

# CS/ENGRD 2110

## FALL 2013

Lecture 4: The class hierarchy; static components  
<http://courses.cs.cornell.edu/cs2110>

# References to text and JavaSummary.pptx

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- A bit about testing and test cases
- Class Object, **superest** class of them all.  
Text: C.23 slide 30
- Function toString() C.24 slide 31-33
- Overriding a method C15–C16 slide 31-32
- Static components (methods and fields) B.27 slide 21, 45
- Java application: a program with a class that declares a method with this signature:

**public static void** toString(String[])

# Homework

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1. Read the text, Appendix A.1–A.3
2. Read the text, about the if-statement: A.38–A.40
3. Visit course website, click on **Resources** and then on Code Style **Guidelines**. Study
  2. **Format Conventions**
  - 4.5 **About then-part and else-part of if-statement**

# Specifications of boolean functions

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```
/** Return true if this Butterfly is male and false if not. */
```

```
public boolean isMale()
```

Says same thing. Shorter, no

```
/** Return “this Butterfly is male”. */
```

case analysis. Think of it as

```
public boolean isMale()
```

**return value of sentence**

**“this Butterfly is male”**

```
abs(-20)
```

Do you say, “it returns absolute value of -20?”

Of course not. Mathematicians may say simply

“that’s the absolute value of 60”

```
/** = “this Butterfly is male”. */
```

Read as: the call `isMale()` equals the value of the sentence “this Butterfly is male”.

# What is “the name of” the object?

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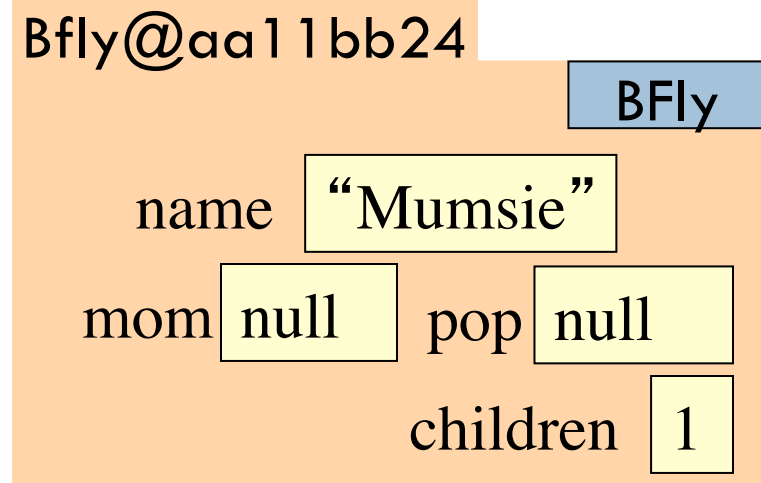
The name of the object below is

**Bfly@aa11bb24**

It contains a pointer to the object –i.e. its address in memory, and you can call it a pointer if you wish. But it contains more than that.

Variable **b**, declared as **Bfly b**;  
contains not the object by the  
name of the object or a pointer to  
the object.

b Bfly@aa11bb24  
Bfly



# A bit about testing

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**Test case:** Set of input values, together with the expected output.

Develop test cases for a method from its specification --- even before you write the methods body.

