Strings and Arrays

The objectives of this chapter are:

- To discuss the String class and some of its methods
- To discuss the creation and use of Arrays

The String Class

- Although we haven't yet discussed classes and object, we will discuss the String class.
- String objects are handled specially by the compiler.
  - String is the only class which has "implicit" instantiation.
- The String class is defined in the java.lang package.
- Strings are immutable. The value of a String object can never be changed.
  - For mutable Strings, use the StringBuffer class.

Creating String Objects

- Normally, objects in Java are created with the *new* keyword.

```
String name;
  name = new String("Craig");
```

- However, String objects can be created "implicitly":

```
String name;
  name = "Craig";
```

- Strings can also be created using the + operator. The + operator, when applied to Strings means concatenation.

```
int age = 21;
String message = "Craig wishes he was " + age + " years old";
```

Commonly used String methods

- The String class has many methods. The most commonly used are:
  - length() - returns the number of characters in the String
  - charAt() - returns the character at the specified index
  - equals() - returns true if two strings have equal contents
  - compareTo() -returns 0 if equal, Less than zero – if the invoking String is "less than" the other, Greater than zero - if the invoking String is "greater than" the other.
  - indexOf() - returns the index of specified String or character
  - substring() -returns a portion of the String's text
  - toUpperCase(), toLowerCase() - converts the String to upper or lower case characters

String Examples

```
String name = "Craig";
String name2 = "Craig";

 if (name.equals(name2))
    System.out.println("The names are the same");
```

```
String name = "Craig Schock";
int lastNameIndex = name.indexOf("Schock");
```

```
String grade = "B+";
double gpa = 0.0;

 if (grade.charAt(0) == 'B')
    gpa = 3.0;

 if (grade.charAt(1) == '+')
    gpa = gpa + 0.3;
```

Testing Strings for Equality

- Important note: The == operator cannot be used to test String objects for equality
  - Variables of type String are references to objects (ie. memory addresses)
  - Comparing two String objects using == actually compares their memory addresses. Two separate String objects may contain the equivalent text, but reside at different memory locations.
- Use the equals method to test for equality.

The StringBuffer Class

- StringBuffer objects are similar to String objects
  - Strings are immutable
  - StringBuffers are mutable
- The StringBuffer class defines methods for modifying the String value
  - insert()
  - append()
  - setLength()
- To clear a StringBuffer, set it's length to 0

```
StringBuffer nameBuffer = new StringBuffer("Joe");
[...]
  nameBuffer.setLength(0);  // clear StringBuffer
```

StringBuffer Example

```
StringBuffer sql = new StringBuffer();

  sql.setLength(0);
  sql.append("Select * from Employee");
  sql.append(" where Employee_ID = " + employeeId);
  sql.append(" and Employee_name = '" + employeeName + "'");
```

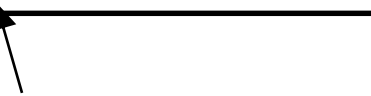
Arrays in Java

- Java supports arrays
- An array is a collection of elements where each element is the same type.
  - Element type can be primitive or Object
  - Each element is a single value
  - The length of the array is set when it is created. It cannot change.
- Individual array elements are accessed via an index.
  - Array index numbering starts at 0.
- ***Note: Some references claim that arrays in Java are Objects. THIS IS NOT TRUE.***
  - Arrays do exhibit some behaviour which is similar to objects, but they are not themselves, objects.

Creating Arrays

- Creating an array is a 2 step process
  - It must be declared (declaration does not specify size)

declaration syntax: `type[] arrayName;`



note the location of the []

  - It must be created (ie. memory must be allocated for the array)

