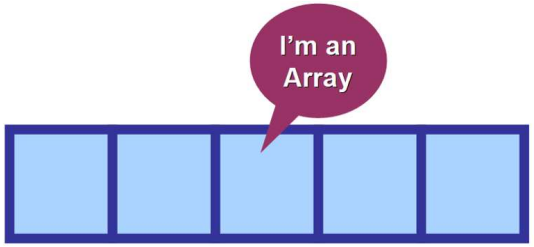
Introduction to Array

Why Array?

- Very often we need to deal with relatively large set of data.
- E.g.
  - Percentage of all the students of the college. (May be in thousands)
  - Age of all the citizens of the city. (May be lakhs)
- We need to declare thousands or lakhs of the variable to store the data which is practically not possible.
- We need a solution to store more data in a single variable.
- **Array** is the most appropriate way to handle such data.
- As per English Dictionary, "***Array means collection or group or arrangement in a specific order.***"



Array

- **An array is a fixed size sequential collection of elements of same data type grouped under single variable name.**

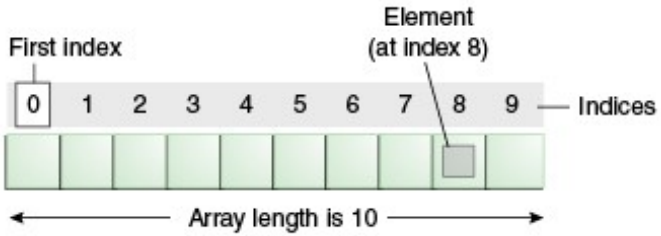
```
int num[10];
```

[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]

Fixed Size	Sequential	Same Data type	Single Variable Name
The size of an array is fixed at the time of declaration which cannot be changed later on. Here **array size** is **10**.	All the elements of an array are stored in a consecutive blocks in a memory. **10** (0 to 9)	Data type of all the elements of an array is same which is defined at the time of declaration. Here **data type** is **int**	All the elements of an array will be referred through common name. Here **array name** is **num**

Array declaration

- Normal Variable Declaration: int **a**;
- Array Variable Declaration: int **b**[10];
- Individual value or data stored in an array is known as an **element of an array**.
- Positioning / indexing of an elements in an array always **starts with 0 not 1**.
  - If 10 elements in an array then index is 0 to 9
  - If 100 elements in an array then index is 0 to 99
  - If 35 elements in an array then index is 0 to 34
- Variable **a** stores 1 integer number where as variable **b** stores 10 integer numbers which can be accessed as b[0], b[1], b[2], b[3], b[4], b[5], b[6], b[7], b[8] and b[9]



Array

- Important point about Java array.
  - An array is **derived** datatype.
  - An array is **dynamically** allocated.
  - The individual elements of an array is refereed by their **index**/**subscript** value.
  - The **subscript** for an array always begins with **0**.

35	13	28	106	35	42	5	83	97	14
a[0]	a[1]	a[2]	a[3]	a[4]	a[5]	a[6]	a[7]	a[8]	a[9]

One-Dimensional Array

- An array using **one subscript** to represent the **list of elements** is called **one dimensional array**.
- A One-dimensional array is essentially a **list** of **like-typed variables.**
- Array declaration: `type var-name[];`

  Example: `int num[];`
- Above example will represent array with no value (null).
- To link **num** with actual array of integers, we must allocate one using ***new*** keyword.

  Example: `int num[] = new int[20];`

Example (Array)

```
public class ArrayDemo{
    public static void main(String[] args) {
        int a[]; // or int[] a
        // till now it is null as it does not assigned any memory

        a = new int[5]; // here we actually create an array
        a[0] = 5;
        a[1] = 8;
        a[2] = 15;
        a[3] = 84;
        a[4] = 53;

        /* in java we use length property to determine the length
         * of an array, unlike c where we used sizeof function */
        for (int i = 0; i < a.length; i++) {
                System.out.println("a["+i+"]="+a[i]);
        }
    }
}
```

WAP to store 5 numbers in an array and print them

```
1. import java.util.*;
2. class ArrayDemo1{
3. public static void main (String[] args){
4.       int i, n;
5.       int[] a=new int[5];
6.       Scanner sc = new Scanner(System.in);
7.       System.out.print("enter Array Length:");
8.       n = sc.nextInt();
9.       for(i=0; i<n; i++) {
10.           System.out.print("enter a["+i+"]:");
11.           a[i] = sc.nextInt();
12.      }
13.      for(i=0; i<n; i++)
14.          System.out.println(a[i]);
15.   }
16.}
```