```
/** = number of vowels in word w.
```

```
Precondition: w contains at least one letter and nothing but letters*/
```

```
public int numberOfVowels(String w) {  
    ...  
}
```

How many vowels in each of these words?

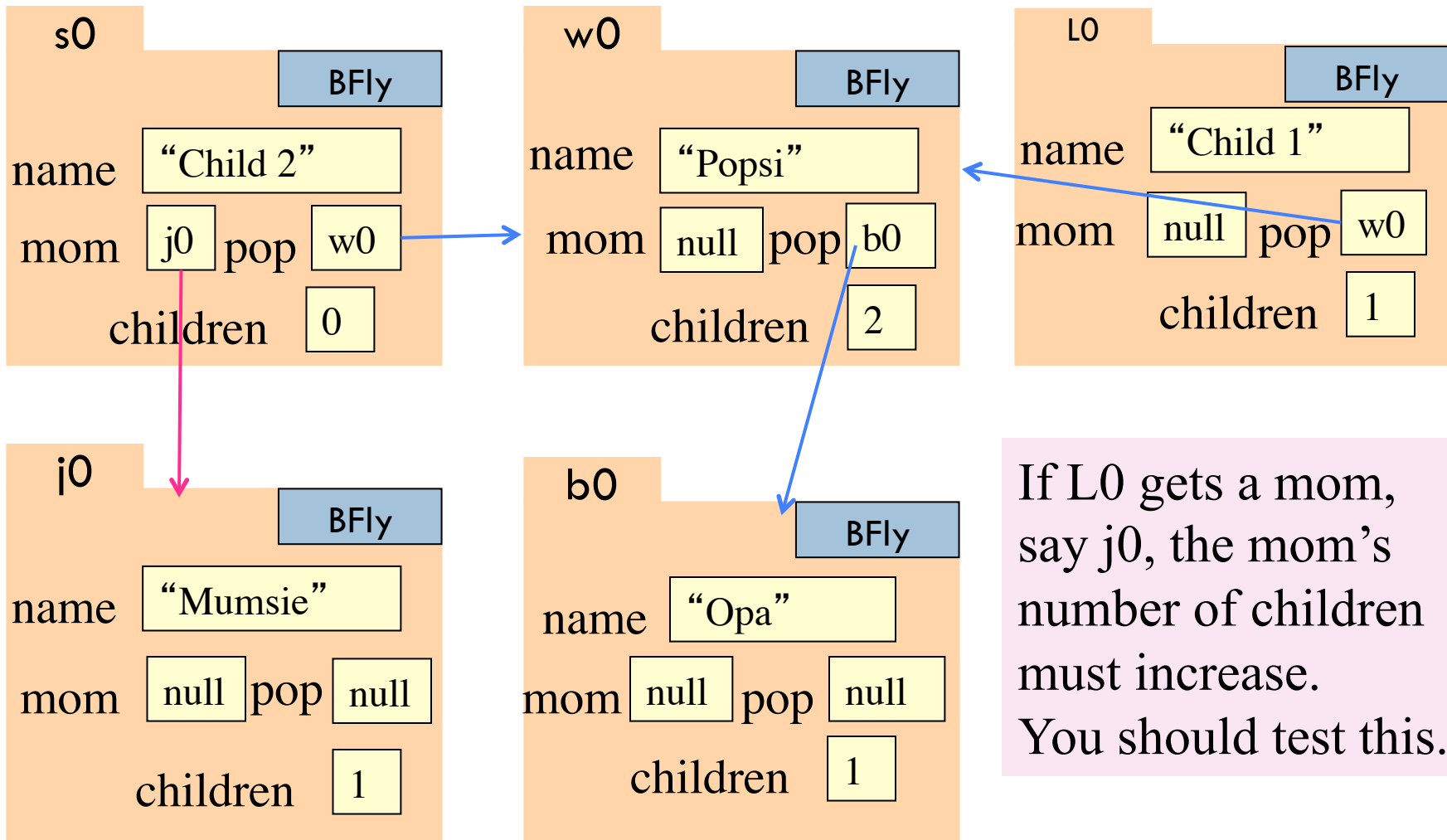
creek

syzygy

Developing test cases first, in “critique” mode, can prevent wasted work and errors.

# Test cases for number of children

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If L0 gets a mom, say j0, the mom's number of children must increase. You should test this.

# Class W (for Worker)

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**/\*\* Constructor: worker with last name n, SSN s, boss b (null if none).**

**Prec: n not null, s in 0..999999999 with no leading zeros.\*\*/**

**public W(String n, int s, W b)**

**/\*\* = worker's last name \*/**

**public String getLname()**

**/\*\* = last 4 SSN digits \*/**

**public String getSsn()**

**/\*\* = worker's boss (null if none) \*/**

**public W getBoss()**

**/\*\* Set boss to b \*/**

**public void setBoss(W b)**

Contains other methods!

W@af

lname

"Obama"

W

ssn

123456789

boss

null

W(...) getLname()

getSsn() getBoss() setBoss(W)

toString()

equals(Object) hashCode()



# Class Object: the superest class of them all

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**Java:** Every class that does not extend another extends class Object. That is,

