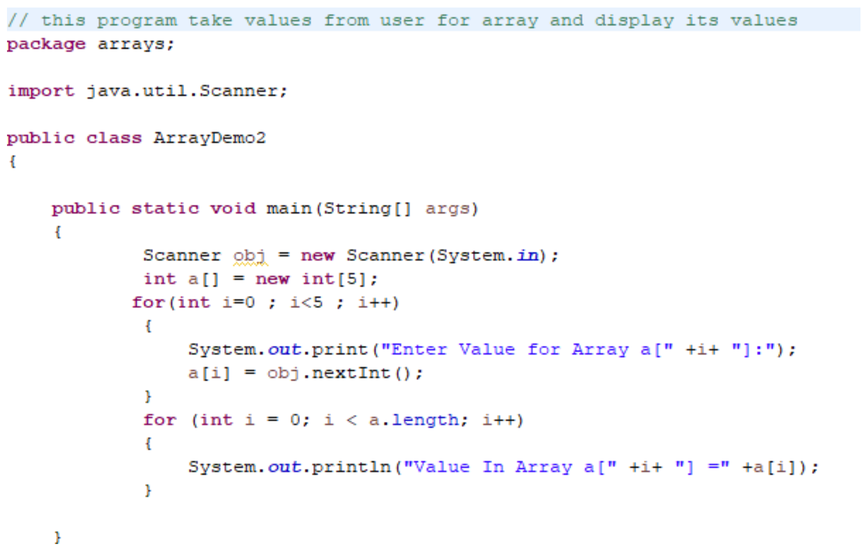
```
// this program will display the value of array

package arrays;

public class ArrayDemo1
{
     public static void main(String[] args)
     {
          int a[] = {3,4,5,6,7};
          for(int i=0 ; i<5 ; i++)
                 {
                      System.out.println("a["+i+"] =" + a[i]);
                 }
     }
}
```

Program 1

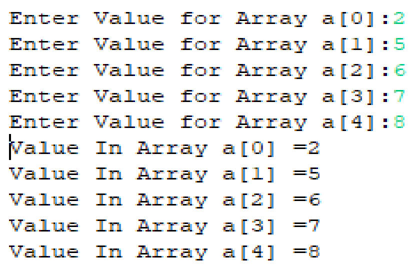


```
a[0] =3
a[1] =4
a[2] =5
a[3] =6
a[4] =7
```

Program 2 Runtime value in array from user



```
// this program take values from user for array and display its values
package arrays;

import java.util.Scanner;

public class ArrayDemo2
{

    public static void main(String[] args)
    {
            Scanner obj = new Scanner(System.in);
            int a[] = new int[5];
           for(int i=0 ; i<5 ; i++)
            {
                System.out.print("Enter Value for Array a[" +i+ "]:");
                a[i] = obj.nextInt();
            }
            for (int i = 0; i < a.length; i++)
            {
                System.out.println("Value In Array a[" +i+ "] =" +a[i]);
            }

    }
```



```
Enter Value for Array a[0]:2
Enter Value for Array a[1]:5
Enter Value for Array a[2]:6
Enter Value for Array a[3]:7
Enter Value for Array a[4]:8
Value In Array a[0] =2
Value In Array a[1] =5
Value In Array a[2] =6
Value In Array a[3] =7
Value In Array a[4] =8
```

Enhanced for loop (for-each loop)

- Works with array.
- Is used for traversing in array.
- It is easy to use than simple for loop because we do not need to increment or decrement counter variable.

Syntax

for (data type variable : arrayName)

{   statement(s); }

Data type must be same as that of array data type.

- Start from 1st element.
- End in last element.
- We cannot use it in reverse order.
- We cannot traverse element in middle of array.
- Only one step incrementation is possible.