WAP to print elements of an array in reverse order

```
1. import java.util.*;
2. public class RevArray{
3. public static void  main(String[] args) {
4.    int i, n;
5.    int[] a;
6.    Scanner sc=new Scanner(System.in);
7.    System.out.print("Enter Size of an Array:");
8.    n=sc.nextInt();
9.    a=new int[n];
10.   for(i=0; i<n; i++){
11.       System.out.print("enter a["+i+"]:");
12.       a[i]=sc.nextInt();
13.   }
14.   System.out.println("Reverse Array");
15.   for(i=n-1; i>=0; i--)
16.       System.out.println(a[i]);
17.  }
18.}
```

Output:

```
Enter Size of an
Array:5
enter a[0]:1
enter a[1]:2
enter a[2]:3
enter a[3]:4
enter a[4]:5
Reverse Array
5
4
3
2
1
```

WAP to count positive number, negative number and zero from an array of n size

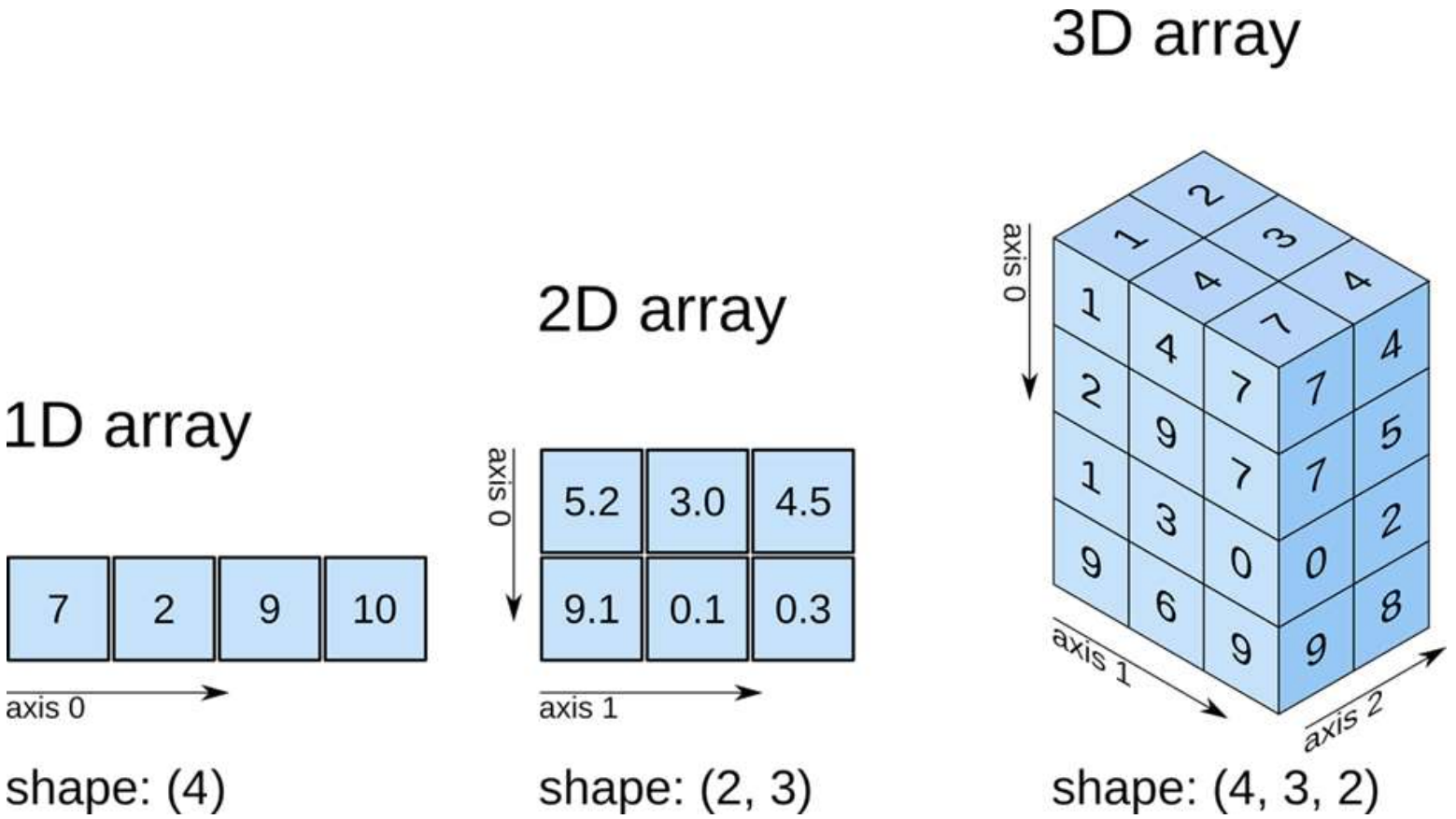
```
1.  import java.util.*;
2.  class ArrayDemo1{
3.  public static void main (String[] args){
4.       int n,pos=0,neg=0,z=0;
5.       int[] a=new int[5];
6.       Scanner sc = new Scanner(System.in);
7.       System.out.print("enter Array Length:");
8.       n = sc.nextInt();
9.       for(int i=0; i<n; i++) {
10.           System.out.print("enter a["+i+"]:");
11.           a[i] = sc.nextInt();
12.           if(a[i]>0)
13.             pos++;
14.           else if(a[i]<0)
15.             neg++;
16.           else
17.             z++;
18.      }
19.      System.out.println("Positive no="+pos);
20.      System.out.println("Negative no="+neg);
21.      System.out.println("Zero no="+z);
22. }}
```