```
public class W {...}
```

is equivalent to

```
public class W extends Object {...}
```

We often leave off the top partition to reduce clutter; we know that it is always there

We draw object like this

W@af

toString()

equals(Object) hashCode()

Object

lname

"Obama"

ssn

123456789

boss

null

W

W(...) getLname()

getSsn(), getBoss() setBoss(W)

# Method toString

10

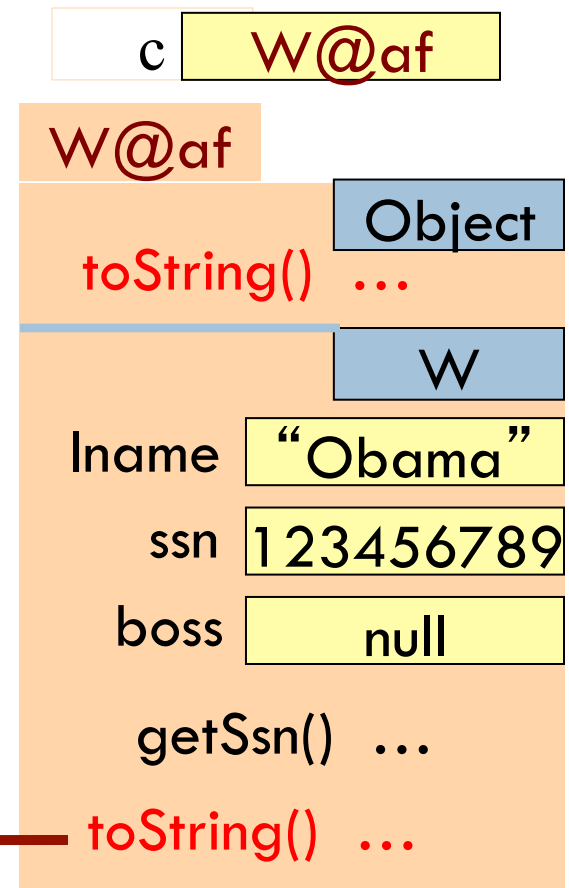
toString() in `Object` returns the name of the object: `W@af`

**Java Convention:** Define `toString()` in any class to return a representation of an object, giving info about the values in its fields.

New definition of `toString()` **overrides** the definition in partition `Object`

In appropriate places, the expression `c` automatically does `c.toString()`

`c.toString()` calls this method



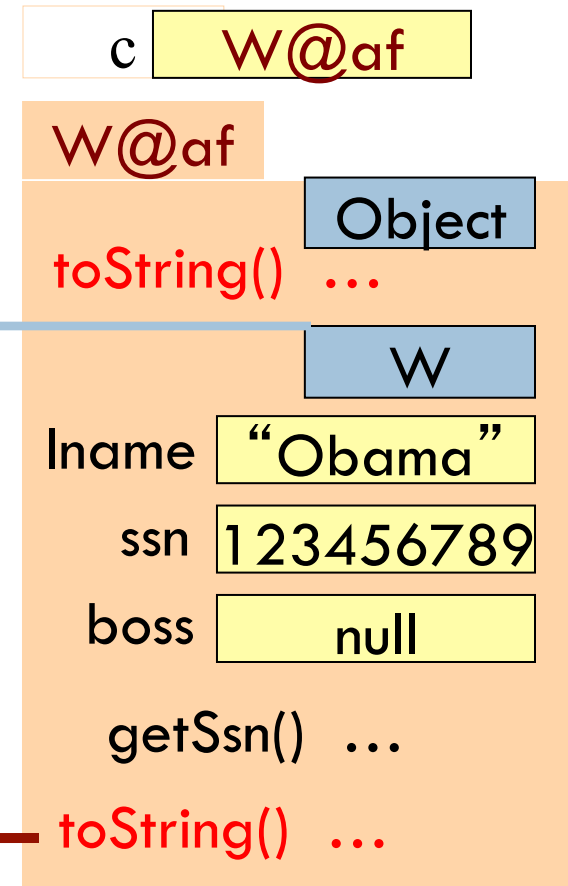
# Method toString

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toString() in **Object** returns the name of the object: **W@af**