Enhanced for loop example 1

class ForEachExample1{

 public static void main(String args[]){

//declaring an array

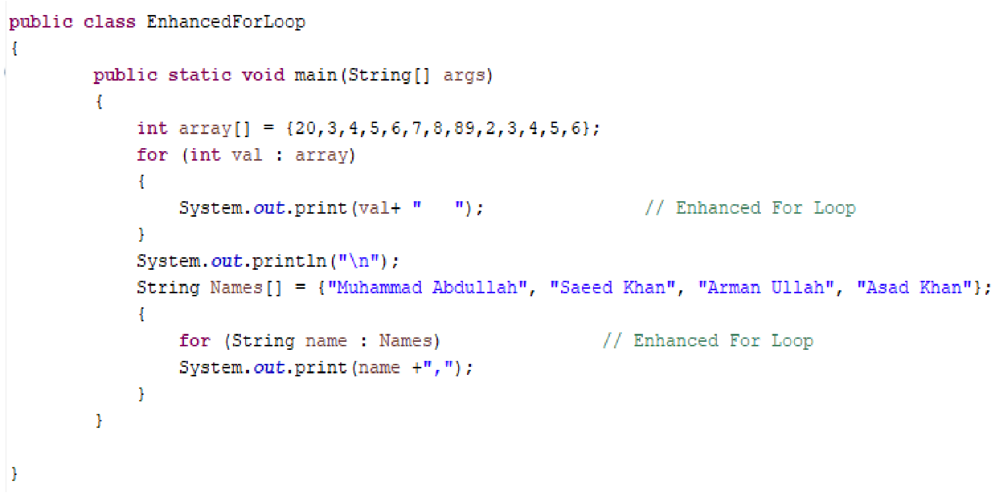
 int arr[]={12,13,14,44};

//traversing the array with for-each loop

 for(**int** i:arr){

```
    System.out.println(i+ " ");

  } }

}
```

Enhanced for loop example 2



```
public class EnhancedForLoop
{
        public static void main(String[] args)
        {
            int array[] = {20,3,4,5,6,7,8,89,2,3,4,5,6};
            for (int val : array)
            {
                System.out.print(val+ "   ");               // Enhanced For Loop
            }
            System.out.println("\n");
            String Names[] = {"Muhammad Abdullah", "Saeed Khan", "Arman Ullah", "Asad Khan"};
            {
                for (String name : Names)               // Enhanced For Loop
                System.out.print(name +",");
            }
        }

}
```

Two dimensional arrays

- An array that is represented with two indices/subscripts is called 2D array.
- It is similar to matrix in maths.
- Logically it consists of rows and columns.
- 2D array is called an array of an arrays.

Syntax of declaration

Datatype arrayName[][] = new datatype[R][C];

// R means number of rows and C means number of columns

Example: int StudentMarks[][] = new int[4][3];

2D Array logical Representation

	0	1	2
0	(0,0) 70	(0,1) 80	(0,2) 90
1	(1,0) 10	(1,1) 20	(1,2) 30
2	(2,0) 5	(2,1) 10	(2,2) 15
3	(3,0) 50	(3,1) 60	(3,2) 70

Declaration of 2D Array

Datatype [][] arrayRefVar;

OR

Datatype   [][]arrayRefVar;

OR

Datatype   arrayRefVar[][];

OR

- Datatype []arrayRefVar[];

Instantiation of 2D Array

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

1st Method

int studentMarks[][] = new int[4][3];

studentName[0][0] = 70;

studentName[0][1] = 90;

studentName[0][2] = 90;