Exercise: Array

1. WAP to count odd and even elements of an array.
2. WAP to calculate sum and average of n numbers from an array.
3. WAP to find largest and smallest from an array.

Multidimensional Array

Multidimensional Array



WAP to read 3 x 3 elements in 2d array

```
1. import java.util.*;
2. class Array2Demo{
3. public static void main(String[] args) {
4.    int size;
5.    Scanner sc=new Scanner(System.in);
6.    System.out.print("Enter size of an array");
7.    size=sc.nextInt();
8.    int a[][]=new int[size][size];
9.    for(int i=0;i<a.length;i++){
10.     for(int j=0;j<a.length;j++){
11.             a[i][j]=sc.nextInt();
12.     }
13.   }

14.   for(int i=0;i<a.length;i++){
15.     for(int j=0;j<a.length;j++){
16.          System.out.print("a["+i+"]["+j+"]:"+a[i][j]+"
17.     }
18.     System.out.println();
19.   }
20. }
21.}
```

	Column-0	Column-1	Column-2
Row-0	**11**	**18**	**-7**
Row-1	**25**	**100**	**0**
Row-2	**-4**	**50**	**88**

Output:

```
11
12
13
14
15
16
17
18
19
a[0][0]:11      a[0][1]:12      a[0][2]:13
a[1][0]:14      a[1][1]:15      a[1][2]:16
a[2][0]:17      a[2][1]:18      a[2][2]:19
```

WAP to perform addition of two 3 x 3 matrices

```
1.  import java.util.*;
2.  class Array2Demo{
3.  public static void main(String[] args) {
4.  int size;
5.  int a[][],b[][],c[][];
6.  Scanner sc=new Scanner(System.in);
7.   System.out.print("Enter size of an
                                  array:");
8.   size=sc.nextInt();
9.   a=new int[size][size];
10.  System.out.println("Enter array
                                 elements:");
11. for(int i=0;i<a.length;i++){
12.     for(int j=0;j<a.length;j++){
13.        System.out.print("Enter
                        a["+i+"]["+j+"]:");
14.        a[i][j]=sc.nextInt();
15.     }
16. }
```

```
1.  b=new int[size][size];
2.  for(int i=0;i<b.length;i++){
3.   for(int j=0;j<b.length;j++){
4.      System.out.print("Enter
                        b["+i+"]["+j+"]:");
5.      b[i][j]=sc.nextInt();
6.   }
7.  }
8.  c=new int[size][size];
9.  for(int i=0;i<c.length;i++){
10.  for(int j=0;j<c.length;j++){
11.  System.out.print("c["+i+"]["+j+"]:“
                  +(a[i][j]+b[i][j])+"\t");
12.   }
13.   System.out.println();
14.   }
15.  }//main()
16. }//class
```

Initialization of an array elements

1. One dimensional Array

1. `int a[5] = { 7, 3, -5, 0, 11 };` // a[0]=7, a[1] = 3, a[2] = -5, a[3] = 0, a[4] = 11
2. `int a[5] = { 7, 3 };` // a[0] = 7, a[1] = 3, a[2], a[3] and a[4] are 0
3. `int a[5] = { 0 };` // all elements of an array are initialized to 0

2. Two dimensional Array

1. `int a[2][4] = { { 7, 3, -5, 10 }, { 11, 13, -15, 2} };` // 1st row is 7, 3, -5, 10 & 2nd row is 11, 13, -15, 2
2. `int a[2][4] = { 7, 3, -5, 10, 11, 13, -15, 2 };` // 1st row is 7, 3, -5, 10 & 2nd row is 11, 13, -15, 2
3. `int a[2][4] = { { 7, 3 }, { 11} };` // 1st row is 7, 3, 0, 0 & 2nd row is 11, 0, 0, 0
4. `int a[2][4] = { 7, 3 };` // 1st row is 7, 3, 0, 0 & 2nd row is 0, 0, 0, 0
5. `int a[2][4] = { 0 };` // 1st row is 0, 0, 0, 0 & 2nd row is 0, 0, 0, 0

