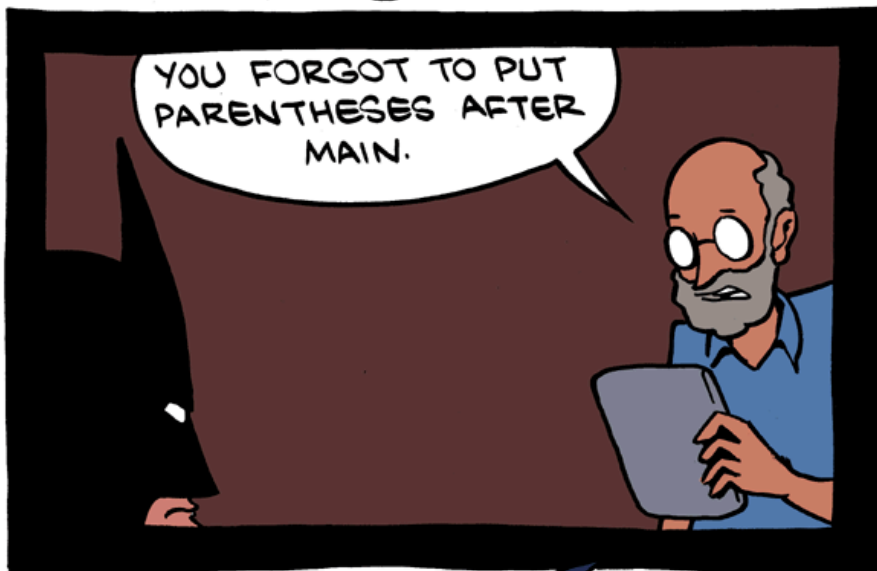


# Homework 9: Critters (cont.)

**reading: HW9 spec**

# BATMAN VS. PROGRAMMING



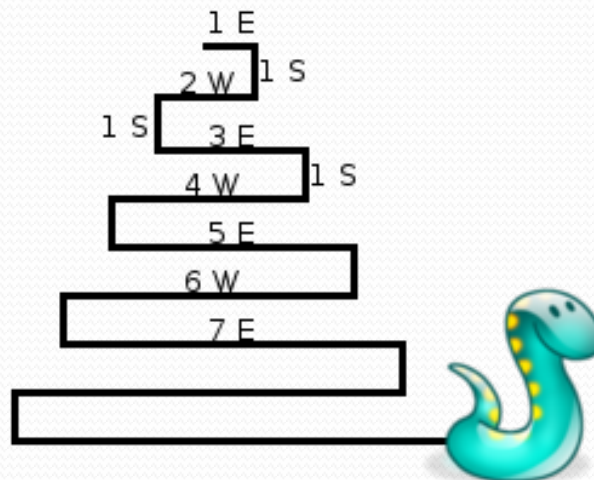
# Critter exercise: Cougar

- Write a critter class `Cougar`:

<b>Method</b>	<b>Behavior</b>
<code>constructor</code>	<code>public Cougar()</code>
<code>eat</code>	Always eats.
<code>fight</code>	Always pounces.
<code>getColor</code>	Blue if the <code>Cougar</code> has never fought; red if he has.
<code>getMove</code>	Walks west until he finds food; then walks east until he finds food; then goes west and repeats.
<code>toString</code>	"C"

# Critter exercise: Snake

Method	Behavior
constructor	<code>public Snake()</code>
eat	Never eats
fight	always forfeits
getColor	black
getMove	<b>1 E, 1 S; 2 W, 1 S; 3 E, 1 S; 4 W, 1 S; 5 E, ...</b>
toString	"S"



# Determining necessary fields

- Information required to decide what move to make?
  - Direction to go in
  - Length of current cycle
  - Number of moves made in current cycle
- Remembering things you've done in the past:
  - an `int` counter?
  - a `boolean` flag?

# Snake solution

```
import java.awt.*;    // for Color

public class Snake extends Critter {
    private int length;    // # steps in current horizontal cycle
    private int step;    // # of cycle's steps already taken

    public Snake() {
        length = 1;
        step = 0;
    }

    public Direction getMove() {
        step++;
        if (step > length) {    // cycle was just completed
            length++;
            step = 0;
            return Direction.SOUTH;
        } else if (length % 2 == 1) {
            return Direction.EAST;
        } else {
            return Direction.WEST;
        }
    }

    public String toString() {
        return "S";
    }
}
```



# Building Java Programs

Chapter 8

Lecture 8-4: Static Methods and Fields

# Critter exercise: Hipster

- All hipsters want to get to the bar with the cheapest PBR
- That bar is at a randomly-generated board location  
(On the 60-by-50 world)
- They go north then east until they reach the bar