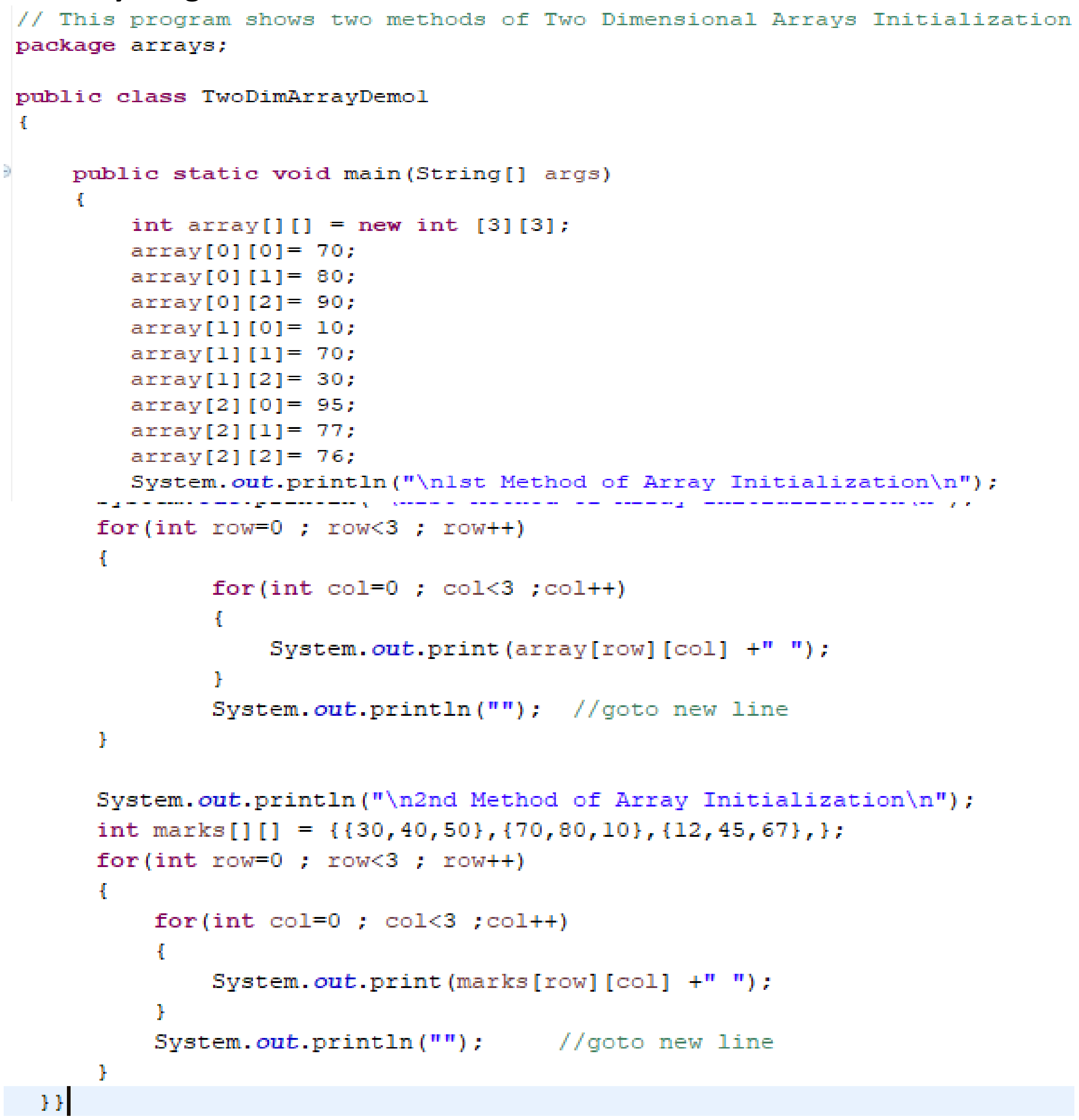
studentName[1][0] = 10;

```
studentName[1][1]  = 20;

studentName[1][2]  = 30;

studentName[2][0]  = 5;

studentName[2][1]  = 10;

studentName[2][2]  = 15;

studentName[3][0]  = 50;

studentName[3][1]  = 60;

studentName[3][2]  = 70;
```

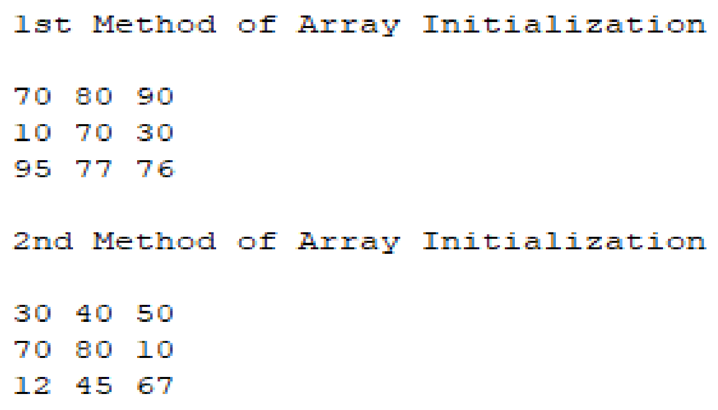
2nd Method

```
int studentMarks[][]  = {   { 70, 80, 90 },

                              { 10, 20, 30 },

                                { 5, 10, 15 },

                                { 50, 60, 70 },

                            };

                          OR

int studentMarks[][]  = {  { 70, 80, 90 },   { 10, 20, 30 },  { 5, 10, 15  }, { 50, 60, 70 } ,};
```