Multi-Dimensional Array

- In java, multidimensional array is actually **array of arrays.**
- **Example**: `int runPerOver[][] = new int[3][6];`

First Over (a[0])	**4** a[0][0]	**0** a[0][1]	**1** a[0][2]	**3** a[0][3]	**6** a[0][4]	**1** a[0][5]
Second Over (a[1])	**1** a[1][0]	**1** a[1][1]	**0** a[1][2]	**6** a[1][3]	**0** a[1][4]	**4** a[1][5]
Third Over (a[2])	**2** a[2][0]	**1** a[2][1]	**1** a[2][2]	**0** a[2][3]	**1** a[2][4]	**1** a[2][5]

- **`length` field:**
  - If we use length field with multidimensional array, it will return length of first dimension.
  - Here, if **runPerOver.length** is accessed it will return **3**
  - Also if **runPerOver[0].length** is accessed it will be **6**

Multi-Dimensional Array (Example)

```
Scanner s = new Scanner(System.in);
int runPerOver[][] = new int[3][6];
for (int i = 0; i < 3; i++) {
    for (int j = 0; j < 6; j++) {
        System.out.print("Enter Run taken" +
        " in Over numner " + (i + 1) +
        " and Ball number " + (j + 1) + " = ");
        runPerOver[i][j] = s.nextInt();
    }
}
int totalRun = 0;
for (int i = 0; i < 3; i++) {
    for (int j = 0; j < 6; j++) {
        totalRun += runPerOver[i][j];
    }
}
double average = totalRun / (double) runPerOver.length;
System.out.println("Total Run = " + totalRun);
System.out.println("Average per over = " + average);
```

```
C:\WINDOWS\system32\cmd.exe
Enter Run taken in Over numner 1 and Ball number 1 = 4
Enter Run taken in Over numner 1 and Ball number 2 = 0
Enter Run taken in Over numner 1 and Ball number 3 = 1
Enter Run taken in Over numner 1 and Ball number 4 = 3
Enter Run taken in Over numner 1 and Ball number 5 = 6
Enter Run taken in Over numner 1 and Ball number 6 = 1
Enter Run taken in Over numner 2 and Ball number 1 = 1
Enter Run taken in Over numner 2 and Ball number 2 = 1
Enter Run taken in Over numner 2 and Ball number 3 = 0
Enter Run taken in Over numner 2 and Ball number 4 = 6
Enter Run taken in Over numner 2 and Ball number 5 = 0
Enter Run taken in Over numner 2 and Ball number 6 = 4
Enter Run taken in Over numner 3 and Ball number 1 = 2
Enter Run taken in Over numner 3 and Ball number 2 = 1
Enter Run taken in Over numner 3 and Ball number 3 = 1
Enter Run taken in Over numner 3 and Ball number 4 = 0
Enter Run taken in Over numner 3 and Ball number 5 = 1
Enter Run taken in Over numner 3 and Ball number 6 = 1
Total Run = 33
Average per over = 11.0
```

Multi-Dimensional Array (Cont.)

- **manually** allocate **different** size:

```
int runPerOver[][] = new int[3][];
runPerOver[0] =  new int[6];
runPerOver[1]  =  new int[7];
runPerOver[2]  =  new int[6];
```

- **initialization**:

```
int runPerOver[][] = {
                        {0,4,2,1,0,6},
                        {1,-1,4,1,2,4,0},
                        {6,4,1,0,2,2},
                }
```