# A flawed solution

```
import java.util.*;    // for Random

public class Hipster extends Critter {
    private int cheapBarX;
    private int cheapBarY;

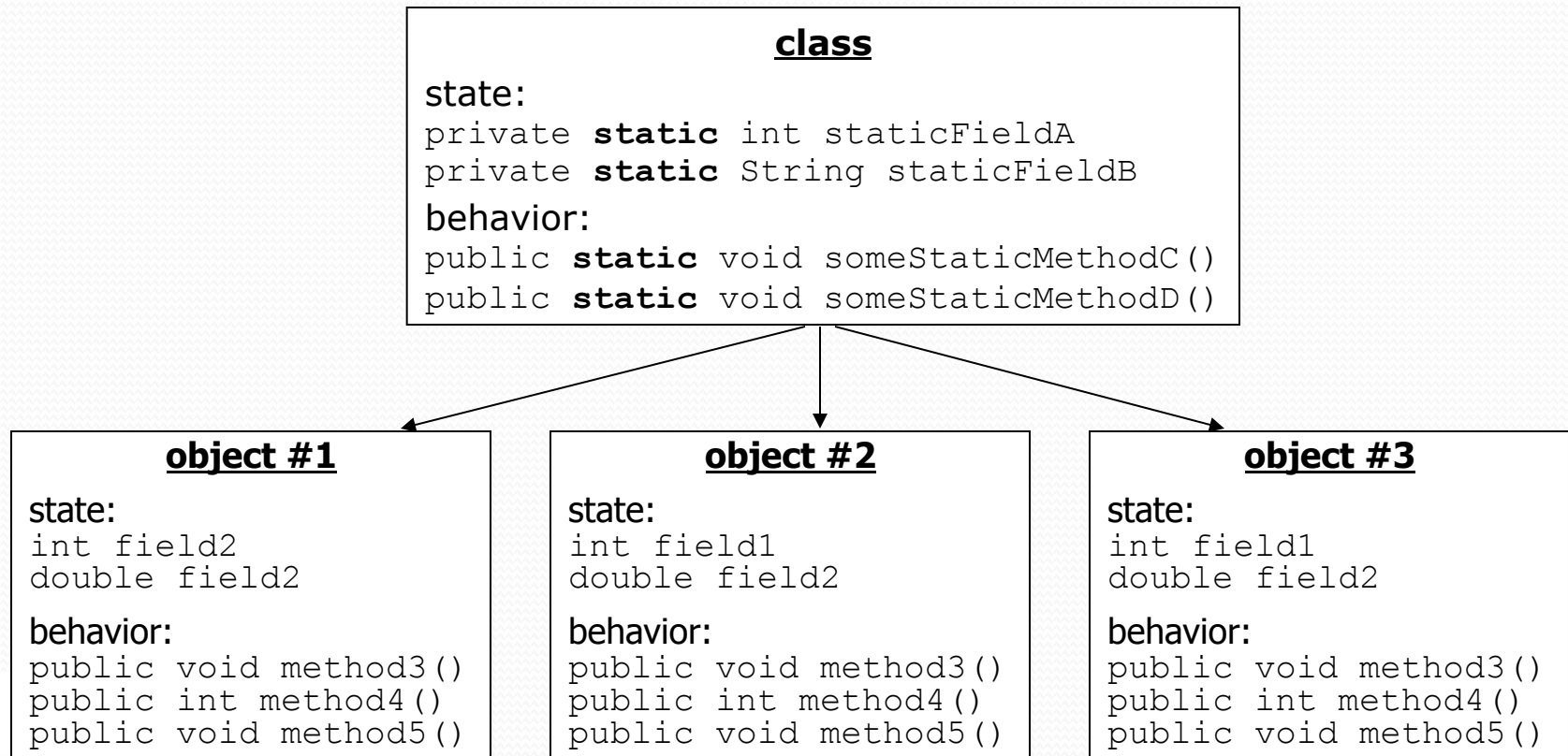
    public Hipster() {
        Random r = new Random();
        cheapBarX = r.nextInt(60);
        cheapBarY = r.nextInt(50);
    }

    public Direction getMove() {
        if (getY() != cheapBarY) {
            return Direction.NORTH;
        } else if (getX() != cheapBarX) {
            return Direction.EAST;
        } else {
            return Direction.CENTER;
        }
    }
}
```

- Problem: Each hipster goes to a different bar.  
We want all hipsters to share the same bar location.

# Static members

- **static:** Part of a class, rather than part of an object.
  - Object classes can have static methods *and fields*.
  - Not copied into each object; shared by all objects of that class.



# Static fields

```
private static type name;
```

or,

```
private static type name = value;
```

- Example:

```
private static int theAnswer = 42;
```

- **static field**: Stored in the class instead of each object.
  - A "shared" global field that all objects can access and modify.
  - Like a class constant, except that its value can be changed.

