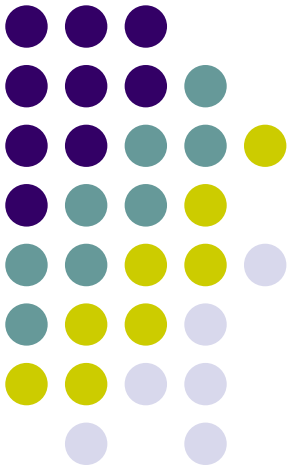
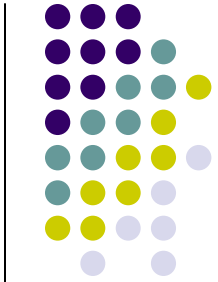
6.092: Thursday Lecture

Lucy Mendel
MIT EECS

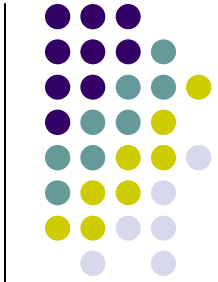


Topics



- Interfaces, abstract classes
- Exceptions
- Inner classes

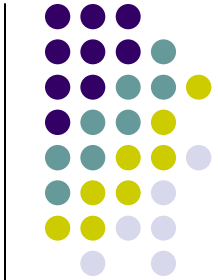
Abstract Classes



- Use when subclasses have some code in common

```
abstract class Person {
    private String name = “”;
    public String getName() { return name; }
    public void setName(String n) { name=n; }
    abstract public String sayGreeting();
}
class EnglishPerson extends Person {
    public String sayGreeting() { return "Hello"; }
}
```

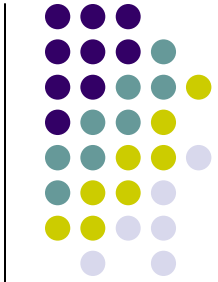
Interfaces



- Use to make distinct or unknown or unspecified components **plug-and-play**

```
public interface Dragable {
    public void drag();
}
public class Icon implements Dragable {
    public void drag() { … }
}
Public class Chair implements Dragable {
    public void drag() { … }
}
```

Another reason to use Interfaces



```
Public abstract class Cowboy {
    /*kill something*/
    public void draw() {…}
}

Public abstract class Curtain {
     /*let in sunshine*/
    public void draw() {…}
}
```

Cowboy Curtain

```
public class CowboyCurtain extends
                                    Cowboy, Curtain {
    …
}
```

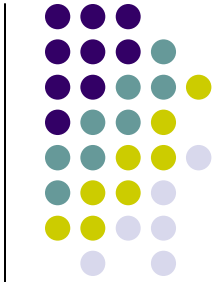
```
CowboyCurtain cowboy = new CowboyCurtain();
Cowboy.draw();
// does it get brighter or does something die?
```

Multiple implements, single extends

```
interface Drawable {
    public void draw();
}

interface Clickable {
    public void click();
}

interface Draggable {
    public void drag();
}
```

```
class Icon implements
Drawable, Clickable, Draggable {

    public void draw() {
        SOP("drawing..."); }
    public void click() {
        SOP("clicking..."); }
    public void drag() {
        SOP("dragging..."); }
}
```

Subtyping



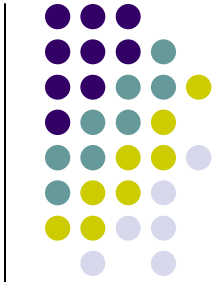
```
class Square {
    public int width;
}
class Rectangle {
    public int width,height;
}
…
int calculateArea (Square x) {
    return (x.width)*(x.width); }
int calculateCircumference (Rectangle x) {
    return 2*(x.width+x.height); }
```

Should:

Square extend Rectangle?

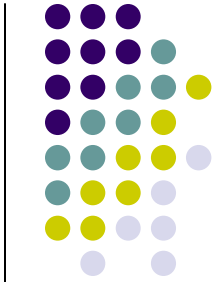
Rectangle extend Square?