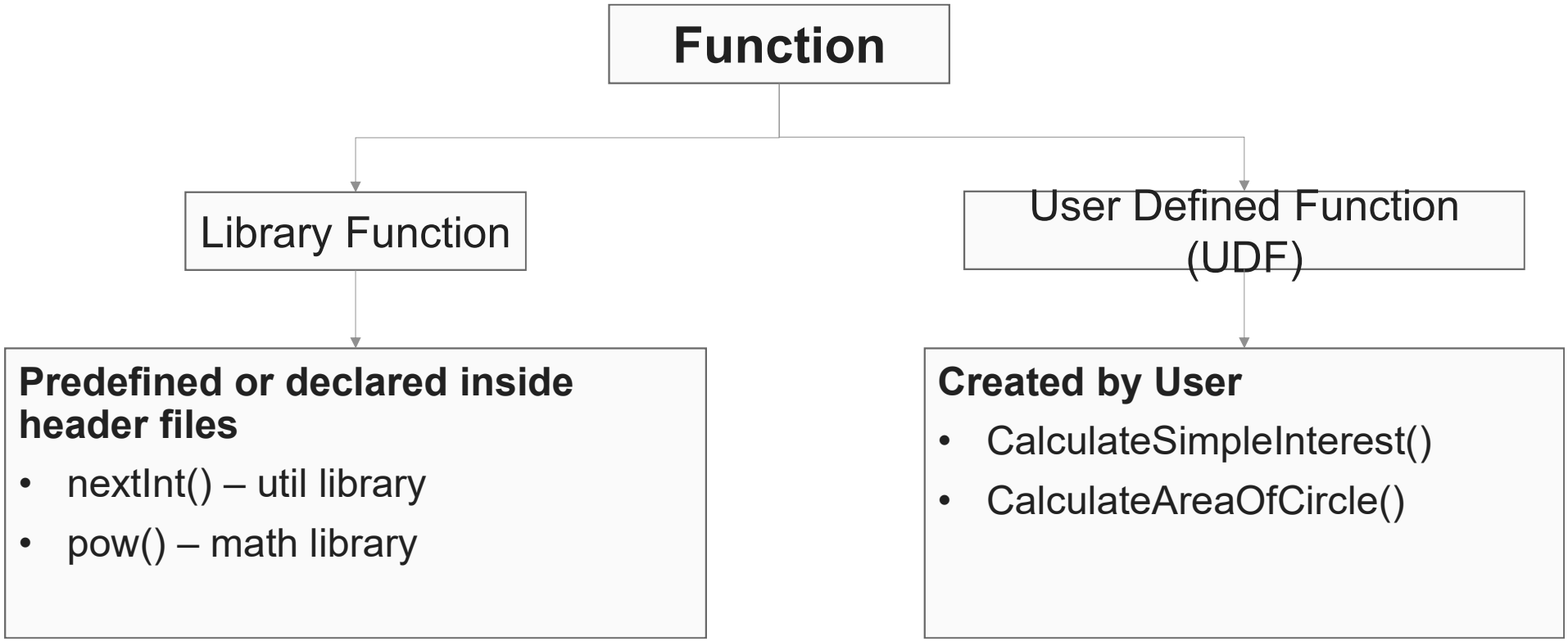
Note : here to specify extra runs (Wide, No Ball etc..) negative values are used

What is Method?

- A **method** is a group of statements that performs a specific task.
- A large program can be divided into the basic building blocks known as **method/function**.
- The function contains the set of programming statements enclosed by { }.
- Program execution in many programming language starts from the **main** function.
- main is also a **method/function**.

```
void main()
{
    // body part
}
```

Types of Function



Program Structure of Function

- User-defined function's program structure is divided into three parts as follows:

C:Function Structure

```
void func1();


void main()
{
  ....
  func1();
}

void func1()
{
  ....
  //function body
  ....
}
```

Function Prototype

Function call

Function definition

Java:Function for addition of 2 numbers

```
class MethodDemo{
 public static void main(String[] ags){
        int a=10,b=20,c;
        c=add(a,b);
        System.out.println("a+b="+c);
 }
static int add(int i, int j){
        return i+j;
 }
}
```

Method Definition

- A method definition defines the **method header** and **body**.
- A **method body** part defines method logic.
  - Method statements

Syntax

```
return-type method_name(datatyp1 arg1, datatype2 arg2, …)
{
        functions statements
}
```

Example

```
int addition(int a, int b);
{
        return a+b;
}
```

WAP to add two number using add(int, int) Function

```
1. class MethodDemo{
2.  public static void main(String[]
   args) {
3.   int a=10,b=20,c;
4.   MethodDemo md=new MethodDemo();
5.   c=md.add(a,b);
6.   System.out.println("a+b="+c);
7.  }//main()
8.  int add(int i, int j){
9.        return i+j;
10. }
11.}
```

Output:

```
a+b=30
```

Actual parameters v/s Formal parameters

- Values that are passed from the calling functions are known **actual parameters**.
- The variables declared in the function prototype or definition are known as **formal parameters**.
- Name of formal parameters can be same or different from actual parameters.
- Sequence of parameter is **important.**

Actual Parameters

```
int a=10,b=20,c;
MethodDemo md=new MethodDemo();
c=md.add(a,b);
// a and b are the actual parameters.
```

Formal Parameters

```
int add(int i, int j)
{
                return i+j;
}
// i and j are the formal parameters.
```

Return Statement

- The function can **return only one value**.
- Function cannot return more than one value.
- If function is not returning any value then return type should be **`void`**.