# Accessing static fields

- From inside the class where the field was declared:

```
fieldName // get the value  
fieldName = value; // set the value
```

- From another class (if the field is `public`):

```
ClassName.fieldName // get the value  
ClassName.fieldName = value; // set the value
```

- generally static fields are not `public` unless they are `final`
- Exercise: Modify the `BankAccount` class shown previously so that each account is automatically given a unique ID.
- Exercise: Write the working version of `Hipster`.

# BankAccount solution

```
public class BankAccount {  
    // static count of how many accounts are created  
    // (only one count shared for the whole class)  
    private static int objectCount = 0;  
  
    // fields (replicated for each object)  
    private String name;  
    private int id;  
  
    public BankAccount() {  
        objectCount++; // advance the id, and  
        id = objectCount; // give number to account  
    }  
  
    ...  
  
    public int getID() { // return this account's id  
        return id;  
    }  
}
```

# Hipster solution

```
import java.util.*;    // for Random

public class Hipster extends Critter {
    // static fields (shared by all hipsters)
    private static int cheapBarX = -1;
    private static int cheapBarY = -1;

    // object constructor/methods (replicated into each hipster)
    public Hipster() {
        if (cheapBarX < 0 || cheapBarY < 0) {
            Random r = new Random();    // the 1st hipster created
            cheapBarX = r.nextInt(60);    // chooses the bar location
            cheapBarY = r.nextInt(50);    // for all hipsters to go to
        }
    }

    public Direction getMove() {
        if (getY() != cheapBarY) {
            return Direction.NORTH;
        } else if (getX() != cheapBarX) {
            return Direction.EAST;
        } else {
            return Direction.CENTER;
        }
    }
}
```



# Static methods

```
// the same syntax you've already used for methods
public static type name(parameters) {
    statements;
}
```

- **static method:** Stored in a class, not in an object.
  - Shared by all objects of the class, not replicated.
  - Does not have any *implicit parameter*, `this`; therefore, cannot access any particular object's fields.
- Exercise: Make it so that clients can find out how many total `BankAccount` objects have ever been created.

# BankAccount solution

```
public class BankAccount {
    // static count of how many accounts are created
    // (only one count shared for the whole class)
    private static int objectCount = 0;

    // clients can call this to find out # accounts created
    public static int getNumAccounts() {
        return objectCount;
    }

    // fields (replicated for each object)
    private String name;
    private int id;

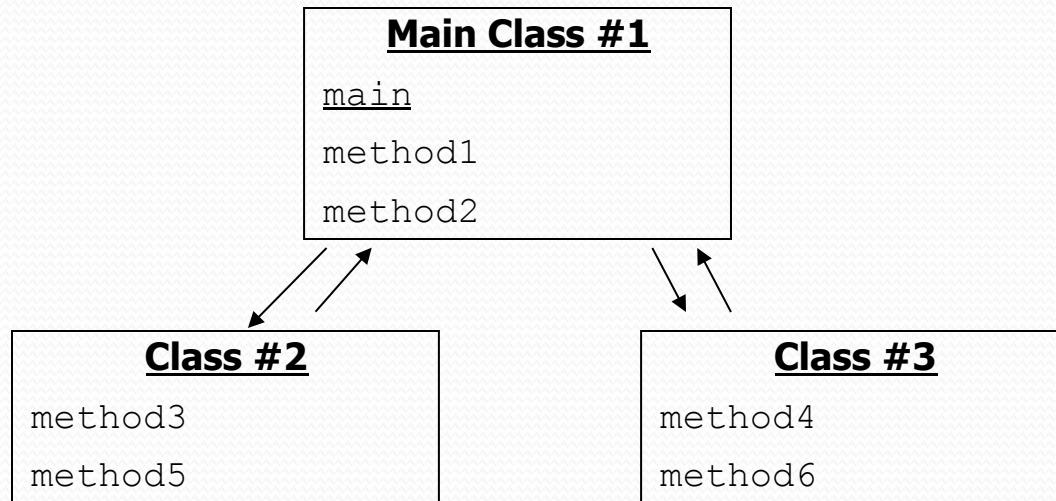
    public BankAccount() {
        objectCount++; // advance the id, and
        id = objectCount; // give number to account
    }

    ...

    public int getID() { // return this account's id
        return id;
    }
}
```

# Multi-class systems

- Most large software systems consist of many classes.
  - One main class runs and calls methods of the others.
- Advantages:
  - code reuse
  - splits up the program logic into manageable chunks



# Summary of Java classes

- A class is used for any of the following in a large program:
  - a *program* : Has a main and perhaps other static methods.
    - example: Bagels, Birthday, BabyNames, CritterMain
    - does not usually declare any static fields (except `final`)
  - an *object class* : Defines a new type of objects.
    - example: Point, BankAccount, Date, Critter, Hipster
    - declares object fields, constructor(s), and methods
    - might declare static fields or methods, but these are less of a focus
    - should be encapsulated (all fields and static fields `private`)
  - a *module* : Utility code implemented as static methods.
    - example: Math