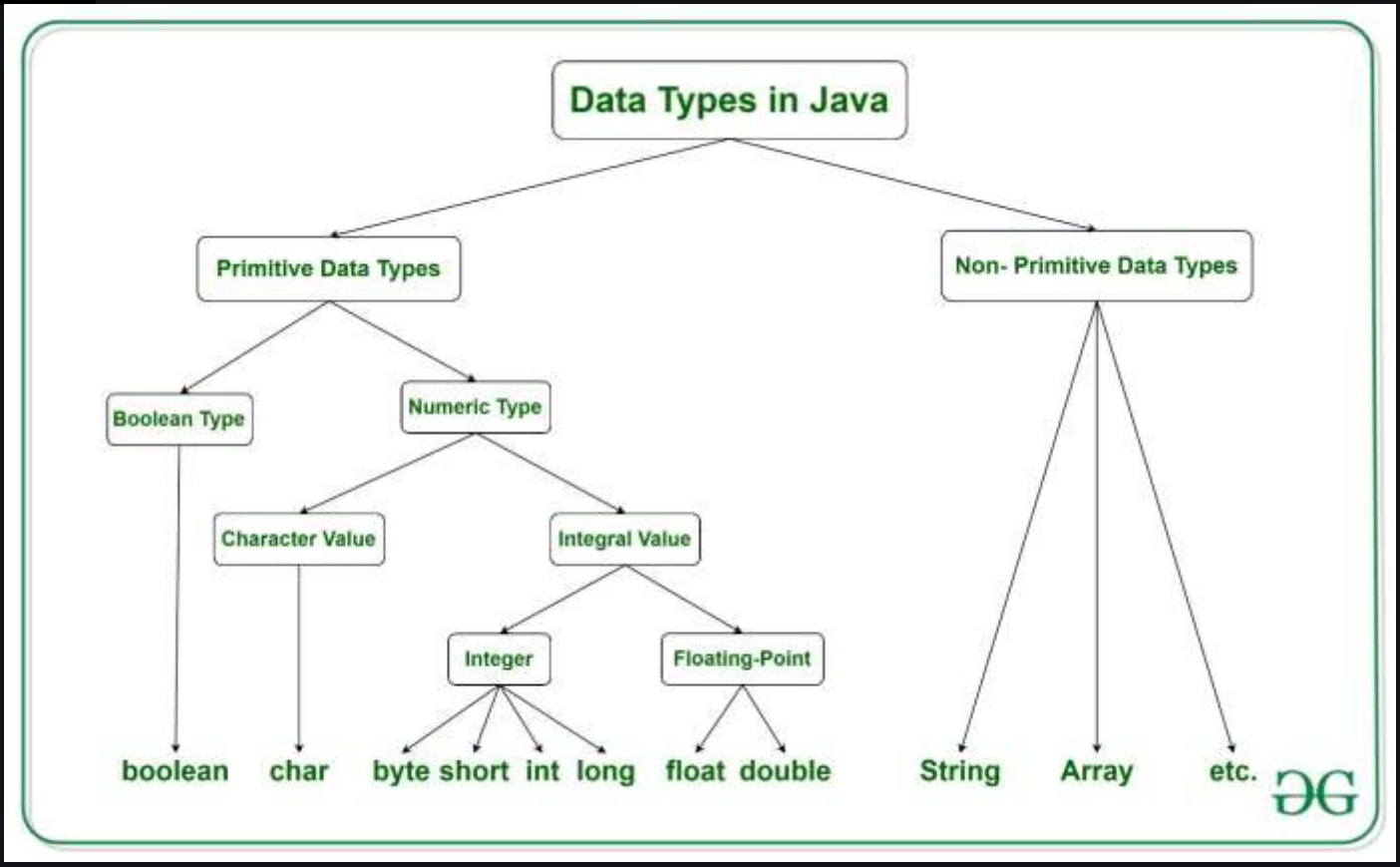
Java Data Types

Java is statically typed and also a strongly typed language because, in Java, each type of data (such as integer, character, hexadecimal, packed decimal, and so forth) is predefined as part of the programming language and all constants or variables defined for a given program must be described with one of the data types.

What are Data Types in Java?

Data types in Java are of different sizes and values that can be stored in the variable that is made as per convenience and circumstances to cover up all test cases. Java has two categories in which data types are segregated

1. **Primitive Data Type:** such as boolean, char, int, short, byte, long, float, and double
2. **Non-Primitive Data Type or Object Data type:** such as String, Array, etc.



