Web Technology 6
Arrays & Classes

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Arrays

- Arrays are:
  - declared
  - created
  - initialized
  - used
- Array Declaration
  - declaring an array identifier
  - declaring the number of dimensions
  - declaring the data type of the array elements

  type array-variable[];
  or
  type [] array-variable;

Arrays...

- Array Creation
  - After declaration, no array actually exists
  - In order to create an array, we use the new operator:

    type array-variable[];
    array-variable = new type[size];

  - We can refer to the elements of this array through their indexes:

    array-variable[index]

  - The array index always starts with zero!
- Array Initialization
  - Arrays can be initialized when they are declared:
    int monthDays[] = {31,28,31,30,31,30,31,31,30,31,30,31};

Arrays...

Multidimensional Arrays

- Multidimensional arrays are arrays of arrays:
  - declaration:

    int array[][];

  - creation:

    int array = new int[2][3];

  - initialization:
    int array[] [] = { {1, 2, 3}, {4, 5, 6} };

For-each Loop

It is mainly used to traverse array or collection elements. It eliminates the possibility of bugs and makes the code more readable

```
public class TestArray {
  public static void main(String[] args) {
    int []arr = {11,22,33,44,55};
    for (int i: arr) {
      System.out.println(i);
    }
  }
}
```

Procedural Programming

- data $\rightarrow$ nouns versus operations $\rightarrow$ verbs
- Procedural programming is verb- oriented:
  - decomposition around operations
  - operation are divided into smaller operations
- Drawbacks:
  - data is given a second- class status when compared with operations
  - difficult to relate to the real world: no functions in real world
  - difficult to create new data types: reduces extensibility
  - programs are difficult to debug: little restriction to data access
  - programs are hard to understand: many variables have global scope
  - programs are hard to reuse: data/functions are mutually dependent
  - little support for developing and comprehending really large programs
  - top- down development approach tends to produce monolithic programs

Object & Class

- Real world objects are things that have:
  - state
  - behavior
- Example: your dog
  - state: name, color, breed
  - behavior: sitting, barking, waging tail, running
- A software object is a bundle of variables (state) and methods (operations)
- A class is a blueprint that defines the variables and methods common to all objects of a certain kind
  - Example: 'your dog' is a object of the class Dog
- An object holds values for the variables defined in the class
- A class is a template for an object, whereas an object is called an instance of the class

Class Outline

- *A basis for the Java language*
- Each concept we wish to describe in Java must be included inside a class
- A class defines a new data type, whose values are objects

- Class Definition
  - A class contains a name, several variable declarations (instance variables) and several method declarations. All are called members of the class

```
class classname {
        type instance-variable-1;
                ...
        type instance-variable-n;
    type method-name-1(parameter-list) { ... }
                ...
    type method-name-m(parameter-list) { ... }
    }
```

Class Outline...

- Example: Box class definition and usage

```
class Box {
      double width;
      double height;
      double depth;
      }

 class BoxDemo {
       public static void main(String args[]) {
            Box mybox = new Box();
            double vol;
            mybox.width = 10;
            mybox.height = 20;
            mybox.depth = 15;
            vol = mybox.width * mybox.height * mybox.depth;
            System.out.println("Volume is " + vol);
           }
      }
```

- Compilation and execution
  - > javac BoxDemo.java
  - > java BoxDemo

Class Outline...

- Declaring Objects
  - *Everything in Java is an object*
  - Declare a variable of the class type:

    Box myBox;
    myBox = new Box();

  - Allocates memory for a Box object and returns its address:

    Box myBox = new Box();
- Assigning Reference Variables
  - *Assignment copies address, not the actual value*

    Box b1 = new Box();
    Box b2 = b1;

  - Both variables point to the same object

Methods

- General form of a method definition:

```
type name(parameter-list) {
                    ... return value; ...
                    }
```

- Classes declare methods to hide their internal data structures, as well as for their own internal use
- Within a class, we can refer directly to its member variables:

```
class  Box {
    double width, height, depth;
    void volume() {
      System.out.print("Volume is ");
      System.out.println(width * height * depth);
      }
    }
```

Methods...

Parameterized Method

- Parameters increase generality and applicability of a method:
  - Method without parameters:
    *int square() { return 10*10; }*
  - Method with parameters:
    *int square(int i) { return i*i; }*

```
void setDim(double w, double h, double d) {
    width = w;
    height = h;
    depth = d;
    }
```

Constructor

- A constructor initializes the instance variables of an object
- It is called immediately after the object is created but before the new operator completes
  - it is syntactically similar to a method
  - it has the same name as the name of its class
  - it is written without return type; the default return type of a class constructor is the same class
- When the class has no constructor, the default constructor automatically initializes all its instance variables with zero

Constructor...

```
class  Box {
        double width;
        double height;
        double depth;
        Box() {
                System.out.println("Constructing Box");
                width = 10; height = 10; depth = 10;
                }
        double volume() {
                return width * height * depth;
                }
        }
```

Constructor...