2D Array Program 1

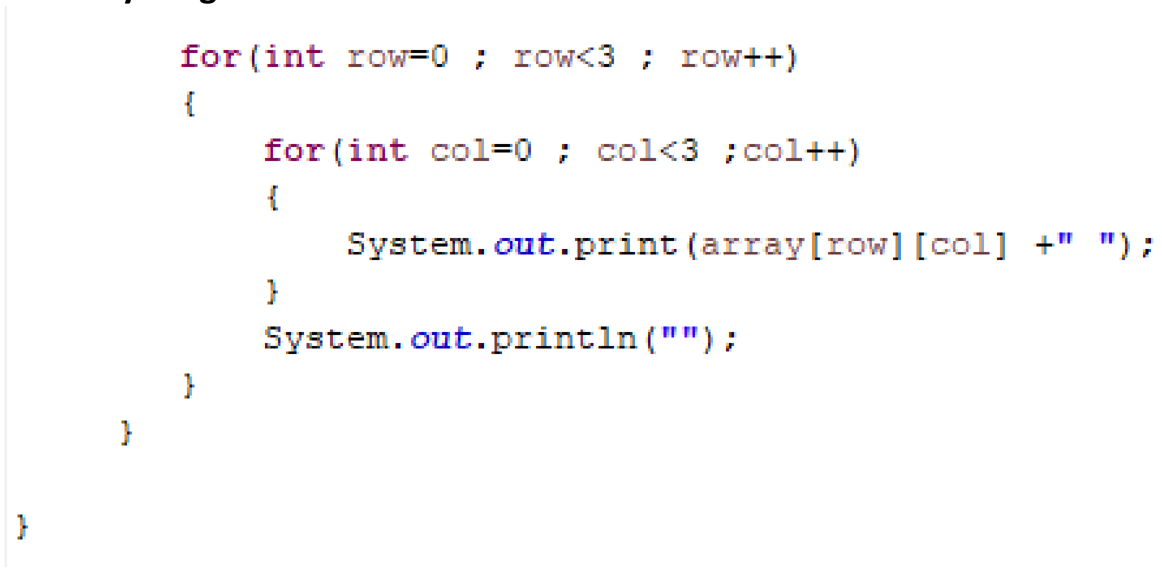


```
// This program shows two methods of Two Dimensional Arrays Initialization
package arrays;

public class TwoDimArrayDemo1
{

    public static void main(String[] args)
    {
        int array[][] = new int [3][3];
        array[0][0]= 70;
        array[0][1]= 80;
        array[0][2]= 90;
        array[1][0]= 10;
        array[1][1]= 70;
        array[1][2]= 30;
        array[2][0]= 95;
        array[2][1]= 77;
        array[2][2]= 76;
        System.out.println("\n1st Method of Array Initialization\n");
        for(int row=0 ; row<3 ; row++)
        {
                for(int col=0 ; col<3 ;col++)
                {
                    System.out.print(array[row][col] +" ");
                }
                System.out.println("");  //goto new line
        }

        System.out.println("\n2nd Method of Array Initialization\n");
        int marks[][] = {{30,40,50},{70,80,10},{12,45,67},};
        for(int row=0 ; row<3 ; row++)
        {
            for(int col=0 ; col<3 ;col++)
            {
                System.out.print(marks[row][col] +" ");
            }
            System.out.println("");     //goto new line
        }
  }}
```

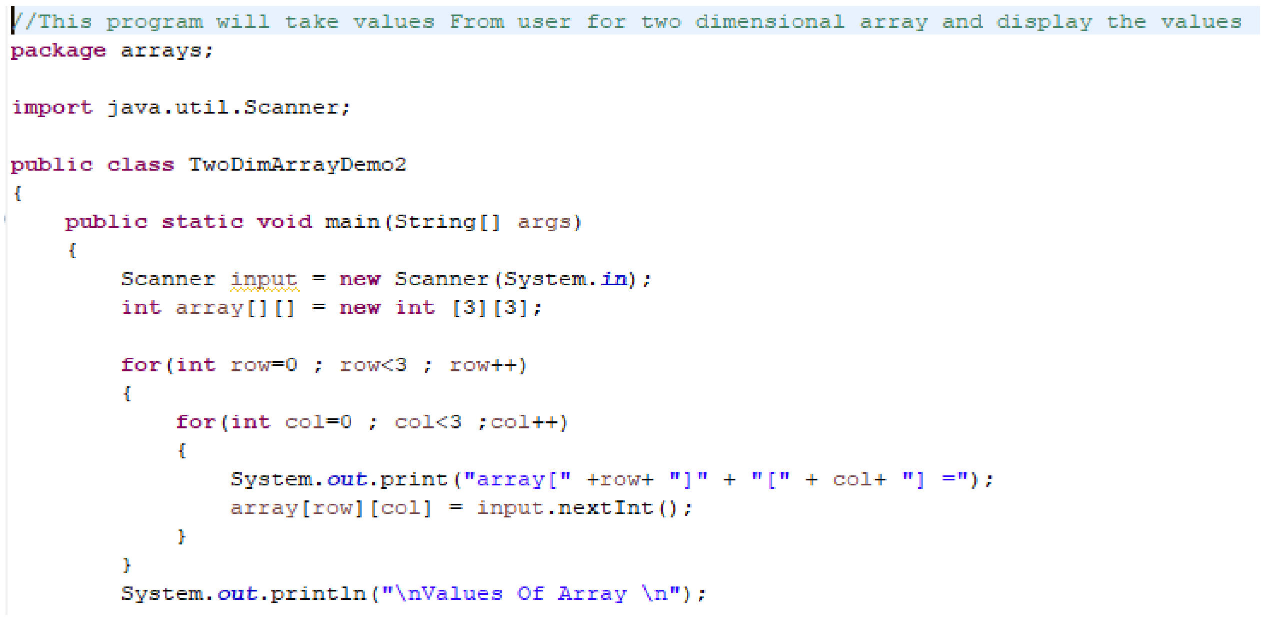


```
1st Method of Array Initialization

70 80 90
10 70 30
95 77 76

2nd Method of Array Initialization

30 40 50
70 80 10
12 45 67
```