Primitive Data Types in Java

Primitive data are only single values and have no special capabilities. There are 8 primitive data types. They are depicted below in tabular format below as follows:

Type	Description	Default	Size	Example Literals	Range of values
boolean	true or false	false	1 bit	true, false	true, false

Type	Description	Default	Size	Example Literals	Range of values
byte	twos-complement integer	0	8 bits	(none)	-128 to 127
char	Unicode character	\u0000	16 bits	‘a’, ‘\u0041’, ‘\101’, ‘\\’, ‘\’, ‘\n’, ‘?’	characters representation of ASCII values 0 to 255
short	twos-complement integer	0	16 bits	(none)	-32,768 to 32,767
int	twos-complement intger	0	32 bits	-2,-1,0,1,2	-2,147,483,648 to 2,147,483,647
long	twos-complement integer	0	64 bits	-2L,-1L,0L,1L,2L	-9,223,372,036,854,775,808 to 9,223,372,036,854,775,807
float	IEEE 754 floating point	0.0	32 bits	1.23e100f , -1.23e-100f , .3f ,3.14F	upto 7 decimal digits
double	IEEE 754 floating point	0.0	64 bits	1.23456e300d , -123456e-300d , 1e1d	upto 16 decimal digits

Let us discuss and implement each one of the following data types that are as follows:

1. Boolean Data Type

Boolean data type represents only one bit of information **either true or false** which is intended to represent the two truth values of logic and Boolean algebra, but the size of the boolean data type is **virtual machine-dependent**. Values of type boolean are not converted implicitly or explicitly (with casts) to any other type. But the programmer can easily write conversion code.

Syntax:

```
boolean booleanVar;
```

Size: Virtual machine dependent

2. Byte Data Type

The byte data type is an 8-bit signed two's complement integer. The byte data type is useful for saving memory in large arrays.

Syntax:

```
byte byteVar;
```

Size: 1 byte (8 bits)

3. Short Data Type

The short data type is a 16-bit signed two's complement integer. Similar to byte, use a short to save memory in large arrays, in situations where the memory savings actually matters.

Syntax:

```
short shortVar;
```

Size: 2 bytes (16 bits)

4. Integer Data Type

It is a 32-bit signed two's complement integer.

Syntax:

```
int intVar;
```

Size: 4 bytes (32 bits)

Remember: *In Java SE 8 and later, we can use the int data type to represent an unsigned 32-bit integer, which has a value in the range [0, 2^{32}-1]. Use the Integer class to use the int data type as an unsigned integer.*

5. Long Data Type

The range of a long is quite large. The long data type is a 64-bit two's complement integer and is useful for those occasions where an int type is not large enough to hold the desired value. The size of the Long Datatype is 8 bytes (64 bits).

Syntax:

```
long longVar;
```

Remember: *In Java SE 8 and later, you can use the long data type to represent an unsigned 64-bit long, which has a minimum value of 0 and a maximum value of 2^{64}-1. The Long class also contains methods like comparing Unsigned, divide Unsigned, etc to support arithmetic operations for unsigned long.*

6. Float Data Type

The float data type is a single-precision 32-bit IEEE 754 floating-point. Use a float (instead of double) if you need to save memory in large arrays of floating-point numbers. The size of the float data type is 4 bytes (32 bits).

Syntax:

```
float floatVar;
```

7. Double Data Type

The double data type is a double-precision 64-bit IEEE 754 floating-point. For decimal values, this data type is generally the default choice. The size of the double data type is 8 bytes or 64 bits.

Syntax:

```
double doubleVar;
```

Note: *Both float and double data types were designed especially for scientific calculations, where approximation errors are acceptable. If accuracy is the most prior concern then, it is recommended not to use these data types and use BigDecimal class instead.*

It is recommended to go through *rounding off errors in java.*

8. Char Data Type

The char data type is a single 16-bit Unicode character with the size of 2 bytes (16 bits).

Syntax:

```
char charVar;
```

Why is the Size of char 2 bytes in Java?

So, other languages like C/C++ use only ASCII characters, and to represent all ASCII characters 8 bits is enough. But java uses the **Unicode system not the ASCII code system** and to represent the Unicode system 8 bits is not enough to represent all characters so java uses 2 bytes for characters. **Unicode** defines a fully international character set that can represent most of the world's written languages. It is a unification of dozens of character sets, such as Latin, Greek, Cyrillic, Katakana, Arabic, and many more.