```
public class W {  
    ...  
    /** Return a representation of this object */  
    public String toString() {  
        return "Worker " + lname + "." +  
            " Soc sec: ..." + getSSn() + "." +  
            (boss == null ? "" : "Boss " + boss.lname + ".");  
    }  
}
```

c.toString() calls this method



# Another example of toString()

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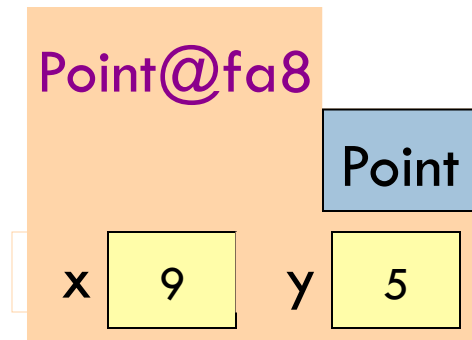
**/\*\* An instance represents a point (x, y) in the plane \*/**

```
public class Point {  
    private int x; // x-coordinate  
    private int y; // y-coordinate  
    ...
```

**/\*\* = repr. of this point in form "(x, y)" \*/**

```
public String toString() {  
    return "(" + x + "," + y + ")";  
}
```

```
}
```



(9, 5)

Function toString should give the values in the fields in a format that makes sense for the class.

# Intro to static components

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*/\*\* = “this object is c’s boss”.*