Rectangle extends Square



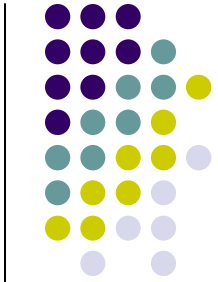
```
class Square {
    public int width;
    Square( int x ) {  width = x; }
}
class Rectangle extends Square {
    public int height;
    Rectangle( int width, int height ) {
            super(width);
            this.height = height; }
}
…
Rectangle rect = new Rectangle( 2, 3 );
calculateArea( rect ) ;       // returns 4, not 6 !
```

Square extends Rectangle



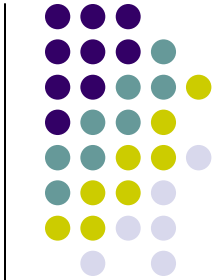
```
class Rectangle {
    public int width, height;
}
class Square extends Rectangle {
     public int side;
}
…
Square square = new Square( 3 );
calculateCircumference( sq ) ; // w.t.f. no height!
```

Square extends Rectangle



```
class Rectangle {
    public int width, height;
    Rectangle( int width, int height ) {
          this.width = width; this.height = height; }
}
class Square extends Rectangle {
     Square( int x ) {  super( x, x ); }
}
…
Square square = new Square( 3 );
calculateCircumference( sq ) ; // 12, ok
```

True Subtyping



- Inheritance (extending classes) re-uses code
- A true subtype will behave the right way when used by code expecting its supertype.

```
class B {
   Bicycle myMethod(Bicycle arg) {…}
}
class A {
   RacingBicycle myMethod(Vehicle arg) {…}
}
```

Composite

- Contain a class, rather than extend it

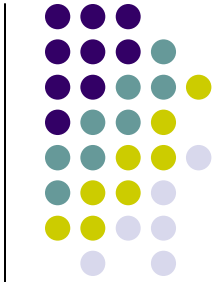
```
class ListSet {  // might want to implement Set
   private List myList = new ArrayList();
   void add(Object o) {
        if (!myList.contains(o)) myList.add(o);
   }
…
```

Exceptions

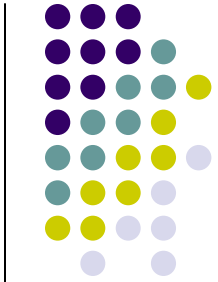
- Goal: help programmers report and handle errors
- What happens when an exception is thrown?
  - Normal program control flow halts
  - Runtime environment searches for handler:

```
try {
    statement(s) that might throw exception
} catch (exceptiontypeA name) {
    handle or report exceptiontypeA
} catch (exceptiontypeB name) {
    handle or report exceptiontypeB
} finally {
    clean-up statement(s)
}
```

Exceptions

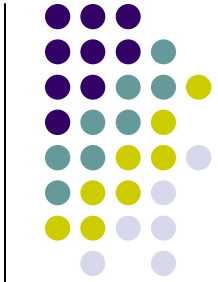


Exception Catching



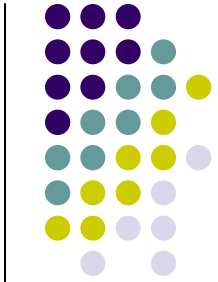
```
class Editor {
    public boolean openFile( String filename ) {
        try {
            boolean fileOpen = true;
            File f = new File(filename);
            // do stuff with f
            return true;
        } catch (FileNotFoundException e) {
            e.printStackTrace();
            return false;
        } finally {
            fileOpen = false;
        }
        System.out.println(“ bar “);
    }
}
```

Exception Throwing



```
public class File {
    public File(String filename) throws
    FileNotFoundException {
        …
        if ( can't find file ) {
            throw new FileNotFoundException();
        }
    }
}
```

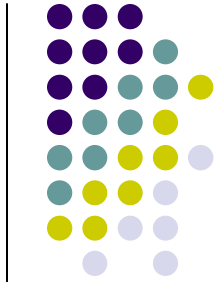
Nested (or Inner) Classes



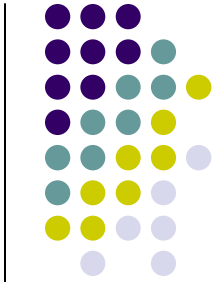
```
class EnclosingClass {
    ...
    class ANestedClass {
        ...
    }
    …
}
```

Why use nested classes?

