Getting Started With Java – Data Types

The basic unit of information on a computer is called a *bit*, which has two states: *on* or *off* (1 or 0). Bits are generally grouped into units of 8, which is called a *byte*. A single byte can store all of the possible combinations of the 8 bits, or $2^8 = 256$ values.

In Java, as with most programming languages, there are various *data types*, which are used to represent and (as variables) store different types of data. Each data type has different demands on how much space it requires in the computer's memory, and this is measured in bytes.

Integer Data Types

We have already referred to a single byte representing 256 states of the 8 bits. Another way to look at this is to imagine each of those states representing a number. In the case of a single byte of data, Java uses the **byte** *integer data type* to represent the numbers from -128 to 127.

Type	Size (bits)	Size (bytes)	Range	Approximate Range
byte	8	1	-2^7 to 2^7-1	± 100
short	16	2	-2^{15} to $2^{15}-1$	± 30000
int	32	4	-2^{31} to $2^{31}-1$	$\pm 2\ 000\ 000\ 000$
long	64	8	-2^{63} to $2^{63}-1$	$\pm 9\times 10^{18}$

The **int** type is adequate for most tasks and will generally be your default integer data type.

Integer constants must not be written with a decimal point, and they cannot contain any separators between digits.

For example, each of the following is an illegal integer constant.

(a) 37.0 contains a decimal point
(b) -12 562 contains a blank space between digits
(c) 1,233,985 contains commas between digits

Real Data Types

Type	Size (bits)	Size (bytes)	Precision	Approximate Range
float	32	4	at least 6 decimal places	$\pm 3.4\times 10^{38}$
double	64	8	at least 15 decimal places	$\pm 1.8\times 10^{308}$

Due to memory and speed considerations, the **float** data type was traditionally used more frequently. With modern computers, however, the **double** data type does not result in the same performance issues, and it should be used for most calculations involving real numbers.

Each of the following is a valid floating point constant.

5.23 .3 2818. -0.0002 6.7

Floating point constants can also be written in a form similar to that used in scientific notation.

(a) 5.6e2 represents the value 5.6×10^2 giving $5.6\times 100 = 560$
(b) 37E-4 represents the value 37×10^{-4} giving $37\times 0.0001 = 0.0037$
(c) -0.667e-2 represents the value -0.667×10^{-2} giving $-0.667\times 0.01 = -0.00667$

Character Data Type

Java follows a character representation called *Unicode*, which uses 16 bits, or 2 bytes, to represent characters. This allows for 65536 possible characters, so all of the world's characters and symbols, along with specialized symbols and shapes, can be represented in Unicode.

Characters in Java are of type **char**.

Boolean Data Type

The **boolean** type represents a *truth* value. There are only two boolean values: `true` or `false`. The words true and false are reserved by Java and cannot be used for any other purpose. Boolean values are very compact, requiring only 1 bit for storage.

Exercises

1. What is the smallest type of integer that can be used to represent the following numbers?
   (a) 50 000
   (b) -3 000 000 000
   (c) -125
   (d) 128

2. State, with reasons, which of the following are not legal Java integer constants.
   (a) -47
   (b) 23.
   (c) -0
   (d) 22 900

3. Rewrite in standard decimal form.
   (a) 2.94e1
   (b) 0.0004e3
   (c) -2e-3
   (d) 26.77e-3
   (e) -54E-3
   (f) -.3e1