

## Java Details

February 4, 2009

Slides by Mark Hancock  
(adapted from notes by Craig Schock)

1

## Lecture 08 Summary

- Java Classes
- Instance Variables
- Instance Methods
- Instantiation
- Creation, and Initialization
- Overloading
- Mutability

February 4, 2009

Slides by Mark Hancock  
(adapted from notes by Craig Schock)

2

By the end of this lecture, you will be able to use Java to implement a class model and an object model.

You will also be able to compile and run a Java program (to test these models).

February 4, 2009

Slides by Mark Hancock  
(adapted from notes by Craig Schock)

3

## Java Class Definition

```
public class ClassName {  
  
}
```

February 4, 2009

Slides by Mark Hancock  
(adapted from notes by Craig Schock)

4

## Instance Variables

```
public class Address {
    private String street;
    private String city;
    private String province;
    private String postalCode;
}
```

- Why is it called an *instance* variable?
- What is stored in memory for each instance of an Address?

February 4, 2009

Slides by Mark Hancock  
(adapted from notes by Craig Schock)

5

## Instance Methods

```
public class Customer {
    private String name;
    private Address mailing;

    public void changeAddress(Address newAddress) {
        if (newAddress != null)
            mailing = newAddress;
    }
}
```

February 4, 2009

Slides by Mark Hancock  
(adapted from notes by Craig Schock)

6

What does our block of memory look like after creating the Address and Customer class definitions?

(hint: this is kind of a trick question)

February 4, 2009

Slides by Mark Hancock  
(adapted from notes by Craig Schock)

7

## Creating Objects

```
Address anAddress = new Address();
```

- How is `new` different than `malloc`?
- How is it similar?
- What does our block of memory look like after this line of code?
- What does our object model look like?

February 4, 2009

Slides by Mark Hancock  
(adapted from notes by Craig Schock)

8

## Initializing Instance Variables

- Method 1: Accessor Methods
  - Setters & Getters
- Method 2: Constructors

February 4, 2009

Slides by Mark Hancock  
(adapted from notes by Craig Schock)

9

## Initializing Using Setters

```
public class Address {
    private String street;
    private String city;
    private String province;
    private String postalCode;

    public String getStreet() {
        return street;
    }

    public void setStreet(String aStreet) {
        street = aStreet;
    }

    public static void main(String[] args) {
        Address anAddress = new Address();
        anAddress.setStreet("123 Any Street");

        Address address2 = new Address();
        address2.setStreet("456 Another Street");

        System.out.println("Street #1: " + anAddress.getStreet());
        System.out.println("Street #2: " + address2.getStreet());
    }
}
```

February 4, 2009

Slides by Mark Hancock  
(adapted from notes by Craig Schock)

10

## Compile and Run

```
> javac Address.java
> java Address
```

February 4, 2009

Slides by Mark Hancock  
(adapted from notes by Craig Schock)

11

Exercise: draw the object model and explain the output.

February 4, 2009

Slides by Mark Hancock  
(adapted from notes by Craig Schock)

12

Are there any issues with this setter?

February 4, 2009

Slides by Mark Hancock  
(adapted from notes by Craig Schock)

13

## Improved Setter

```
public void setStreet(String aStreet) {
    if (aStreet != null && aStreet.trim().length() > 0)
        street = aStreet;
}
```

February 4, 2009

Slides by Mark Hancock  
(adapted from notes by Craig Schock)

14

What is your reaction to the idea of having to use setters to change the value of instance variables?

What would the code look like if you did this for all of the instance variables?

February 4, 2009

Slides by Mark Hancock  
(adapted from notes by Craig Schock)

15

## Initializing Using Constructors

```
public class Address {
    ...
    public Address(String aStreet, String aCity,
                   String aProvince, String aPostalCode) {
        street = aStreet;
        city = aCity;
        province = aProvince;
        postalCode = aPostalCode;
    }
    public static void main(String[] args) {
        Address anAddress =
            new Address("123 Any Street", "Calgary", "AB", "T1T 2T3");
        Address address2 =
            new Address("234 Another Street", "Vancouver", "BC", "V1V 2V3");
        System.out.println("Address #1");
        System.out.println(anAddress.getStreet());
        System.out.println(anAddress.getCity() + ", " + anAddress.getProvince());
        System.out.println(anAddress.getPostalCode());
        System.out.println("Address #2");
        System.out.println(address2.getStreet());
        System.out.println(address2.getCity() + ", " + address2.getProvince());
        System.out.println(address2.getPostalCode());
    }
}
```

February 4, 2009

Slides by Mark Hancock  
(adapted from notes by Craig Schock)

16

Exercise: draw the object model and explain the output.

February 4, 2009

Slides by Mark Hancock  
(adapted from notes by Craig Schock)

17

## Constructors

- Must have the same name as the class
- Cannot have a return type
  - What happens if you add one?
- In our example, what happens if we do this?

```
Address anAddress = new Address();
```

February 4, 2009

Slides by Mark Hancock  
(adapted from notes by Craig Schock)

18

## Overloading Constructors

```
public class Address {
    public Address() {
    }

    public Address(String aStreet, String aCity,
                   String aProvince, String aPostalCode) {
        street = aStreet;
        city = aCity;
        province = aProvince;
        postalCode = aPostalCode;
    }
}
```

February 4, 2009

Slides by Mark Hancock  
(adapted from notes by Craig Schock)

19

If the constructors have the same name, how does the compiler know which one you're calling?

