Java

More Details

Array

Arrays

- A group of variables containing values that all have the same type
- Arrays are fixed-length entities
- In Java, arrays are objects, so they are considered reference types
- But the elements of an array can be either primitive types or reference types

Arrays

- We access the element of an array using the following syntax
  - name[index]
  - “index” must be a nonnegative integer
    - “index” can be int/byte/short/char but not long
- In Java, every array knows its own length
- The length information is maintained in a public final int member variable called **length**

Declaring and Creating Arrays

- int c[ ] = new int [12]
  - Here, “c” is a reference to an integer array
  - “c” is now pointing to an array object holding 12 integers
  - Like other objects arrays are created using “new” and are created in the heap
  - “int c[ ]” represents both the data type and the variable name. Placing number here is a syntax error
  - **int c[12]; // compiler error**

Declaring and Creating Arrays

- int[ ] c = new int [12]
  - Here, the data type is more evident i.e. “int[ ]”
  - But does the same work as
    - int c[ ] = new int [12]
- Is there any difference between the above two approaches?

Declaring and Creating Arrays

- int c[ ], x
  - Here, ‘c’ is a reference to an integer array
  - ‘x’ is just a normal integer variable
- int[ ] c, x;
  - Here, ‘c’ is a reference to an integer array (same as before)
  - But, now ‘x’ is also a reference to an integer array

Arrays

ArrayDemo.java

```java
public class ArrayDemo {
    public static void main(String[] args) {
        int [] a = new int[10];
        for (int i = 0; i < a.length; i++) {
            a[i] = i;
        }
        for (int i = 0; i < a.length; i++) {
            System.out.println(a[i]);
        }
    }
}
```

Using an Array Initializer

- We can also use an array initializer to create an array
  - int n[ ] = {10, 20, 30, 40, 50}
- The length of the above array is 5
- n[0] is initialized to 10, n[1] is initialized to 20, and so on
- The compiler automatically performs a “new” operation taking the count information from the list and initializes the elements properly

Arrays of Primitive Types

- When created by “new”, all the elements are initialized with default values
  - byte, short, char, int, long, float and double are initialized to zero
  - boolean is initialized to false
- This happens for both member arrays and local arrays

Arrays of Reference Types

- String [] str = new String[3]
  - Only 3 String references are created
  - Those references are initialized to **null** by default
  - Need to explicitly create and assign actual String objects in the above three positions.
    - str[0] = new String(“Hello”);
    - str[1] = “World”;
    - str[2] = “I” + “ Like” + “ Java”;

Passing Arrays to Methods

void modifyArray(double d[ ]) {…}

double [] temperature = new double[24];

modifyArray(temperature);

- Changes made to the elements of ‘d’ inside “modifyArray” is visible and reflected in the “temperature” array
- But inside “modifyArray” if we create a new array and assign it to ‘d’ then ‘d’ will point to the newly created array and changing its elements will have no effect on “temperature”

Passing Arrays to Methods

- Changing the elements is visible, but changing the array reference itself is not visible

```
void modifyArray(double d[ ]) {
    d[0] = 1.1; // visible to the caller
}
void modifyArray(double d[ ]) {
    d = new double [10];
    d[0] = 1.1; // not visible to the caller
}
```

Multidimensional Arrays

- Can be termed as array of arrays.
- int b[ ][ ] = new int[3][4];
  - Length of first dimension = 3
    - b.length equals 3
  - Length of second dimension = 4
    - b[0].length equals 4
- int[ ][ ] b = new int[3][4];
  - Here, the data type is more evident i.e. “int[ ][ ]”

Multidimensional Arrays

- int b[ ][ ] = { { 1, 2, 3 }, { 4, 5, 6 } };
  - b.length equals 2
  - b[0].length and b[1].length equals 3
- All these examples represent rectangular two dimensional arrays where every row has same number of columns
- Java also supports jagged array where rows can have different number of columns

