

Object Oriented Programming using Java 3

Arrays & Classes

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For-each Loop

Command - Line Arguments

Procedural Programming

Object & Class

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Garbage Collection

this keyword

Method Overloading

Constructor Overloading

Passing Object to
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Argument Passing

Recursion

Static Members

Array of Objects

Array as Argument

Returning array from
Method

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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;

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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};
```

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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} };
```

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For-each Loop

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);  
        }  
    }  
}
```

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Command - Line Arguments

Command - Line Arguments

- A command-line argument is the information that directly follows the program's name on the command line when it is executed
- The command-line arguments are stored as strings in the **String** array passed to main()

```
class CommandLine {  
    public static void main(String args[]) {  
        for(int i=0; i<args.length; i++)  
            System.out.println("args[" + i + "]: " + args[i]);  
    }  
}
```

- javac CommandLine.java
- java CommandLine this is a test
- *All command-line arguments are passed as strings*

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Procedural Programming

Procedural Programming

- data → nouns versus operations → 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

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Object & Class

- Real world objects are things that have:
 - state
 - behavior
- Example: your dog
 - state: name, color, breed
 - behavior: sitting, barking, wagging 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 an 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

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Class Outline

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) { ... }  
}
```

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Class Outline...

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

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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

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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);  
    }  
}
```

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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;  
}
```

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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

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```
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;  
    }  
}
```

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Constructor...

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

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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

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this keyword

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;  
}
```

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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

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Arrays & Classes

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```
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; }  
}
```

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```
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);

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

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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;
    }
}
```

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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

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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);

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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();  
        }  
    }  
}
```

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Array as Argument

- When passing an array to a method, the reference of the array is passed to the method
- Array can be passed to method similar to passing primitive type
- To pass an array as argument, specify the array name without any square bracket within a method call
- As array reference is passed to the method, the corresponding parameter in the called method header must be of array type

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Array as Argument...

Array as Argument...

```

class Test{
    public static void main(String []args){
        int [] data={40,50, 10, 30, 20, 5};
        System.out.println("Unsorted Array:");
        disp(data);
        sort(data);
        System.out.println("Sorted Array:");
        disp(data);
    }
    static void disp(int num[]){
        for(int i=0;i<num.length; i++)
            System.out.print(num[i]+" ");
    }
    static void sort(int num[]){
        int i,j, temp;
        for(i=0; i<num.length-1; i++){
            for(j=0; j<num.length-i-1; j++){
                if(num[j]>num[j+1]){
                    temp=num[j];
                    num[j]=num[j+1];
                    num[j+1]=temp;
                }
            }
        }
    }
}

```

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Returning array from Method

Returning array from Method

When a method returns an array, the reference of the array is returned

```
public class Test{  
    public static void main(String []args){  
        int [] data={40,50,10,30,20,5};  
        System.out.println("Original Array:");  
        disp(data);  
        int []rdata=rev(data);  
        System.out.println("Reversed Array:");  
        disp(rdata);  
    }  
    static void disp(int num[]){  
        for(int i=0;i<num.length; i++)  
            System.out.print(num[i] + " ");  
    }  
    static int [] rev(int num[]){  
        int []rdata=new int[num.length];  
        for(int i=0, j=rdata.length-1; i<num.length; i++, j--)  
            rdata[j]=num[i];  
        return rdata;  
    }  
}
```

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