February 4, 2009

Slides by Mark Hancock  
(adapted from notes by Craig Schock)

20

Consider the following:

```
public class Vector {
    private float x;

    private float y;

    public Vector(float aX, float aY) {
        x = aX;
        y = aY;
    }

    public Vector(Point a, Point b) {
        x = b.getX() - a.getX();
        y = b.getY() - a.getY();
    }
}
```

February 4, 2009

Slides by Mark Hancock  
(adapted from notes by Craig Schock)

21

How do we decide what constructors to provide?

February 4, 2009

Slides by Mark Hancock  
(adapted from notes by Craig Schock)

22

If we provide multiple constructors, an instance variable can be manipulated in many ways.

What is the disadvantage?

How do we fix this problem?

February 4, 2009

Slides by Mark Hancock  
(adapted from notes by Craig Schock)

23

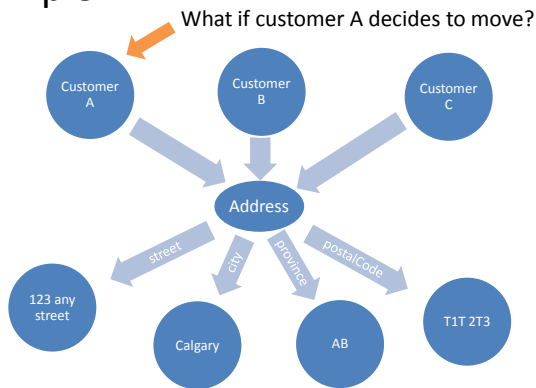
Exercise: decide which constructors might be needed for the Font class we talked about last class and create them.

February 4, 2009

Slides by Mark Hancock  
(adapted from notes by Craig Schock)

24

## Example



February 4, 2009

Slides by Mark Hancock  
(adapted from notes by Craig Schock)

25

## Mutability

- Immutable Objects
  - all instance variables *cannot* be changed after creation of the object

February 4, 2009

Slides by Mark Hancock  
(adapted from notes by Craig Schock)

26

Exercise: make our Address class immutable.

February 4, 2009

Slides by Mark Hancock  
(adapted from notes by Craig Schock)

27

## Design Decisions

- Should a class be mutable or immutable?
  - no general answer
- Good approach:
  - immutable by default
  - as the program evolves, can do one of:
    - make setters public (class now mutable)
    - make a method to modify instance variables

February 4, 2009

Slides by Mark Hancock  
(adapted from notes by Craig Schock)

28

## Is this class immutable?

```
public class Location {
    public float longitude;
    public float latitude;
}
```

February 4, 2009

Slides by Mark Hancock  
(adapted from notes by Craig Schock)

29

## Is this class immutable?

```
public class Location {
    private float longitude;
    private float latitude;

    public Location(float lon, float lat) {
        longitude = lon;
        latitude = lat;
    }
}
```

February 4, 2009

Slides by Mark Hancock  
(adapted from notes by Craig Schock)

30

## Is this class immutable?

```
public class Location {
    private float longitude;
    private float latitude;

    public Location(float lon, float lat) {
        longitude = lon;
        latitude = lat;
    }

    public void print() {
        System.out.println("Longitude:" + longitude);
        System.out.println("Latitude:" + latitude);
    }
}
```

February 4, 2009

Slides by Mark Hancock  
(adapted from notes by Craig Schock)

31

## Is this class immutable?

```
public class Location {
    private float longitude;
    private float latitude;

    public Location(float lon, float lat) {
        setLongitude(lon);
        latitude = lat;
    }

    public void setLongitude(float lon) {
        longitude = lon;
    }
}
```

February 4, 2009

Slides by Mark Hancock  
(adapted from notes by Craig Schock)

32



## Is this class immutable?

```
public class Location {
    private float longitude;
    private float latitude;

    public Location(float lon, float lat) {
        setLongitude(lon);
        latitude = lat;
    }

    private void setLongitude(float lon) {
        longitude = lon;
    }
}
```

February 4, 2009

Slides by Mark Hancock  
(adapted from notes by Craig Schock)

33

## Is this class immutable?

```
public class Location {
    private float longitude;
    private float latitude;

    public Location(float lon, float lat) {
        longitude = lon;
        latitude = lat;
    }

    public void add(float lon, float lat) {
        longitude += lon;
        latitude += lat;
    }
}
```

February 4, 2009

Slides by Mark Hancock  
(adapted from notes by Craig Schock)

34

## Is this class immutable?

```
public class Customer {
    private String name;
    private Address address;

    public Address(String n, Address a) {
        name = n;
        address = a;
    }

    public Address getAddress() {
        return address;
    }
}
```

February 4, 2009

Slides by Mark Hancock  
(adapted from notes by Craig Schock)

35

## Lecture 08 Summary

- Java Classes
- Instance Variables
- Instance Methods
- Instantiation
- Creation, and Initialization
- Overloading
- Mutability

February 4, 2009

Slides by Mark Hancock  
(adapted from notes by Craig Schock)

36

## Next Class

- Navigability
- Multiplicity
- Class Variables and Methods

February 4, 2009

Slides by Mark Hancock  
(adapted from notes by Craig Schock)

37