- Parameterized Constructor

```
Box(double w, double h, double d) {
    width = w; height = h; depth = d;
}
```

- finalize() Method:
  - finalize method is invoked just before the object is destroyed
  - implemented inside a class as:

    protected void finalize() { ... }

  - implemented when the usual way of removing objects from memory is insufficient, and some special actions has to be carried out

Garbage Collection

- Garbage collection is a mechanism to remove objects from memory when they are no longer needed

- Garbage collection is carried out by the garbage collector:
  - The garbage collector keeps track of how many references an object has
  - It removes an object from memory when it has no longer any references
  - Thereafter, the memory occupied by the object can be allocated again
  - Garbage collector is parts of the Java Run-Time Environment
  - The garbage collector invokes the finalize() method

this keyword

- Keyword this allows a method to refer to the object that invoked it
- It can be used inside any method to refer to the current object

```
Box(double w, double h, double d) {
        this.width = w;
        this.height = h;
        this.depth = d;
        }
Box(double width, double height, double depth) {
        this.width = width;
        this.height = height;
        this.depth = depth;
        }
```

Method Overloading

Method Overloading

```
class OverloadDemo {
        void test() { System.out.println("No parameters"); }

        void test(int a) { System.out.println("a: " + a); }

        void test(int a, int b) { System.out.println("a and b: " + a + " " + b);}

        double test(double a) { System.out.println("double a: " + a);
                                return a*a;
                              }
      }
```

- When an overloaded method is called, Java looks for a match between the arguments used to call the method and the method's parameters
- When no exact match can be found, Java's automatic type conversion can aid overload resolution

Constructor Overloading

```
class  Box {
        double width, height, depth;
        Box(double w, double h, double d) {
                width = w; height = h; depth = d;
                }
        Box() {
                width = -1;  height = -1;  depth = -1;
               }

        Box(double len) {
                width = height = depth = len;
                }
        double volume() { return width * height * depth; }
        }
```

Passing Object to Constructor

```
class Box {
        double width, height, depth;
        Box(Box ob) {
                width = ob.width;
                height = ob.height;
                depth = ob.depth;
                }
        Box(double w, double h, double d){
                width=w;  height=h;   depth=d;
                }
}
```

- Box mybox1 = new Box(10, 20, 15);
- Box mybox2 = new Box(mybox1);

Argument Passing

Argument Passing

- Two types of variables:
  - simple types
  - class types
- Two corresponding ways of how the arguments are passed to methods:
  - by value: a method receives a copy of the original value; parameters of simple types

    void meth(int i, int j){ i=2; j/=2; }*

  - by reference: a method receives the memory address of the original value, not the value itself; parameters of class types

    *void meth(Test o) { o.a *= 2; o.b /= 2; }*

Recursion

Recursion

- A recursive method is a method that calls itself
  - all method parameters and local variables are allocated on the stack
  - arguments are prepared in the corresponding parameter positions
  - the method code is executed for the new arguments
  - upon return, all parameters and variables are removed from the stack
  - the execution continues immediately after the invocation point

```
class Factorial {
        int fact(int n) {
                if (n= 1)
                        return 1;
                return fact(n-1) * n;
                }
        }
```

Static Members

Static Members

Static keyword is used for memory management. It belongs to the class than instance of the class

- static variable:
  - *static int a=0;*
  - It can be used to refer the common property of all objects
  - It is a global variable shared by all instances of the class
  - It gets memory only once at the time of class loading
  - It cannot be used within a non-static method
- static method:
  - *static void meth() { ... }*
  - It belongs to the class rather than object of a class. It can be invoked without the need for creating an instance of a class
  - It can access static data member & can change its value
  - It can only call static methods & access static variables
  - It cannot refer to this or super in any way
- static block:
  - *static { ... }*
  - This is where the ***static variables are initialized***
  - It is executed exactly once, when the class is first loaded

Array of Objects

Array of Objects

- **classname[] arrayname=new classname[no of objects];**

  child [] children=new child[5];

- **objectname[objectnumber]=new classname(age);**

  children[0]=new child(23);

Array of Objects...

Array of Objects...

```
class Child{
  int age;
  Child(int a){age=a;}
  void display(){
    System.out.println("Age"+age);
   }
}
class Test{
 public static void main(String []args){
   Child []ch=new Child[3];
   ch[0]=new Child(20);
   ch[1]=new Child(21);
   ch[2]=new Child(22);
   for(int i=0;i<3; i++){
      ch[i].display();
     }
  }
}
```