2D Array Program 2



```java
        for(int row=0 ; row<3 ; row++)
        {
            for(int col=0 ; col<3 ;col++)
            {
                System.out.print(array[row][col] +" ");
            }
            System.out.println("");
        }
    }

}
```



```
//This program will take values From user for two dimensional array and display the values
package arrays;

import java.util.Scanner;

public class TwoDimArrayDemo2
{
    public static void main(String[] args)
    {
        Scanner input = new Scanner(System.in);
        int array[][] = new int [3][3];

        for(int row=0 ; row<3 ; row++)
        {
            for(int col=0 ; col<3 ;col++)
            {
                System.out.print("array[" +row+ "]" + "[" + col+ "] =");
                array[row][col] = input.nextInt();
            }
        }
        System.out.println("\nValues Of Array \n");
```

Java Function/Methods

- Function is a set of instructions that are designed to perform a specific task.
- A function is a complete and independent program.
- It is executed by the main method to perform its tasks.
- Functions are used to write the code of a large program by dividing it into smaller independent units.
- It avoids the replication of code in the program.

Functions VS Methods

Function — a set of instructions that perform a task.

Method — a set of instructions that are associated with an object.

METHODS

A method, like a function, is a set of instructions that perform a task. The difference is that a method is associated with an object, while a function is not.

Functions Types

1. Built in Functions or standard library methods

The standard library methods are built-in methods in Java that are readily available for use.

Example:

I. println()

II. nextInt()

III. showMessageDialog

IV. showInputDialog etc.

2. User Defined Functions

We can also create methods of our own choice to perform some task. Such methods are called user-defined methods.

Example:

```
public static void myMethod() {

System.out.println("My Function called");

}
```

Function definition

```
Access specifier   return type    methodName(list of parameter)

{

        statement(s);

}
```

The function definition is called method header.

Calling Method or Invoking Method

- Executing the statement(s) of method to perform task is called calling a function.
- Calling a method is called invoking a method.

Example:

```
        addition();
```

1. Function have no parameters list and return type

```
Class Test

{

public void printStar()

        {

        System.out.println("*****");

        }
public static void main(String args[])

{

Test object=new Test();

object.printStar();                  //method call

}

}  // Test Class body closed
```

2. Function have no return type but parameter list

```
Class Test1

{

public void sum(int x, int y)  // formal arguments

            {

            int sum=x+y;

            System.out.println("Result is"+sum);

            }

public static void main(String args[])

{

Test1 object=new Test1();

object.sum(5,6);      //Actual Arguments

}

}  // Test1 class body closed
```

3. Function return values

Function can return only one value.

Return Statement: The return statement is used to return calculated value from function definition to calling function.

Syntax:

```
return x;

Class Test2
```

```
{
public int sum(int x, int y)              // formal arguments
            {
            return(x+y);
            }
public static void main(String args[])
{
Test2 object=new Test2();
int result = object.sum(5,6);              //Actual Arguments
System.out.println("Result is"+result);
}
}  // Test2 Class body closed
```

Function/Method Overloading

- Method having same name with different set of parameters (type, order, number) then such kind of method is called overloaded method and this mechanism is called method overloading.
- Method overloading is compile time polymorphism or static binding.
- It increases the readability of the program.

Note: In java method overloading is not possible by changing the return type of method.

```
Class methodOverloading
{
public void sum(int x, int y)  // formal arguments
            {
            System.out.println("sum of int is"+(x+y));
            }
public void sum(double x, double y)  // formal arguments
            {
            System.out.println("sum of double is"+(x+y));
            }
public void sum(int x, double y)  // formal arguments
            {
            System.out.println("sum of int & double is"+(x+y));
            }
public void sum(double y, int x)  // formal arguments
            {
            System.out.println("sum of double & int is"+(x+y));
            }
public static void main(String args[])
{
methodOverloading object=new methodOverloading();
object.sum(3,5);
object.sum(3.3,5.6);
object.sum(3,5.4);
object.sum(3.6,5);
}
}
```