Multidimensional Arrays

Example – 1

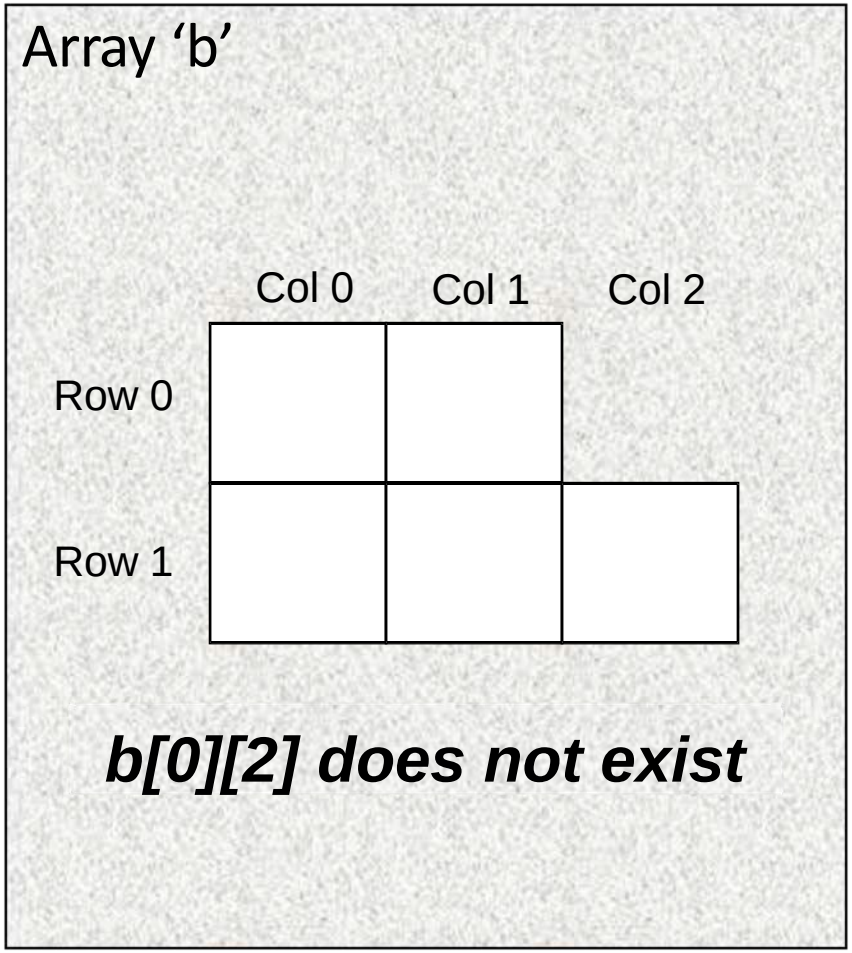
```
int b[ ][ ];
b = new int[2][ ];
b[0] = new int[2];
b[1] = new int[3];
b[0][2] = 7; //will throw an exception
```

Example – 2

```
int b[ ][ ] = { { 1, 2 }, { 3, 4, 5 } };
b[0][2] = 8; //will throw an exception
```

In both cases

b.length equals 2
b[0].length equals 2
b[1].length equals 3



Command Line Arguments

Using Command-Line Arguments

- java MyClass arg1 arg2 … argN
  - words after the class name are treated as command-line arguments by Java
  - Java creates a separate String object containing each command-line argument, places them in a String array and supplies that array to main
  - That's why we have to have a String array parameter (String args[ ]) in main
  - We do not need a "argc" type parameter (for parameter counting) as we can easily use "args.length" to determine the number of parameters supplied.

