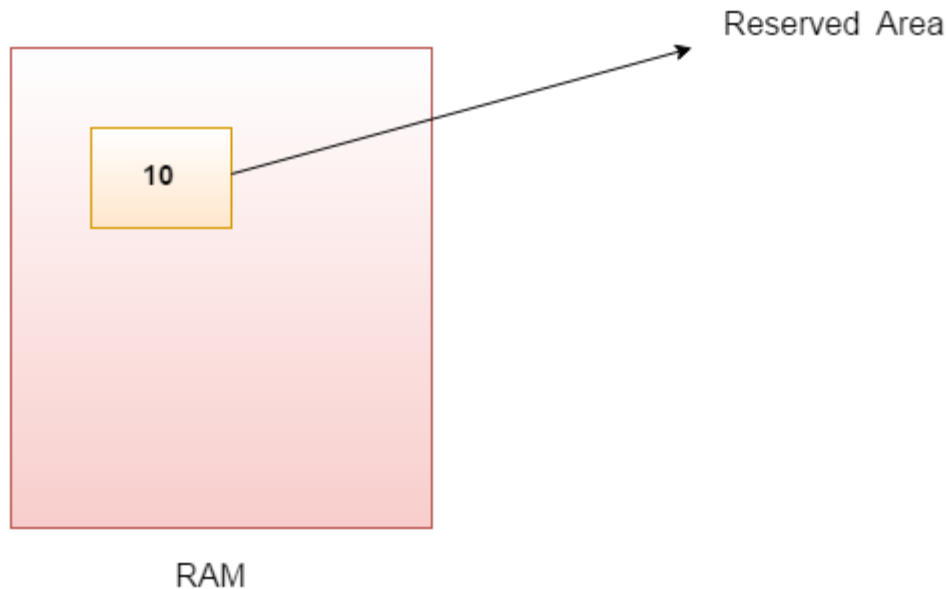


## Variables and Data Types in Java

- Java variable is a name given to a memory location. It is the basic unit of storage in a program.
- Variables are the data containers that save the data values during Java program execution.
- The value stored in a variable can be changed during program execution.
- Variables in Java are only a name given to a memory location.
- In Java, all variables must be declared before use.

### Example:

```
int a=10;
```



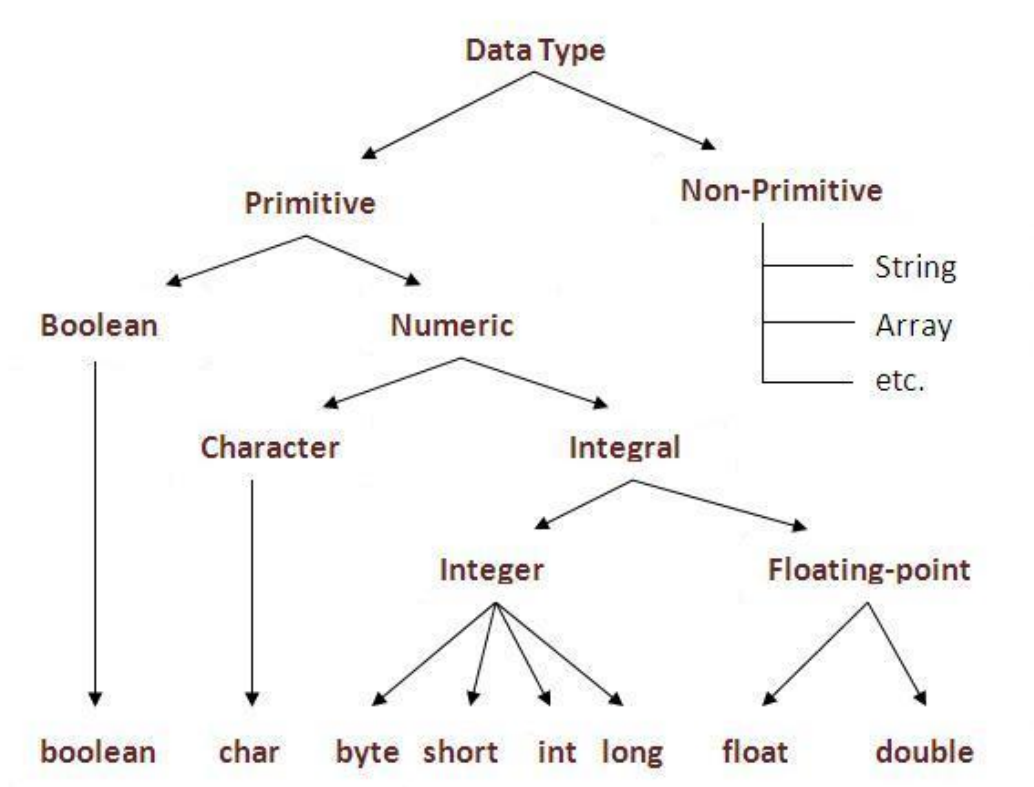
### Note:

In Java, every variable and expression has some type, every assignment should be checked by the compiler for type compatibility, because of this reason Java language is a **Strongly-Typed** programming language.

