MORE DATA TYPES AND OPERATORS

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More Data Types and Operators

Arrays

- An array is a group of like-typed variables that are referred to by a common name.
- Array of any type (primitive or class) can be created and may have one or more dimensions.
- A specific element in an array is accessed by its index.
- Arrays offer a convenient means of grouping related information.
- In Java, an array is an object.
- Array is a fixed size list of values.
- When declaring an array, the size must be supplied.

One-Dimensional Arrays

- A one-dimensional array is, essentially, a list of like-typed variables.
- Syntax to declare a one-dimensional array.

  type array-var = new *type* [*size*];

  ```
  int month_days = new int[12];
  ```

- To access and display array element, use the index.

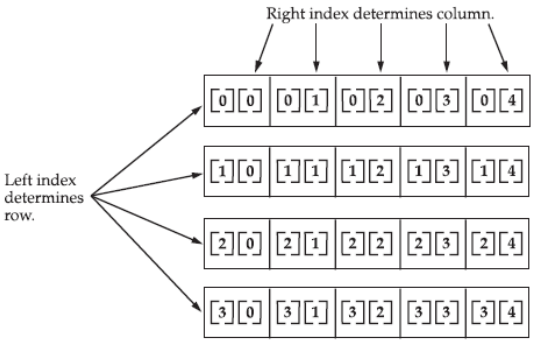
  ```
  System.out.println(month_days[3]);
  ```

Multidimensional Arrays

- In Java, multidimensional arrays are actually arrays of arrays.
- To declare a multidimensional array variable, specify each additional index using another set of square brackets.

  ```
  int twoD[][] = new int[4][5];
  ```

- This allocates a 4 by 5 array and assigns it to twoD.
- Internally, this matrix is implemented as an array of arrays of int.



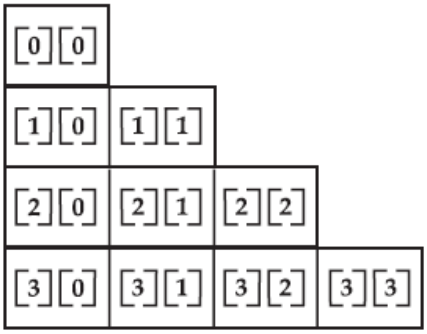
Given: int twoD [ ] [ ] = new int [4] [5] ;

Jagged Array

- When you allocate memory for a multidimensional array, you need only specify the memory for the first (leftmost) dimension.
- You can allocate the remaining dimensions separately.

```
int twoD[][] = new int[4][];
twoD[0] = new int[1];
twoD[1] = new int[2];
twoD[2] = new int[3];
twoD[3] = new int[4];
```

The array created by this program looks like this:



Alternative Array Declaration Syntax

- There is a second form that may be used to declare an array:

  type[ ] *var-name*;

- Here, the square brackets follow the type specifier, and not the name of the array variable.
- For example, the following two declarations are equivalent:

```
int a1[] = new int[3];
int[] a2 = new int[3];
```

- This alternative declaration form offers convenience when declaring several arrays at the same time.

```
int[] nums, nums2, nums3; // create three arrays

int nums[], nums2[], nums3[]; // create three arrays
```

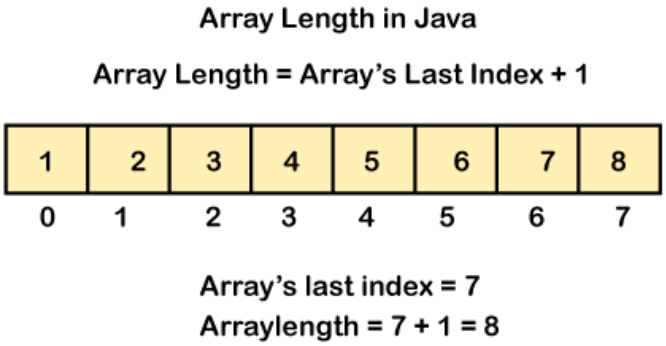
Assigning Array References

- As with other objects, when you assign one array reference variable to another, you are simply changing what object that variable refers to.
- You are not causing a copy of the array to be made, nor are you causing the contents of one array to be copied to the other.

Using the length Member

- All array indices in Java begin at 0.
- The number of elements in an array is stored as part of the array object in the length attribute.
- If an out-of-bounds runtime access occurs, then a runtime exception is thrown.

```
int[] arr = new int[5];
int arrayLength = arr.length;
```



The For-Each Style for Loop

- For-each is another array traversing technique like for loop, while loop, do-while loop introduced in Java5.
- It starts with the keyword for like a normal for-loop.
- Instead of declaring and initializing a loop counter variable, you declare a variable that is the same type as the base type of the array, followed by a colon, which is then followed by the array name.
- In the loop body, you can use the loop variable you created rather than using an indexed array element.
- It's commonly used to iterate over an array or a Collections class (eg, ArrayList)

```
int[] numbers = {1, 2, 3, 4, 5};
int total = 0;

for(int num : numbers) {
	total += num;
}
System.out.println("Total is " + total);
```

Strings

- Java's string type, called String, is not a primitive type.
- It is in fact a class.
- When you declare a variable of type String, you basically creating an object.
- String class is immutable.
- When you create a String object, you are creating a string that cannot be changed. That is, once a String object has been created, you cannot change the characters that comprise that string.
- Each time you need an altered version of an existing string, a new String object is created that contains the modifications. The original string is left unchanged.

String Declarations

There are two ways to declare String variables.

```
// literals
String name = "John Smith";
// constructor
String email = new String("john@example.com");
```

String Length

The length of a string is the number of characters that it contains. To obtain this value, call the length( ) method.

```
char chars[] = { 'a', 'b', 'c' };
String s = new String(chars);
System.out.println(s.length());
```

String Concatenation

- In general, Java does not allow operators to be applied to String objects.
- The one exception to this rule is the + operator, which concatenates two strings, producing a String object as the result.

```
String age = "9";
String s = "He is " + age + " years old.";
System.out.println(s);
```

Using Command-Line Arguments

- Sometimes you will want to pass information into a program when you run it.
- This is accomplished by passing command-line arguments to main( ).
- To access the command-line arguments inside a Java program is quite easy - they are stored as strings in a String array passed to the args parameter of main( ).
- The first command-line argument is stored at args[0], the second at args[1], and so on.

```
/*
 * access program arguments and then display to console
 */
System.out.println(args[0]);     // hello
System.out.println(args[1]);     // 1
System.out.println(args[2]);     // 2
System.out.println(args[3]);     // 3


for(String s : args) {
      System.out.println(s);
}
```

Using Type Inference with Local Variables

- Java 10 introduced a new shiny language feature called local variable type inference.
- Until Java 9, we had to mention the type of the local variable explicitly and ensure it was compatible with the initializer used to initialize it:

```
String message = "Good bye, Java 9";
```

- In Java 10, this is how we could declare a local variable:

```
var message = "Hello, Java 10";
```

- Note that this feature is available only for local variables with the initializer.
- It cannot be used for member variables, method parameters, return types, etc – the initializer is required as without which compiler won't be able to infer the type.
- This enhancement helps in reducing the boilerplate code; for example:

```
Map<Integer, String> map = new HashMap<>();
```

- This can now be rewritten as:

```
var idToNameMap = new HashMap<Integer, String>();
```

- Another thing to note is that var is not a keyword – this ensures backward compatibility for programs using var say, as a function or variable name.
- var is a reserved type name, just like int.
- Finally, note that there is no runtime overhead in using var nor does it make Java a dynamically typed language.
- The type of the variable is still inferred at compile time and cannot be changed later.