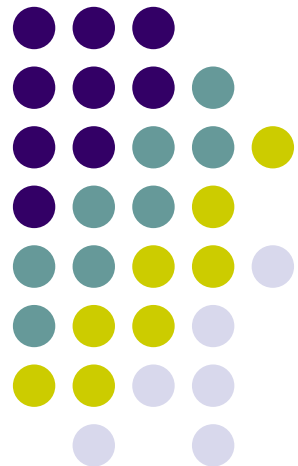
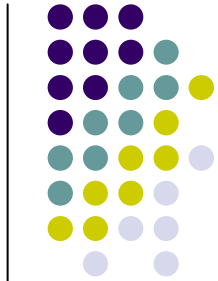
Day 1
Java Objects

6.092 Lecture 1 Part 2

Corey McCaffrey



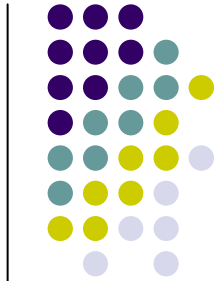
Review of references



- References point to objects
- A reference points to an instance of a particular class
- Declare a reference

```
Integer x;
```

Review of objects



- Classes define objects
- An object is an ***instance*** of a particular class
- Invoke a constructor to create an object:

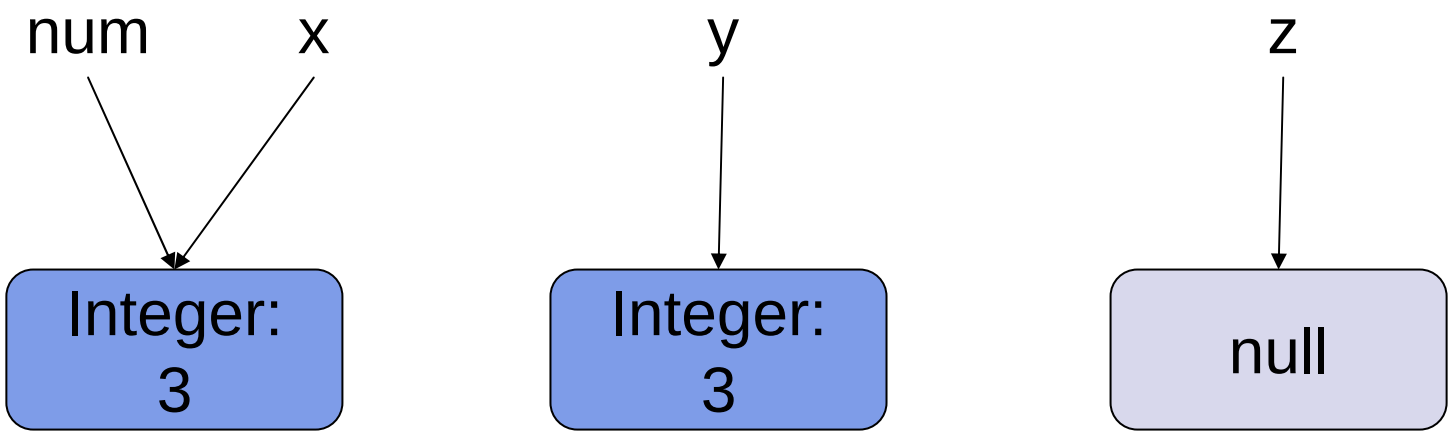
  new Integer(3);

Review of assignment

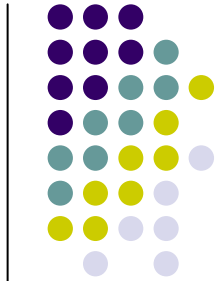
```
public class AssignmentReview {
    public static void main(String[] args) {
        Integer num;
        num = new Integer(3);
        Integer x = num;
        Integer y = new Integer(3);
        Integer z;
    }
}
```

Introducing the Java Heap

The Java Heap shows what references and objects exist at runtime:



Null references



- Unassigned references point to ***null***
- ***null*** is not an object (no fields, no methods)
- z.intValue() results in an error
  - (a NullPointerException, to be exact)

Assignment versus mutation

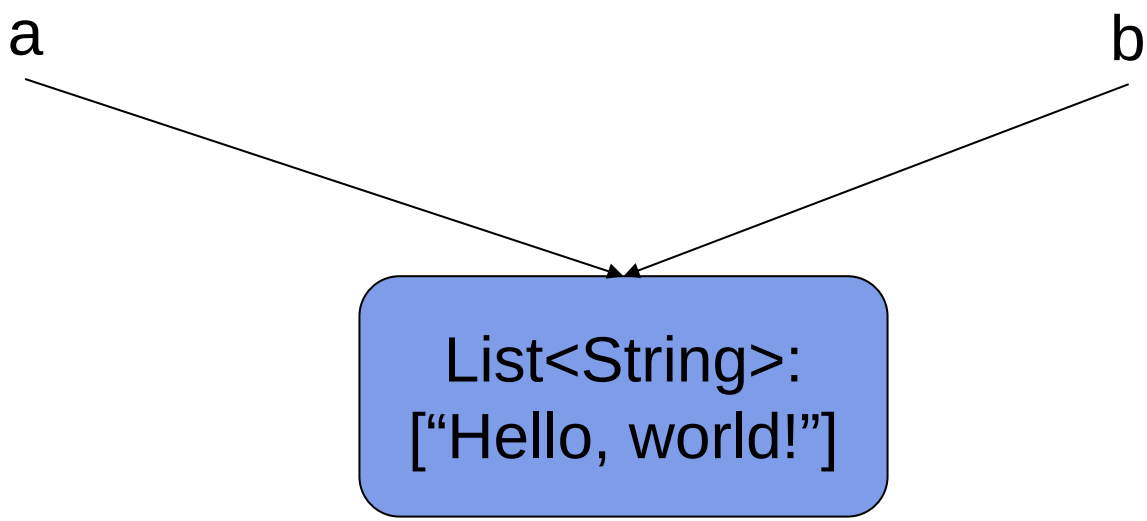
- Use “=” to assign an object to a reference
- Some methods mutate their objects
- References may share objects, so beware of side effects

Mutation of shared object

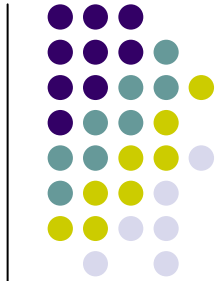
```
public class MutationExample {
    public static void main(String[] args) {
        List<String> a = new ArrayList<String>();
        List<String> b = a; // b & a share the List
        a.add("Hello, world!");
        System.out.println(b);
        // Prints "Hello, world!"
    }
}
```

Mutation of shared object

Java Heap:



Static versus non-static

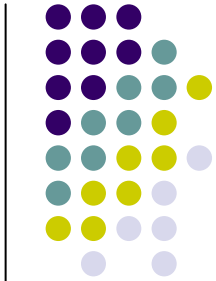


- Fields and methods may be declared “static”
- Static members belong to the class
- Non-static members belong to instances of the class

Non-static fields

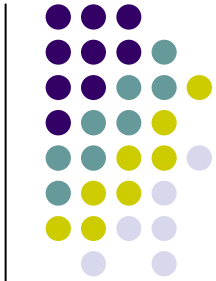
```
public class Bean {
    public int beanCounter = 0;
    public Bean() {
        beanCounter++;
    }

    public static void main(String[] args) {
        new Bean(); new Bean();
        Bean bean = new Bean();
        System.out.println(bean.beanCounter);
        // Prints “1”
    }
}
```

Static fields



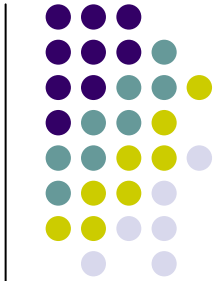
```
public class Bean {
    public static int beanCounter = 0;
    public Bean() {
        beanCounter++;
    }

    public static void main(String[] args) {
        new Bean(); new Bean(); new Bean();
        System.out.println(Bean.beanCounter);
        // Prints “3”
    }
}
```