Actual Parameters

```
int a=10,b=20,c;
MethodDemo md=new MethodDemo();
c=md.sub(a,b);
// a and b are the actual parameters.
```

Formal Parameters

```
int sub(int i, int j)
{
        return i - j;
}
// i and j are the formal parameters.
```

WAP to calculate the Power of a Number using method

```
1.  import java.util.*;
2.  public class PowerMethDemo1{
3.  public static void main(String[] args){
4.     int num, pow, res;
5.     Scanner sc=new Scanner(System.in);
6.     System.out.print("enter num:");
7.     num=sc.nextInt();
8.     System.out.print("enter pow:");
9.     pow=sc.nextInt();
10.    PowerMethDemo1 pmd=new
                              PowerMethDemo1();
11.    res = pmd.power(num, pow);
12.    System.out.print("ans="+res);
13.    } //main()
```

```
14.     int power(int a, int b){
15.      int i, r = 1;
16.      for(i=1; i<=b; i++)
17.      {
18.            r = r * a;
19.      }
20.      return r;
21.    }//power()
22. }//class
```

Output:

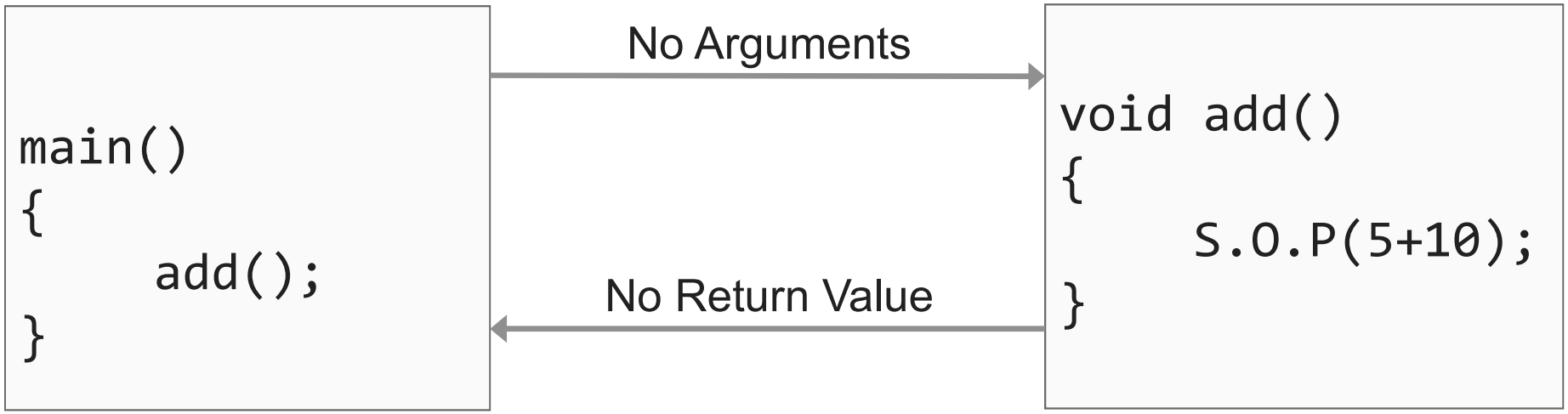
```
enter num:5
enter pow:3
ans=125
```

Types of Methods(Method Categories)

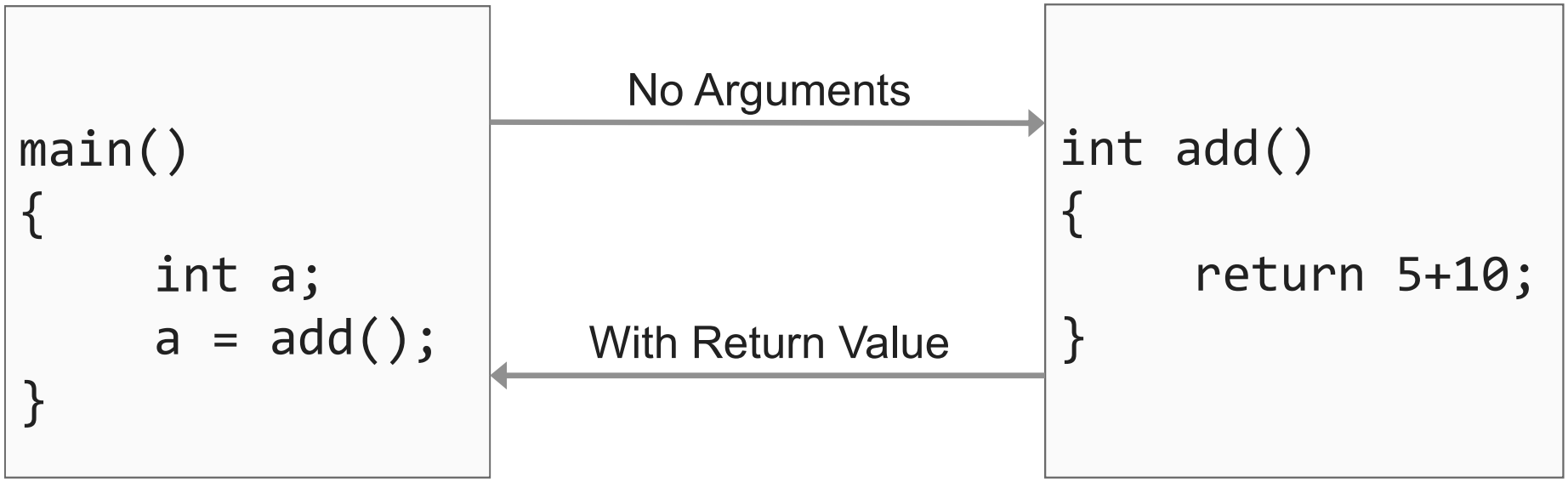
- Functions can be divided in 4 categories based on arguments and return value.
  1. Method without arguments and without return value
  2. Method without arguments and with return value
  3. Method with arguments and without return value
  4. Method with arguments and with return value

```
void add();
int add();
void add(int, int);
int add(int, int);
```