## Data Types in Java

Data types represent the different values to be stored in the variable. In Java, there are two types of data types:

- **Primitive data types:** The primitive data types include boolean, char, byte, short, int, long, float, and double.
- **Non-primitive data types:** The non-primitive data types include Classes, Interfaces, and Arrays.



Data Type	Default Value	Default size
boolean	false	1 bit
char	'\u0000'	2 byte
byte	0	1 byte
short	0	2 byte
int	0	4 byte
long	0L	8 byte
float	0.0f	4 byte
double	0.0d	8 byte

## Data Type Range

The range of values is calculated as  $-(2^{n-1})$  to  $(2^{n-1})-1$ ; where n is the number of bits required.

For example, the byte data type requires 1 byte = 8 bits. Therefore, the range of values that can be stored in the byte data type is  $-(2^{8-1})$  to  $(2^{8-1})-1$ . =  $-2^7$  to  $(2^7) - 1$ . = -128 to 127.

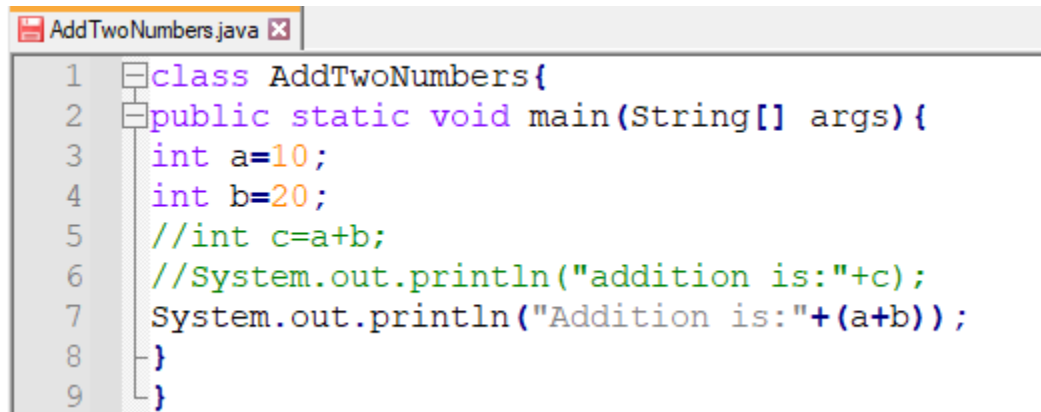
Data Type	Size	Description
byte	1 byte	Stores whole numbers from -128 to 127
short	2 bytes	Stores whole numbers from -32,768 to 32,767

int	4 bytes	Stores whole numbers from -2,147,483,648 to 2,147,483,647
long	8 bytes	Stores whole numbers from -9,223,372,036,854,775,808 to 9,223,372,036,854,775,807
float	4 bytes	Stores fractional numbers. Sufficient for storing 6 to 7 decimal digits
double	8 bytes	Stores fractional numbers. Sufficient for storing 15 decimal digits
boolean	1 bit	Stores true or false values
char	2 bytes	Stores a single character/letter or ASCII values

### Assignment Q.1:

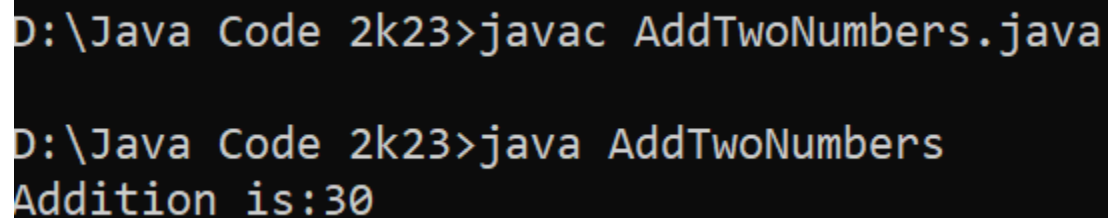
**What are the minimum and maximum range of primitive data types in java.**

## Example: Add Two Numbers



```
AddTwoNumbers.java x
1 class AddTwoNumbers{
2     public static void main(String[] args){
3         int a=10;
4         int b=20;
5         //int c=a+b;
6         //System.out.println("addition is:"+c);
7         System.out.println("Addition is: "+(a+b));
8     }
9 }
```

## Output:



```
D:\Java Code 2k23>javac AddTwoNumbers.java
D:\Java Code 2k23>java AddTwoNumbers
Addition is:30
```

## Example: Arithmetic Operations

```
ArithOperation.java
1  class ArithOperation
2  {
3      public static void main(String args[])
4      {
5          int a=52,b=20;
6          System.out.println("Value of a:"+a);
7          System.out.println("Value of b:"+b);
8          //System.out.println("Value of a is:"+a +"\nValue of b is:"+b);
9          int c=a+b;
10         System.out.println("Sum is:"+ c);
11         //System.out.println("Sum is:"+ (a+b));
12         System.out.println("Difference is:"+ (a-b));
13         System.out.println("Multiplication is:"+ (a*b));
14         System.out.println("Division is:"+ (a/b));
15         System.out.println("Remainder is:"+ (a%b));
16     }
17 }
18
```