Non-static methods



```
public class Bean {
    private boolean planted = false;
    public void plantBean() {
        planted = true;
    }

    public static void main(String[] args) {
        Bean bean = new Bean();
        bean.plantBean();        // Invoked on instance
    }
}
```

Static methods



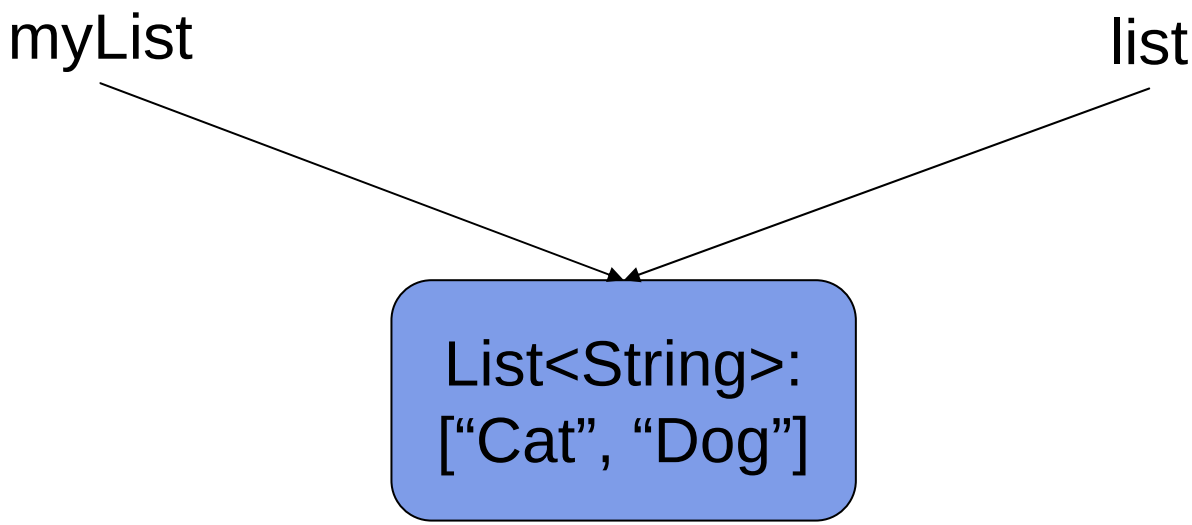
```
public class Bean {
    private boolean planted = false;
    public static void plantBean(Bean bean) {
        bean.planted = true;
    }

    public static void main(String[] args) {
        Bean bean = new Bean();
        Bean.plantBean(bean); // Invoked on class
        // "bean.plantBean(bean);" legal but inadvisable!
    }
}
```

Objects passed by reference

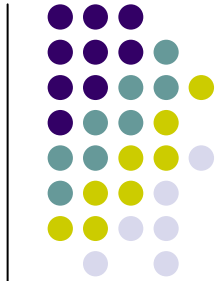
```
public static <T> void removeFirst(List<T> list) {
    list.remove(0);
}

public static void main(String[] args) {
    List<String> myList = new ArrayList<String>();
    myList.add("Cat"); myList.add("Dog");
    removeFirst(myList);
    System.out.println(myList);  // Prints "[Dog]"
}
```

Objects passed by reference

Java Heap:



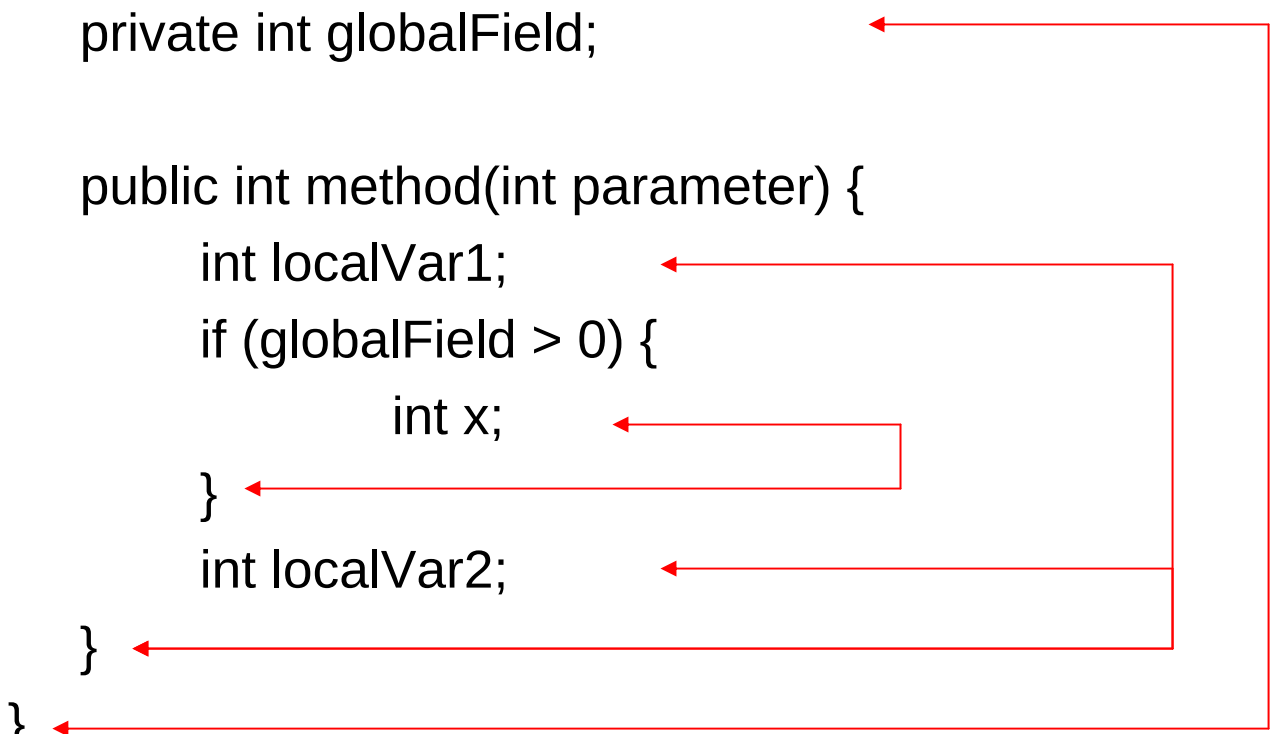
References have scope



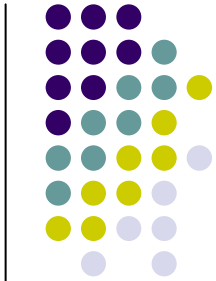
- Curly braces {…} define regions of scope
- References exist from the time they are declared until they “go out of scope”
- Fields may be referenced throughout class
- Parameters may be referenced throughout method

Examples of scope

```
public class ScopeExample {
    private int globalField;

    public int method(int parameter) {
        int localVar1;
        if (globalField > 0) {
            int x;
        }
        int localVar2;
    }
}
```

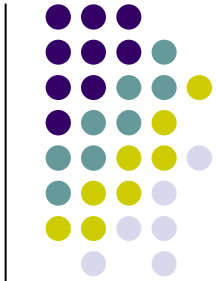


More examples of scope



```
public class ScopeExample {
    private int globalField;

    public int method(int parameter) {
        int globalField; // Legal, but hides field!
        int localVar;
        if (this.globalField > 0) { // Accesses field
            int x;
        }
        int localVar; // Illegal: same scope
    }
}
```

Quick Morals



- Assignment: References merely point to objects; beware of null pointers
- Static: Don’t invoke static methods on instances
- Pass by Reference: Make a *defensive copy* to avoid accidental mutation
- Scope: Minimize the scope of references as much as possible (e.g. don’t make everything global)