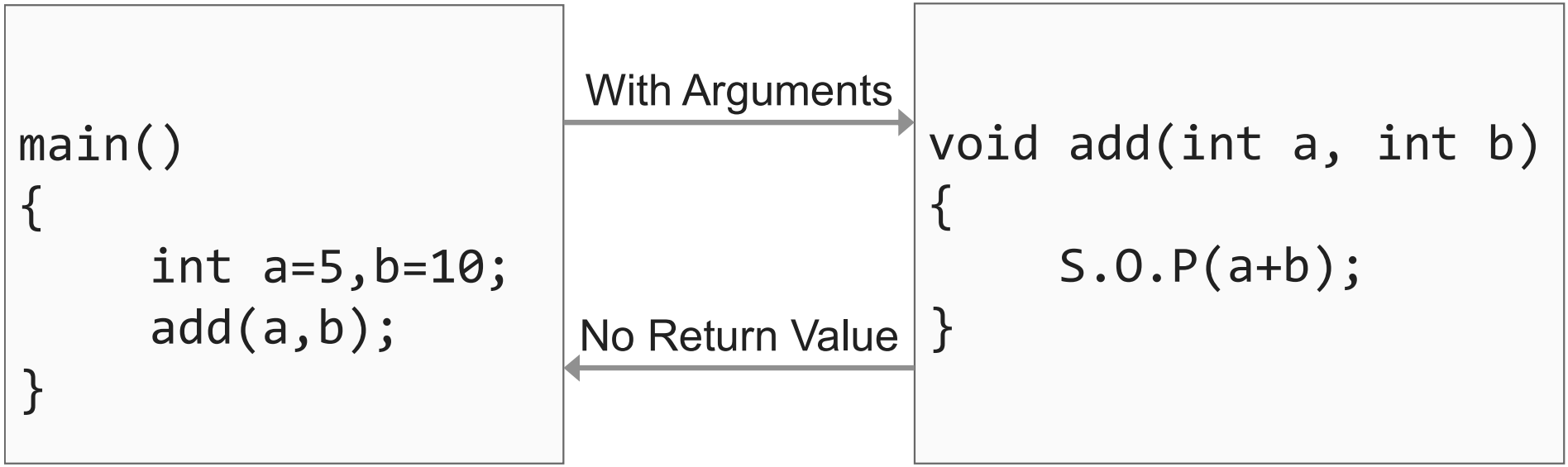
Method without arguments and without return value



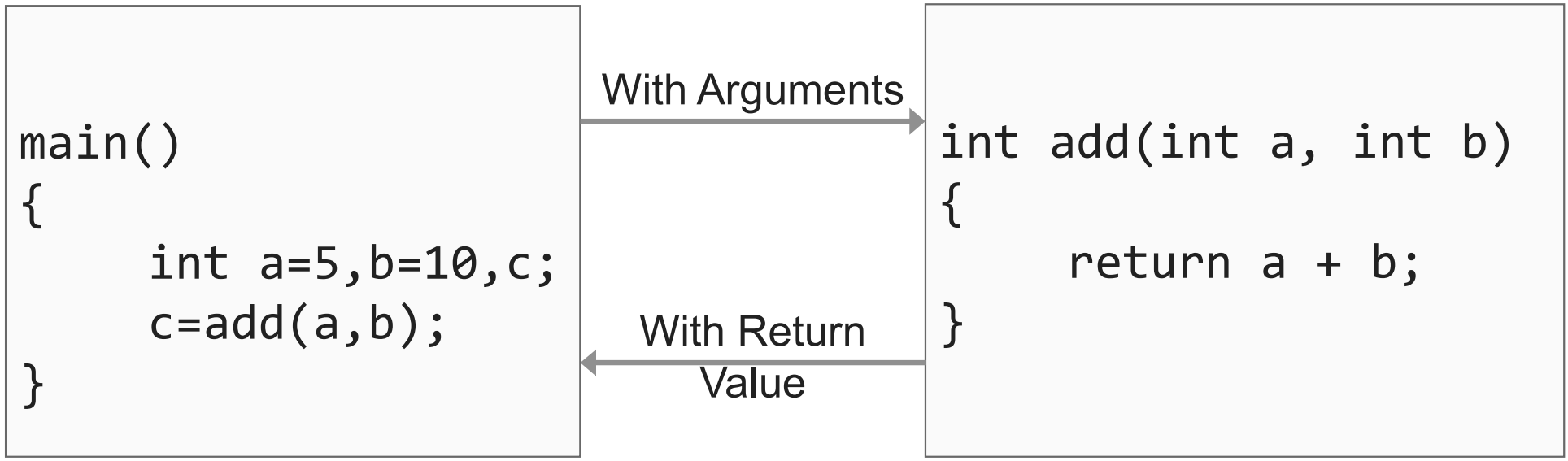
Method without arguments and with return value