Output:

```
C:\> C:\Windows\system32\cmd.exe

D:\Java Code 2k23>javac ArithOperation.java

D:\Java Code 2k23>java ArithOperation
Value of a:52
Value of b:20
Sum is:72
Difference is:32
Multiplication is:1040
Division is:2
Remainder is:12
```

### Example: Calculate the area and circumference of a circle.

```
Area.java
1  class Area
2  {
3      public static void main(String args[])
4      {
5          int r=42;
6          double area, circum;
7          area=3.14*r*r;
8          //area=Math.PI*Math.pow(r, 2);
9          circum=2*3.14*r;
10         //circum =2*Math.PI*rad;
11         System.out.println ("Radius of Circle is:"+r);
12         System.out.println ("Area of Circle is:"+area);
13         System.out.println ("Circumference of Circle is:"+circum);
14     }
15 }
```

Output:

```
C:\Windows\system32\cmd.exe

D:\Java Code 2k23>javac Area.java

D:\Java Code 2k23>java Area
Radius of Circle is:42
Area of Circle is:5538.96
Circumference of Circle is:263.76
```

## Printing default values of primitive data types.

### Case 1:

```
DefaultValues.java x
1  class DefaultValues
2  {
3  public static void main(String args[])
4  {
5  int i;
6  float f;
7
8  System.out.println(i);
9  System.out.println(f);
10 }
11 }
```

```
C:\Windows\system32\cmd.exe
D:\Java Code 2k23>javac DefaultValues.java
DefaultValues.java:8: error: variable i might not have been initialized
System.out.println(i);
                   ^
DefaultValues.java:9: error: variable f might not have been initialized
System.out.println(f);
                   ^
2 errors
```



### Solution:

```
1  class DefaultValues
2  {
3      public static void main(String args[])
4      {
5          int i=0;
6          float f=0.0f;
7
8          System.out.println(i) ;
9          System.out.println(f) ;
10     }
11 }
```

### Output:

```
D:\Java Code 2k23>javac DefaultValues.java
D:\Java Code 2k23>java DefaultValues
0
0.0
```

## Case 2

### Declaring variables outside the main method.

```
DefaultValues.java x
1  class DefaultValues
2  {
3      int i;
4      float f;
5      public static void main(String args[])
6      {
7          System.out.println(i);
8          System.out.println(f);
9      }
10 }
11
12
```

```
C:\Windows\system32\cmd.exe
D:\Java Code 2k23>javac DefaultValues.java
DefaultValues.java:7: error: non-static variable i cannot
be referenced from a static context
System.out.println(i);
                   ^
DefaultValues.java:8: error: non-static variable f cannot
be referenced from a static context
System.out.println(f);
                   ^
2 errors
```

**Solution:**

```
1  class DefaultValues
2  {
3      static int i;
4      static float f;
5      public static void main(String args[])
6      {
7          System.out.println(i);
8          System.out.println(f);
9      }
10 }
```

```
D:\Java Code 2k23>javac DefaultValues.java
```

```
D:\Java Code 2k23>java DefaultValues
```

```
0
```

```
0.0
```

## Java program that prints the range of primitive data types

```
1 public class DataTypeRangeExample {
2     public static void main(String[] args) {
3         System.out.println("Range of primitive data types:");
4
5         System.out.println("byte: " + Byte.MIN_VALUE + " to " + Byte.MAX_VALUE);
6         System.out.println("short: " + Short.MIN_VALUE + " to " + Short.MAX_VALUE);
7         System.out.println("int: " + Integer.MIN_VALUE + " to " + Integer.MAX_VALUE);
8         System.out.println("long: " + Long.MIN_VALUE + " to " + Long.MAX_VALUE);
9
10        System.out.println("float: " + Float.MIN_VALUE + " to " + Float.MAX_VALUE);
11        System.out.println("double: " + Double.MIN_VALUE + " to " + Double.MAX_VALUE);
12
13        System.out.println("char: " + (int) Character.MIN_VALUE + " to " + (int) Character.MAX_VALUE);
14        System.out.println("boolean: " + Boolean.FALSE + " to " + Boolean.TRUE);
15    }
16 }
17
```

### Output:

```
D:\Java Code 2k23>javac DataTypeRangeExample.java

D:\Java Code 2k23>java DataTypeRangeExample
Range of primitive data types:
byte: -128 to 127
short: -32768 to 32767
int: -2147483648 to 2147483647
long: -9223372036854775808 to 9223372036854775807
float: 1.4E-45 to 3.4028235E38
double: 4.9E-324 to 1.7976931348623157E308
char: 0 to 65535
boolean: false to true
```