Using Command-Line Arguments

CommandLineTest.java

```
1  public class CommandLineTest {
2      public static void main(String[] args) {
3          System.out.println( args.length );
4
5          for( int i = 0; i < args.length; i++)
6          {
7              System.out.println( args[i] );
8          }
9      }
10 }
11
```

java CommandLineTest Hello 2 You

3
Hello
2
You

For-Each

For-Each version of the for loop

ForEachTest.java

```
1  public class ForEachTest {
2      public static void main(String[] args) {
3          int numbers [] = {1,2,3,4,5};
4          for(int x : numbers)
5          {
6              System.out.print(x + " ");
7              x = x * 10; // no effect on numbers
8          }
9          System.out.println();
10
11         int numbers2 [][] = { {1,2,3}, {4,5,6}, {7,8,9} };
12         for(int []x:numbers2)
13         {
14             for(int y:x)
15             {
16                 System.out.print(y + " ");
17             }
18             System.out.println("");
19         }
20     }
21 }
```

Scanner

Scanner

- It is one of the utility class located in the java.util package
- Using Scanner class, we can take inputs from the keyboard
- Provides methods for scanning
  - int
  - float
  - double
  - line etc.

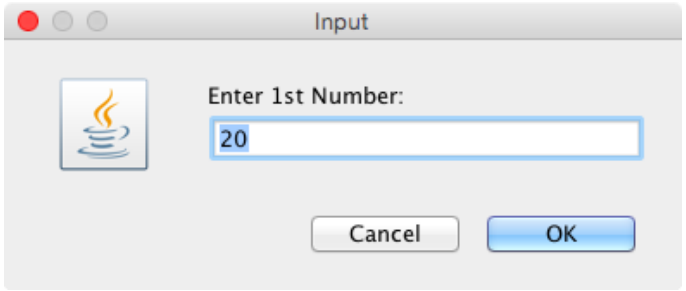
Scanner

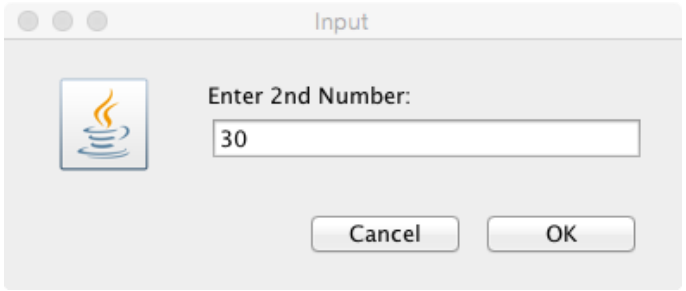
```
3   import java.util.Scanner;
4
5   public class ScannerTest {
6       public static void main(String[] args) {
7           Scanner scn=new Scanner(System.in);
8           while(scn.hasNextLine())
9           {
10              System.out.println(scn.nextLine());
11          }
12      }
13  }
```

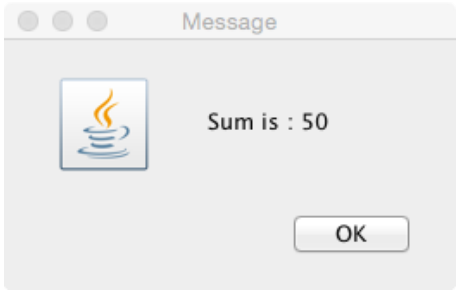
```
3   import java.util.Scanner;
4
5   public class ScannerTest {
6       public static void main(String[] args) {
7           Scanner scn=new Scanner(System.in);
8           while(scn.hasNextInt())
9           {
10              System.out.println(scn.nextInt());
11          }
12      }
13  }
```

JOptionPane

```
3  import javax.swing.JOptionPane;
4
5  public class JOptionPaneTest {
6      public static void main(String[] args) {
7          String s1 = JOptionPane.showInputDialog(null,"Enter 1st Number:");
8          String s2 = JOptionPane.showInputDialog(null,"Enter 2nd Number:");
9          int num1 = Integer.parseInt(s1);
10         int num2 = Integer.parseInt(s2);
11         JOptionPane.showMessageDialog(null,"Sum is : " + (num1+num2));
12     }
13 }
```







Static

Static Variables

- When a member (both methods and variables) is declared static, it can be accessed before any objects of its class are created, and without reference to any object
- Static variable
  - Instance variables declared as static are like global variables
  - When objects of its class are declared, no copy of a static variable is made

