Data Types

Exercises and solutions

1. What is an identifier in Java? What an identifier may consist of? List five valid and five invalid identifiers in Java.

An identifier is the name given to an entity in a Java program such as a module, a package, a class, a method, a variable, etc.

A Java identifier a sequence of one or more Unicode letters and digits and it must start with a letter.

Valid identifiers: Employer, नाम, charTest, map$, and id.

Invalid identifiers: 1int, set&, two words, a\*b, and \_.

1. What are keywords, reserved keywords, and restricted keywords in Java? Is an underscore a keyword in Java?

Keywords are words that have predefined meanings in the Java programming language. Reserved words are words reserved for future use and you cannot use them as identifiers in your program. Restricted keywords are keywords only in pre-defined places; all other places they are normal words and can be used as identifiers.

Yes, underscore (\_) is a Java keyword from Java 9.

1. What is a data type? What is the difference between a primitive data type and a reference data type?

A data type is defined in terms of three components:

* A set of values (or data objects)
* A set of operations that can be applied to all values in the set
* A data representation, which determines how the values are stored

A primitive data type consists of an atomic, indivisible value, and is defined without the help of any other data types.

A reference data type is a composite data type that is defined in terms of primitive data types and other reference data types. Unlike the values of a primitive data type, the values of a reference type data are represented as objects in memory and those objects are manipulated using references.

A variable of primitive data type holds a value whereas a variable of a reference data type holds the reference to an object in memory.

1. List the names of all eight primitive data types supported by the Java programming language. List their size in bytes.

|  |  |  |
| --- | --- | --- |
|  | Data Type | Size in bytes |
|  | byte | 1 |
|  | short | 2 |
|  | int | 4 |
|  | long | 8 |
|  | char | 2 |
|  | float | 4 |
|  | double | 8 |
|  | boolean | Unspecified |

1. What are literals? List two literals of each primitive type in Java?

A literal of type X means a value of type X that can be directly represented in the source code without requiring any computations.

|  |  |  |
| --- | --- | --- |
|  | Data Type | Example |
|  | byte | 1, -128 |
|  | short | 1024, -130 |
|  | int | 0x1234567, -100 |
|  | long | 23L, -4294967296L |
|  | char | 'a', '#' |
|  | float | 3.25E3F, -2F |
|  | double | 64.0, -1.2E200 |
|  | boolean | true, false |

1. What is the shortest numeric primitive type in Java? What is the range of its values?

The byte data type is the shortest numeric primitive type. Its range is -128 to 127.

1. Consider the following two variable declarations:   
   byte small = 10;  
   int big = 99;  
     
   How will you assign the value in the big variable to the small variable?

small = (byte) big;

1. Why do you need to use a cast when you assign a variable of a bigger size to a variable of smaller size, for example, assigning an int variable to a byte variable?

Java does not allow assigning a variable of a bigger size to a variable of smaller size, to avoid loss of precision. This is allowed using a cast. When a cast is used the compiler is assured that the programmer writing the code knows that there may be a loss of precision when the assignment from a variable of bigger size to a variable of smaller size occurs.

1. Name two primitive data types in Java whose values can be floating-point numbers.

float and double

1. If you declare a variable of the boolean type, what are the two possible values it can have?

true and false

1. Can you cast a boolean value to an int type as shown in the following statement?  
     
   boolean done = true;  
   int x = (int) done;  
     
   What happens when you compile this snippet of code?

No. A boolean variable cannot be cast to any other data type and vice versa. This snippet of code will result in compile-time error.

1. Are the boolean literals true and false the same as integers 1 and 0?

No. Java allows only two values true and false to be assigned to a boolean variable. Unlike other programing languages such as C, 1 and 0 do not represent boolean values in Java. 1 and 0 are of int data type in Java.

1. Name an unsigned numeric data type in Java?

char

1. Name the four different formats of writing the literals of char data types. Give two examples of each.

* A character enclosed in single quotes  
    
  char c1 = 'a';  
  char c2 = 'A';
* As a character escape sequence  
    
  char c3 = '\n'; // assign linefeed  
  char c4 = '\''; // assign single quote
* As a Unicode escape sequence  
    
  char c5 = '\u0041'; // assign 'A'  
  char c6 = '\u007A'; // assign 'z'
* As an octal escape sequence  
    
  char c7 = '\101'; // assign 'A'  
  char c8 = '\141'; // assign 'a'

1. How do you represent a backslash (\) and a double quote (") as char literals in Java? Write code to declare two char variables named c1 and c2. Assign a backslash character to c1 and a double quote character to c2.

char c1 = '\\';

char c2 = '\"';

1. What are 1's and 2's complements of binary numbers? Compute the 1's and 2's complements of the binary number 10111011.

1’s complement is diminished radix complement, 1's complement of a binary number can be computed just by inverting the bits of the number, that is, by changing 1 to 0 and 0 to 1. For example, 1's complement of 10110 is 01001 and 1's complement of 0110001 is 1001110.

2’s complement is radix complement of binary number system. 2's complement of a binary number is obtained by adding 1 to its 1's complement. For example. 2's complement of 10110 is 01001 + 1, which is 01010.

1’s complement of 1011 1011 is 0100 0100. 2’s complement of 1011 1011 is 0100 0101.

1. Why does the following line of comment in a Java program not compile? \u000A is a Unicode code value for linefeed.  
     
   char c = '\u000A';

The Java compiler first converts every occurrence of a Unicode escape sequence to a Unicode character. The above snipped will split into two lines. Since a character literal cannot continue in two lines, a compile-time error is generated.

1. How many zeros are supported by float and double data types?

The float data type supports two zeros: +0.0F and -0.0F. The double data type supports two zeros: +0.0 and -0.0.

1. What is NaN? How many NaNs are supported by float and double types in Java? Differentiate between a quiet NaN and a signaling NaN. What types of NaNs are supported by Java — quiet NaNs, signaling NaN, or both?

Not-a-Number or NaN is a special value to represent an indeterminate result such as dividing zero by zero. The float and double data type support one NaN each. Java supports quiet NaN.

1. What are denormals or denormalized floating-point numbers?

The floating-point numbers, which are not normalized, are called denormalized floating-point numbers, denormals, or subnormals. Refer to the "Binary Representation of Floating-Point Numbers" section in this chapter for more details on denormals.

1. What are different rounding modes for floating-point numbers? What rounding modes are supported by Java?

There are four rounding modes:

* Round toward zero
* Round toward positive infinity
* Round toward negative infinity
* Round toward nearest

Java uses round toward nearest mode to round the inexact results and round towards zero to convert a floating value to an integer.

1. What are little-endian order and big-endian order? What endian-order does Java use to encode the multi-byte binary data in class files?

Computer memory is referenced by addresses that are positive integers. In little-endian order less significant byte comes before more significant byte in memory. In big-endian order is reversed, most significant byte is stored first. Java uses big-endian order.