*Pre: c is not null. \*/*

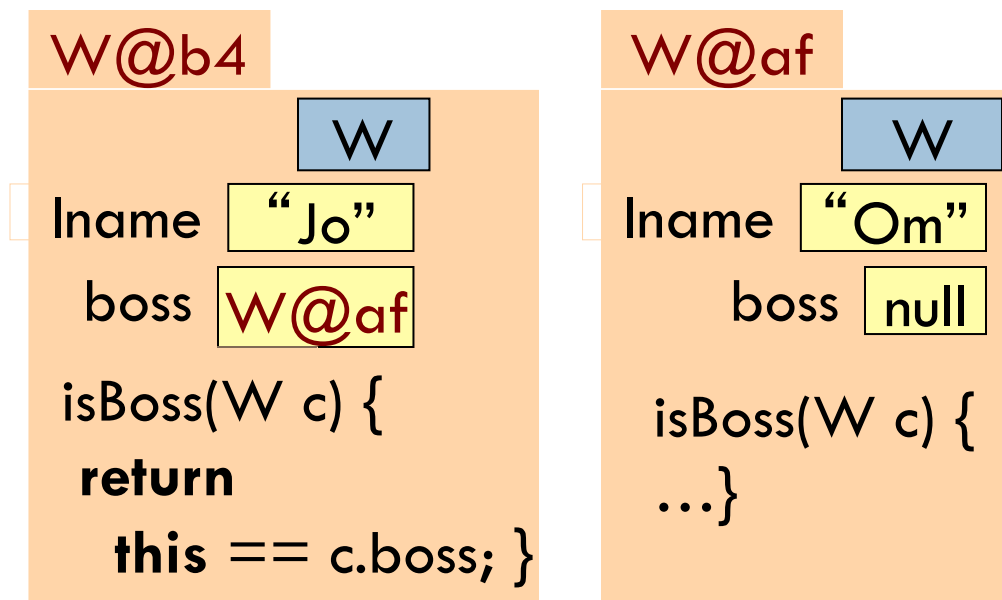
```
public boolean isBoss(W c) {  
    return this == c.boss;  
}
```

**Spec:** return the value of that true-false sentence. True if this object is c’s boss, false otherwise

keyword **this** evaluates to the name of the object in which it appears

x.isBoss(y) is **false**

y.isBoss(x) is **true**

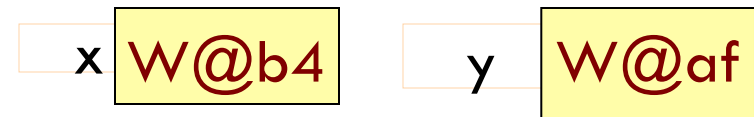


# Intro to static components

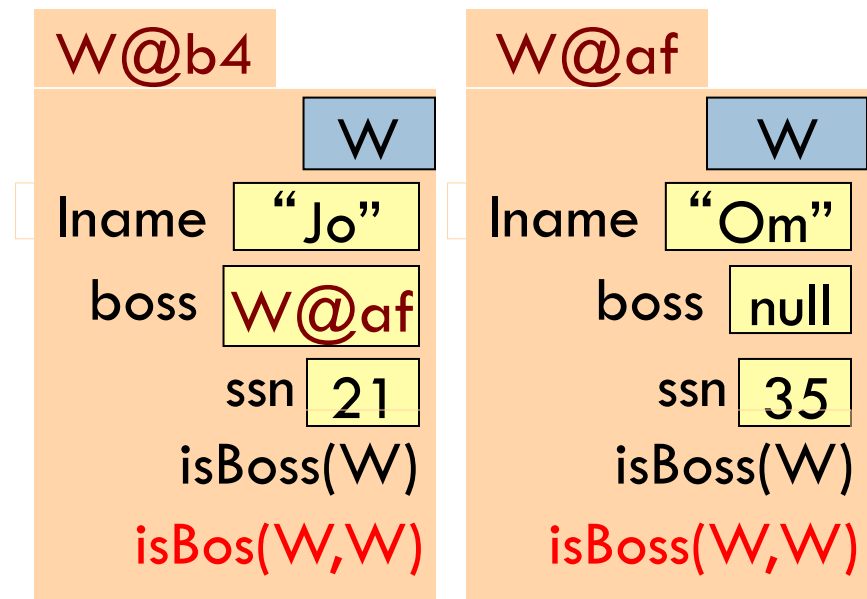
14

```
/** = "b is c' s boss".  
Pre: b and c are not null. */  
public boolean isBoss(W b, W c) {  
    return b == c.getBoss();  
}
```

Body doesn't refer to any field or method in the object.  
Why put method in object?



```
/** = "this object is c' s boss".  
Pre: c is not null. */  
public boolean isBoss(W c) {  
    return this == c.boss;  
}
```



# Intro to static components

15

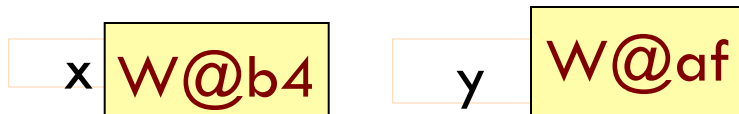
```
/** = "b is c's boss".  
Pre: b and c are not null. */
```