Static Methods & Blocks

- Static method
  - They can only call other static methods
  - They must only access static data
  - They cannot refer to ***this*** or ***super*** in any way
- Static block
  - Initialize static variables.
  - Get executed exactly once, when the class is first loaded

Static

```
3   public class StaticTest {
4       static int a = 3, b;
5       int c;
6
7       static void f1(int x) {
8           System.out.println("x = " + x);
9           System.out.println("a = " + a);
10          System.out.println("b = " + b);
11          // System.out.println("c = " + c); // Error
12      }
13      int f2() {
14          return a*b;
15      }
16      static {
17          b = a*4;
18          // c = b; // Error
19      }
20      public static void main(String[] args) {
21          f1(42); // StaticTest.f1(84);
22          System.out.println("b = " + b);
23          //System.out.println("Area = " + f2());   // Error
24      }
25  }
```

Final

- Declare a final variable, prevents its contents from being modified
- final variable must initialize when it is declared
- It is common coding convention to choose all uppercase identifiers for final variables

```
final int FILE_NEW = 1;
final int FILE_OPEN = 2;
final int FILE_SAVE = 3;
final int FILE_SAVEAS = 4;
final int FILE_QUIT = 5;
```

Unsigned right shift operator

- The >> operator automatically fills the high-order bit with its previous contents each time a shift occurs
- This preserves the sign of the value
- But if you want to shift something that doesn't represent a numeric value, you may not want the sign extension
- Java's >>> shifts zeros into the high-order bit

int a= -1; a = a >>>24;

11111111 11111111 11111111 11111111 [-1]
00000000 00000000 00000000 11111111 [255]

Nested and Inner Classes

Nested Classes

- It is possible to define a class within another classes, such classes are known as nested classes
- The scope of nested class is bounded by the scope of its enclosing class. That means if class B is defined within class A, then B doesn’t exists without A
- The nested class has access to the members (including private!) of the class in which it is nested
- The enclosing class doesn’t have access to the members of the nested class

Static Nested Classes

- Two types of nested classes.
  - Static
  - Non-Static
- A static nested class is one which has the static modifier applied. Because it is static, it must access the members of its enclosing class through an object
- That is, it cannot refer to members of its enclosing class directly. Because of this restriction, static nested classes are seldom used

Static Nested Classes

```
1  class OuterStaticInner {
2      private int outer_x = 100;
3
4      void test() {
5          Inner inner = new Inner();
6          inner.display( outer: this);
7      }
8      // this is a static nested class
9      static class Inner {
10         void display(OuterStaticInner outer) {
11             System.out.println(outer.outer_x);
12         }
13     }
14 }
15
16 public class StaticNestedClassDemo {
17     public static void main(String[] args) {
18         OuterStaticInner outer = new OuterStaticInner();
19         outer.test();
20         OuterStaticInner.Inner x = new OuterStaticInner.Inner();
21         x.display(outer);
22     }
23 }
```

Inner Classes

- The most important type of nested class is the inner class
- An inner class is a non-static nested class
- It has access to all of the variables and methods of its outer class and may refer to them directly in the same way that other non-static members of the outer class do
- Thus, an inner class is fully within the scope of its enclosing class

Inner Classes

```
1   class Outer1
2   {
3       private int outer_x = 100;
4
5       void test() {
6           Inner inner = new Inner();
7           inner.display();
8       }
9       // this is an inner class
10      class Inner {
11          void display() {
12              System.out.println(outer_x);
13          }
14      }
15  }
16
17  public class InnerClassDemo1 {
18      public static void main(String[] args) {
19          Outer1 outer = new Outer1();
20          outer.test();
21          Outer1.Inner innerObj = outer.new Inner();
22          innerObj.display();
23      }
24  }
```

Inner Classes

```java
class Outer2
{
    int outer_x = 100;

    void test() {
        Inner inner = new Inner();
        inner.display();
    }

    class Inner {
        int y = 10; // y is local to Inner
        void display() { System.out.println(outer_x); }
    }

    void showy() {
        //System.out.println(y); // error, y not known here!
    }
}

public class InnerClassDemo2 {
    public static void main(String[] args) {
        Outer2 outer = new Outer2();
        outer.test();
    }
}
```