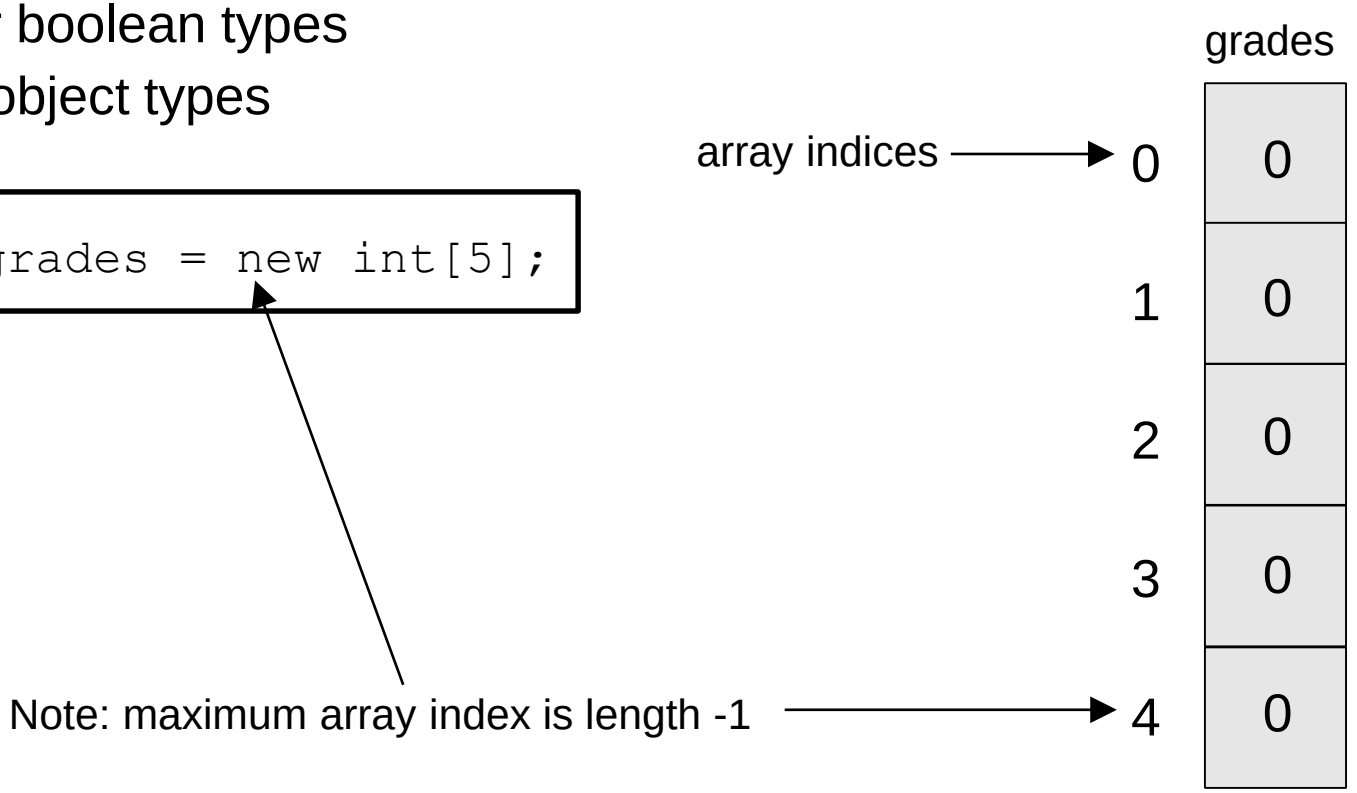
```
int[] grades;                  // declaration

grades = new int[5];           // Create array.
                          // specify size
```

Creating Arrays

- When an array is created, all of its elements are automatically initialized
  - 0 for integral types
  - 0.0 for floating point types
  - false for boolean types
  - null for object types

```
int[] grades = new int[5];
```



Initializing and Using Arrays

- Because array elements are initialized to 0, the array should be initialized with usable values before the array is used.
  - This can be done with a loop
  - Arrays have a length attribute which can be used for bounds checking
  - Elements are accessed using an index and []

```
int[] sequence = new int[5];

for (int i=0; i< sequence.length; i++)
{
  sequence[i] = i * 25;
}
```

Array element being accessed. In this case, it is being assigned a value.

array length: ensures loop won't go past end of the array

Using initializer lists

- Another way of initializing lists is by using initializer lists.
  - The array is automatically created
  - The array size is computed from the number of items in the list.

```
type[] arrayName = {initializer_list};
```

```
int[] grades = {100, 96, 78, 86, 93};
```

```
String[] colours = { "Red", "Orange",
                     "Yellow", "Green",
                     "Blue", "Indigo",
                     "Violet"};
```

Array Bounds Checking

- Whenever and array is accessed, the index is checked to ensure that it within the bounds of the array.
- Attempts to access an array element outside the bounds of the array will cause an ArrayIndexOutOfBounds exception to be thrown.

```
int[] sequence = new int[5];

sequence[0] = 50;                    // ok
sequence[1] = 60;                    // ok
sequence[-1] = 100;                  //
  Exception
sequence[5] = 30;                    //
  Exception
```