Nested Classes



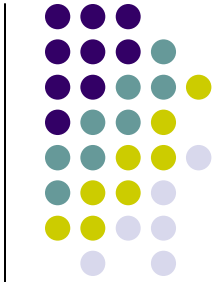
Nested Class Properties



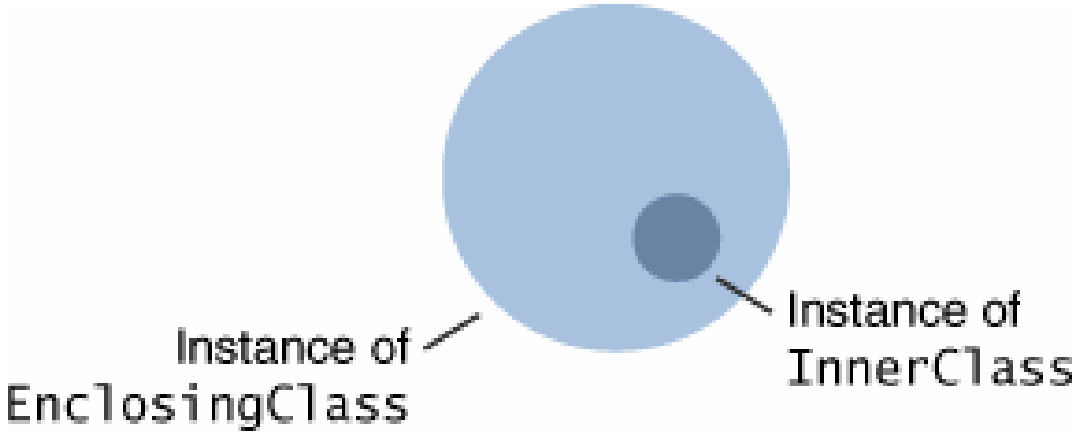
- Have access to **all** members of the enclosing class, even private members
- can be declared **static** (and final, abstract)
- Non-static (or instance) nested classes are called **inner classes**

```
class EnclosingClass {
    static class StaticNestedClass { ... }
    class InnerClass { … }
}
```

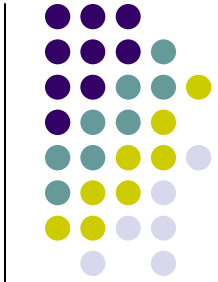
Inner Classes (non-static nested classes)



- Associated with an instance of the enclosing class
  - Cannot declare static members
  - Can only be instantiated within context of enclosing class

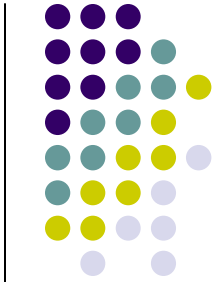


Local Anonymous Inner Class



```
public class Stack {
    private ArrayList items;
    public Iterator iterator() {
        private class StackIterator implements Iterator {
            int currentItem = items.size() - 1;
            public boolean hasNext() { ... }
            public ArrayList<Object> next() { ... }
            public void remove() { ... }
        }
        return new StackIterator();
    }
    /* or declare here */
}
```

Anonymous Inner Class



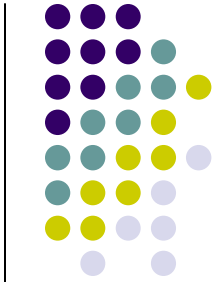
```
public class Stack {
    private ArrayList items;
    public Iterator iterator() {
        return new Iterator() {
            int currentItem = items.size() - 1;
            public boolean hasNext() { ... }
            public ArrayList<Object> next() { ... }
            public void remove() { ... }
        } ;
    }
}
```

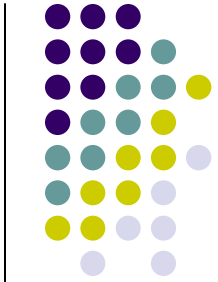
Floating Point Precision

```
System.out.println(1.00 - .42);
        // 0.6100000000000001
System.out.println(1.00 - 9*.10) ;
        // 0.09999999999999995
```

- BigDecimal
  - Pain of using Objects
- int or long
  - keep track of decimal yourself, eg, put money in terms of pennies

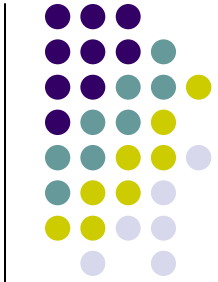
Defensive Programming





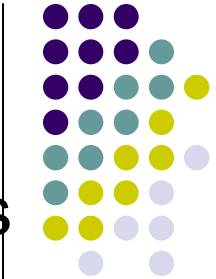
```
public class Man {
    private Wallet myWallet;
    public Money payPaperboy() {
        return myWallet.money;
    }
}
public class Paperboy {
    public Money payment;
    public void getPaid( Man m ) {
        payment += m.payPaperboy();
    }
}
```

Minimize Accessibility



```
public class Man {
    public Wallet myWallet;
}
public class Paperboy {
    public Money payment;
    public void getPaid( Man m ) {
        payment += m.myWallet.money;
    }
}
```

Keep field references unique



- Copy parameters before assigning them to fields
- Copy fields before returning them

```
public final class Period {
    private final Date start;
    private final Date end;
    public Period(Date satrt, Date end) {
            if (start.compareTo(end) > 0)
                    throw new IllegalArgumentException(start
                    + " after " + end);
            this.start = start;
            this.end = end;
    }
    public Date start() { return start; }
    public Date end() { return end; }
}
```