```
public static boolean isBoss(W b, W c) {  
    return b == c.getBoss();  
}
```

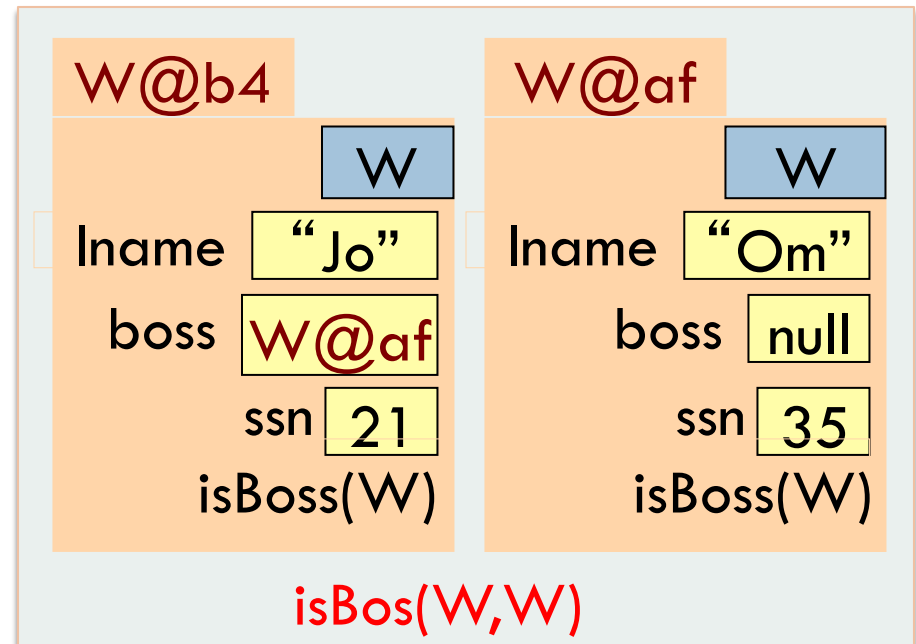
**static**: there is only **one** copy of the method. It is *not* in each object

~~x.isBoss(x, y)  
y.isBoss(x, y)~~

**Preferred:**  
W.isBoss(x, y)



Box for **W** (objects, static components)



# Java application

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Java application: bunch of classes with at least one class that has this procedure:

```
public static void main(String[] args) {  
    ...  
}
```

Type **String[]**: array of elements of type **String**. We will discuss later

Convention: if method **main** doesn't use parameter **args**, then call it with argument **null**

Running the application consists of calling method **main**

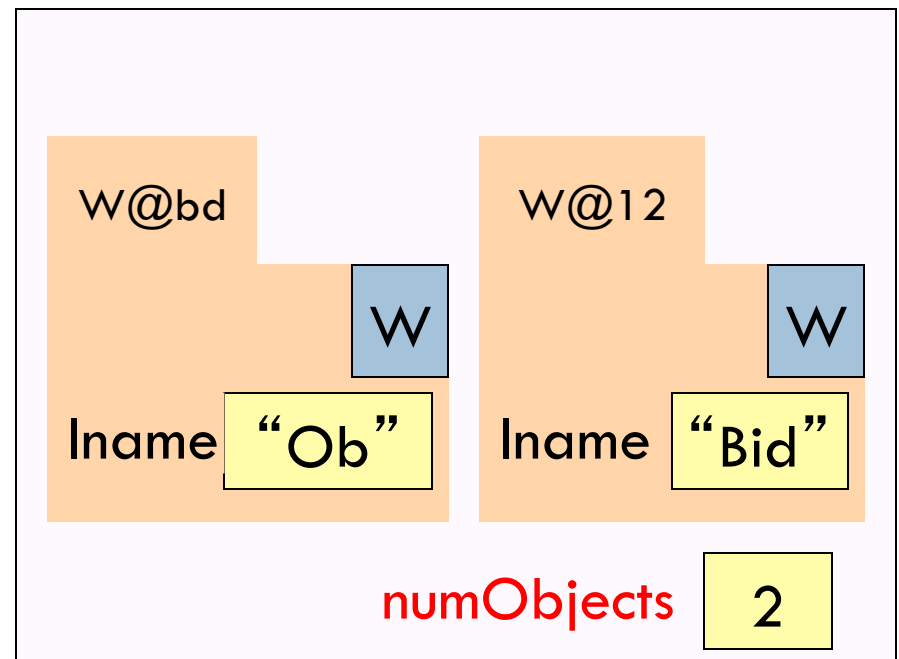


# One use of static variable: maintain info about all objects

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```
public class W {  
    private static int numObjects;  
    ...  
  
    /** Constructor: */  
    public W(...) {  
        ...  
        numObjects=  
            numObjects + 1;  
    }  
}
```

To have `numObjects` contain the number of Objects of class `W` that have been created, simply increment it in constructors



Box for W