Variable Arguments

```
1  public class VarArgsTest {
2      static void vaTest(int ... v){
3          for(int x: v) {
4              System.out.print(x + " ");
5          }
6          System.out.println();
7      }
8      static void vaTest(boolean ... v){
9          for(boolean x: v) {
10             System.out.print(x + " ");
11         }
12         System.out.println();
13     }
14     static void vaTest(String msg, int ... v){
15         System.out.print(msg + " ");
16         for(int x: v) {
17             System.out.print(x + " ");
18         }
19         System.out.println();
20     }
21     public static void main(String[] args) {
22         vaTest( msg: "Testing",  ...v: 10, 20);
23         vaTest( ...v: true, false, false);
24         vaTest( ...v: 1, 2, 3);
25     }
26 }
```

Variable Arguments Ambiguity

```
1  public class VarArgsTest {
2      static void vaTest(int ... v){
3          for(int x: v) {
4              System.out.print(x + " ");
5          }
6          System.out.println();
7      }
8      static void vaTest(boolean ... v){
9          for(boolean x: v) {
10             System.out.print(x + " ");
11         }
12         System.out.println();
13     }
14     static void vaTest(int n, int ... v){
15         for(int x: v) {
16             System.out.println(x + " ");
17         }
18     }
19     public static void main(String[] args) {
20         vaTest(); // ambiguity type 1 because of int and boolean but works with int and double
21         vaTest(1, 2, 3); // ambiguity type 2 with vaTest(int n, int ... v) and vaTest(int ... v)
22     }
23 }
24
```

Local Variable Type Inference

Local Variable Type Inference

- Recently added to the Java language (Java 10)
  - all variables must be declared prior to their use
  - a variable can be initialized with a value when it is declared
  - when a variable is initialized, the type of the initializer must be the same as the declared type of the variable
- In principle, it would not be necessary to specify an explicit type for an initialized variable
  - it could be inferred by the type of its initializer

Local Variable Type Inference

- Compiler infer the type of a local variable based on the type of its initializer without explicit specification
- Advantages:
  - Streamline code by eliminating the need to redundantly specify a variable's type when it can be inferred
  - Simplify declarations when the type name is quite lengthy, such as can be the case with some class names
  - Helpful when a type is difficult to determine
  - Its inclusion helps keep Java up-to-date with evolving trends in language design

Local Variable Type Inference

- The context-sensitive identifier var was added to Java as a reserved type name
- To use local variable type inference, the variable must be declared with var as the type name and it must include an initializer
  - **double avg = 10.0; // *type is explicitly specified***
  - **var avg = 10.0; // *type is inferred as double because initializer (10.0) is of type double***
- var can still be used as user-defined identifier
  - **int var = 1; // *valid***

Local Variable Type Inference

- var cannot be used as the name of a class
- var can be used to declare an array type, but cannot be used with an array initializer
  - **var myArray = new int[10]; // *valid***
  - **var myArray = { 1, 2, 3 }; // *invalid***
- var is not allowed as an element type of an array
  - **var[] myArray = new int[10]; // *invalid***
  - **var myArray[] = new int[10]; // *invalid***

Local Variable Type Inference

- var can be used to declare a variable only when that variable is initialized
  - **var counter; // *invalid***
- var cannot be used to declare a variable with null as the initializer
- var can be used only to declare local variables, it cannot be used when declaring instance variables, parameters, or return types
- var can be used in a for/for-each loop when declaring and initializing the loop control/iteration variable

Local Variable Type Inference

- Local variable type inference can also be used with reference types
  - **var str = “This is a string”;**
  - Type inference is primarily used with reference types
- Local variable type inference is especially effective in shortening declarations that involve long class names
- Local variable type inference can also be used with user-defined classes
  - **var mc = new MyClass();**