Example:

- Java

```java
// Java Program to Demonstrate Char Primitive Data Type


// Class
class GFG {


    // Main driver method
    public static void main(String args[])
    {
```

```java
        // Creating and initializing custom character
        char a = 'G';

        // Integer data type is generally
        // used for numeric values
        int i = 89;

        // use byte and short
        // if memory is a constraint
        byte b = 4;

        // this will give error as number is
        // larger than byte range
        // byte b1 = 7888888955;

        short s = 56;

        // this will give error as number is
        // larger than short range
        // short s1 = 87878787878;

        // by default fraction value
        // is double in java
        double d = 4.355453532;

        // for float use 'f' as suffix as standard
        float f = 4.7333434f;

        // need to hold big range of numbers then we need
        // this data type
        long l = 12121;

        System.out.println("char: " + a);
```

```
        System.out.println("integer: " + i);
        System.out.println("byte: " + b);
        System.out.println("short: " + s);
        System.out.println("float: " + f);
        System.out.println("double: " + d);
        System.out.println("long: " + l);
    }
}
```

Output

```
char: G
integer: 89
byte: 4
short: 56
float: 4.7333436
double: 4.355453532
long: 12121
```

Non-Primitive Data Type or Reference Data Types

The **Reference Data Types** will contain a memory address of variable values because the reference types won't store the variable value directly in memory. They are strings, objects, arrays, etc.

1. Strings

Strings are defined as an array of characters. The difference between a character array and a string in Java is, that the string is designed to hold a sequence of characters in a single variable whereas, a character array is a collection of separate char-type entities. Unlike C/C++, Java strings are not terminated with a null character.

Syntax: Declaring a string

```
<String_Type> <string_variable> = "<sequence_of_string>";
```

Example:

```
// Declare String without using new operator
String s = "GeeksforGeeks";

// Declare String using new operator
String s1 = new String("GeeksforGeeks");
```

2. Class

A class is a user-defined blueprint or prototype from which objects are created. It represents the set of properties or methods that are common to all objects of one type. In general, class declarations can include these components, in order:

1. **Modifiers**: A class can be public or has default access. Refer to access specifiers for classes or interfaces in Java
2. **Class name:** The name should begin with an initial letter (capitalized by convention).
3. **Superclass(if any):** The name of the class's parent (superclass), if any, preceded by the keyword extends. A class can only extend (subclass) one parent.
4. **Interfaces(if any):** A comma-separated list of interfaces implemented by the class, if any, preceded by the keyword implements. A class can implement more than one interface.
5. **Body:** The class body is surrounded by braces, { }.

3. Object

An Object is a basic unit of Object-Oriented Programming and represents real-life entities. A typical Java program creates many objects, which as you know, interact by invoking methods. An object consists of :

1. **State**: It is represented by the attributes of an object. It also reflects the properties of an object.
2. **Behavior**: It is represented by the methods of an object. It also reflects the response of an object to other objects.
3. **Identity**: It gives a unique name to an object and enables one object to interact with other objects.

4. Interface

Like a class, an interface can have methods and variables, but the methods declared in an interface are by default abstract (only method signature, no body).

- Interfaces specify what a class must do and not how. It is the blueprint of the class.
- An Interface is about capabilities like a Player may be an interface and any class implementing Player must be able to (or must implement) move(). So it specifies a set of methods that the class has to implement.
- If a class implements an interface and does not provide method bodies for all functions specified in the interface, then the class must be declared abstract.
- A Java library example is Comparator Interface. If a class implements this interface, then it can be used to sort a collection.

5. Array

An Array is a group of like-typed variables that are referred to by a common name. Arrays in Java work differently than they do in C/C++. The following are some important points about Java arrays.

- In Java, all arrays are dynamically allocated. (discussed below)

- Since arrays are objects in Java, we can find their length using member length. This is different from C/C++ where we find length using size.
- A Java array variable can also be declared like other variables with [] after the data type.
- The variables in the array are ordered and each has an index beginning with 0.
- Java array can also be used as a static field, a local variable, or a method parameter.
- The **size** of an array must be specified by an int value and not long or short.
- The direct superclass of an array type is Object.
- Every array type implements the interfaces Cloneable and java.io.Serializable.

Frequently Asked Questions:

1. What are data types in Java?

Data types are of different sizes and values that can be stored in the variable that is made as per convenience and circumstances to cover up all test cases.

2. What are the 8 data types that use in Java?

There are 8 main primitive data types in java as mentioned below:

- boolean
- byte
- char
- short
- int
- long
- float
- double

3. Which is a primitive type?

Primitive data types are the types in java that can store a single value and do not provide any special capability.

4. Why char uses 2 bytes in java and what is \u0000?

Char uses 2 bytes in java because it uses the Unicode system rather than the ASCII system. “\u000” is the lowest range of the Unicode system.