Method with arguments and without return value



Method with arguments and with return value



Method Overloading

Method Overloading: Compile-time Polymorphism

- **Definition**: When two or more methods are implemented that share same name but different parameter(s), the methods are said to be ***overloaded***, and the process is referred to as ***method overloading***
- Method overloading is one of the ways that Java implements polymorphism.
- When an overloaded method is invoked, Java uses the type and/or number of arguments as its guide to determine which version of the overloaded method to actually call.
  - E.g.

```
public void draw()
public void draw(int height, int width)
public void draw(int radius)
```

- Thus, overloaded methods must differ in the type and/or number of their parameters.
- While in overloaded methods with different return types and same name & parameter are not allowed ,as the return type alone is insufficient for the compiler to distinguish two versions of a method.

Method Overloading: Compile-time Polymorphism

```
1. class Addition{
2. int i,j,k;
3.   void add(int a){
4.     i=a;
5.     System.out.println("add i="+i);
6.   }
7.   void add(int a,int b){\\overloaded add()
8.     i=a;
9.     j=b;
10.    System.out.println("add i+j="+(i+j));
11.  }
12.  void add(int a,int b,int c){\\overloaded add()
13.    i=a;
14.    j=b;
15.    k=c;
16.    System.out.println("add i+j+k="+(i+j+k));
17.  }
18.}
```

```
19. class OverloadDemo{
20.public static void
        main(String[] args){
21.   Addition a1= new Addition();
22.   //call all versions of add()
23.     a1.add(20);
24.     a1.add(30,50);
25.     a1.add(10,30,60);
26.     }
27.}
```

Output

```
add i=20
add i+j=80
add i+j+k=100
```

Method Overloading: Compile-time Polymorphism

```
1. class Addition{
2. int i,j,k;
3.   void add(int a){
4.      i=a;
5.      System.out.println("add i="+i);
6.   }
7.   void add(int a,int b){\\overloaded add()
8.      i=a;
9.      j=b;
10.     System.out.println("add i+j="+(i+j));
11.  }
12.  void add(double a, double b){\\overloaded add()
13.     System.out.println("add a+b="+(a+b));
14.  }
15.  void add(int a,int b,int c){\\overloaded add()
16.     i=a;
17.     j=b;
18.     k=c;
19.     System.out.println("add i+j+k="+(i+j+k));
20.  }
21.}
```

```
22. class OverloadDemo{
23. public static void
        main(String[] args){
24.   Addition a1= new Addition();
25.   //call all versions of add()
26.     a1.add(20);
27.     a1.add(30,50);
28.     a1.add(10,30,60);
29.     a1.add(30.5,50.67);
30.     }
31. }
```

Output

```
add i=20
add i+j=80
add i+j+k=100
add a+b=81.17
```

Method Overloading: Points to remember

- Method overloading supports polymorphism because it is one way that Java implements the “one interface, multiple methods” paradigm.
- Overloading **increases** the readability of the program.
- There are two ways to overload the method in java
  1. By changing number of arguments
  2. By changing the data type
- In java, method overloading is not possible by changing the return type of the method only because of ambiguity.

Method Overloading: Points to remember

Can we overload java main() method?

- Yes, by method overloading. We can have any number of main methods in a class by method overloading
- But JVM calls main() method which receives string array as arguments only.

Advantages of Method

- Reduced Code Redundancy
  - Rewriting the same logic or code again and again in a program can be avoided.
- Reusability of Code
  - Same function can be call from multiple times without rewriting code.
- Reduction in size of program
  - Instead of writing many lines, just function need to be called.
- Saves Development Time
  - Instead of changing code multiple times, code in a function need to be changed.
- More Traceability of Code
  - Large program can be easily understood or traced when it is divide into functions.
- Easy to Test & Debug
  - Testing and debugging of code for errors can be done easily in individual function.

Thank You