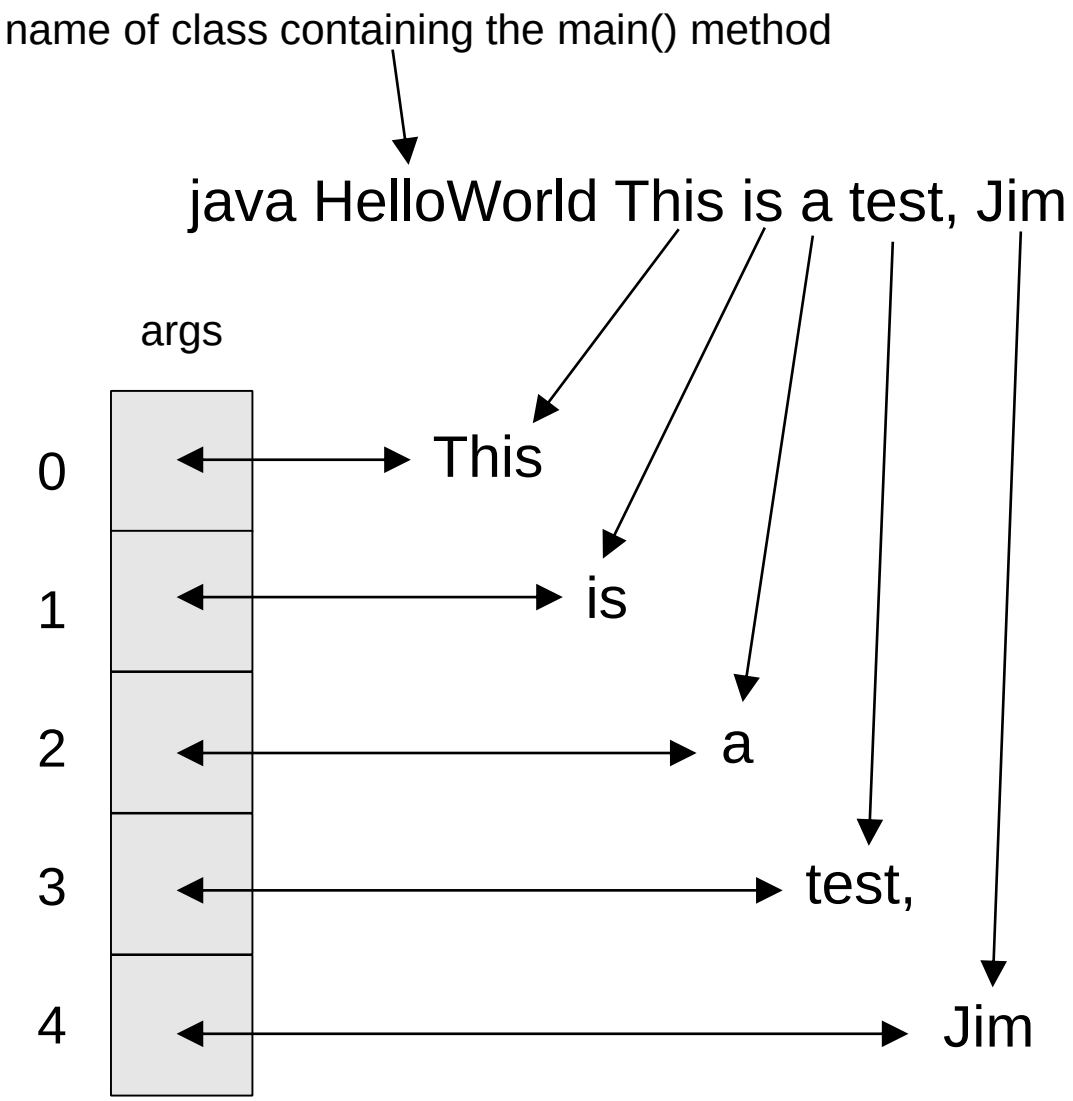
The main() method

- You may recall that the main method takes an array of String objects as a parameter.
  - This array of Strings holds the command line parameters which were passed to the java program when it was started

```
public class HelloWorld
{
  public static void main(String[] args)
  {
     System.out.println("Hello World");
  }
}
```

Array holding command line parameters

Command line parameters



Multi-dimensional Arrays

- Arrays with multiple dimensions can also be created.

declaration syntax:

```
type[][] arrayName;
```

each [] indicates another dimension

- They are created and initialized in the same way as single dimensioned arrays.

```
int[][] grades = new int[20][5];
  for(int i = 0; i< 20; i++)
     for(int j = 0; j<5; j++)
        grades[i][j] = 100;
```

```
String[][] colours = {{"Red", "Green", "Blue"},
                      {"Cyan", "Magenta", "Yellow"},
                      {"Russet", "Mauve", "Orange"}};
```

Review

- Is String a fundamental data type in Java?
- How is the String class treated specially?
- Name some commonly used methods of the String class and describe their function.
- What is a StringBuffer?
- What is an array?
- What are the steps needed to create and use an array?
- How are arrays initialized?
- How does bounds checking work in Java?
- What are the parameters to the method called "main"?