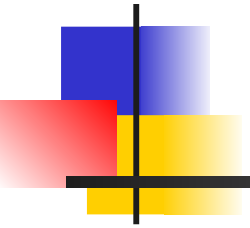


Abstract Classes

Jim Brucker

What is an Abstract Method?

An *abstract method* is a method declaration without a method body.

An abstract method specifies behavior but no implementation.

Example: In the Number class, `intValue`, `longValue`, ... are abstract.

```
public abstract int intValue( ) ;

public abstract long longValue( ) ;
```

Methods declared to be **`abstract`** along with other qualifiers (public, int, "throws ...").

Use semi-colon to end the method declaration.

Interface Methods are Abstract

All the methods in an interface are abstract:

```
public interface Valuable {
   public int getValue( );
}
```

is the same as:

```
public interface Valuable {
   public abstract int getValue( );
}
```

Class with Abstract Method

A class can have abstract methods.

Example:

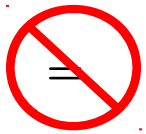
In the `Number` class, `intValue()`, `longValue()`, etc. are abstract

```
public abstract class Number {

  public abstract int intValue( ) ;
  public abstract long longValue( ) ;
```

Abstract Classes

A class with any abstract methods is an abstract class.

Abstract classes *cannot be instantiated* since they lack definitions for the abstract methods.

Example: `Number num`  `new Number( );`

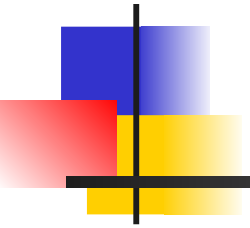
```
public abstract class Number {

   public abstract int intValue( ) ;
   public abstract long longValue( ) ;
   ...etc...
   public byte byteValue() { // not abstract
      return (byte)intValue();
   }
```

What Can You Put in Abstract Class?

An abstract class can contain anything that a normal class can contain.

- ✓ static and instance attributes
- ✓ constructors
- ✓ concrete methods and abstract methods
- ✓ implement interfaces and extend other classes

```
public abstract class Money {
   static final String CURRENCY = "Baht";
   public Money( ) { ... }
   public abstract int getValue( );
   // not abstract
   public int compareTo(Money m) { ... }
```



Why Use Abstract Classes?

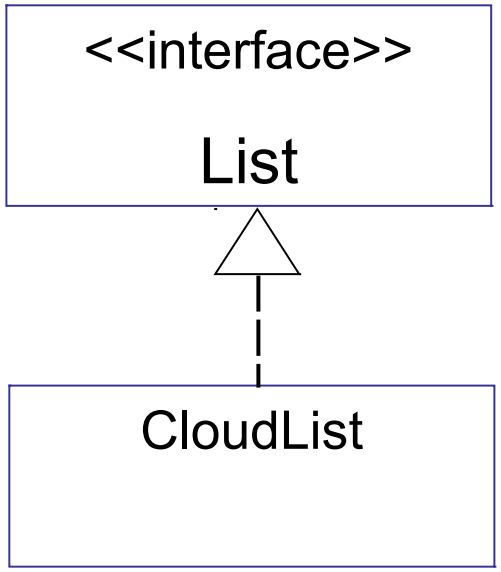
So you don't have to sleep at the office.

Assignment: Write a List

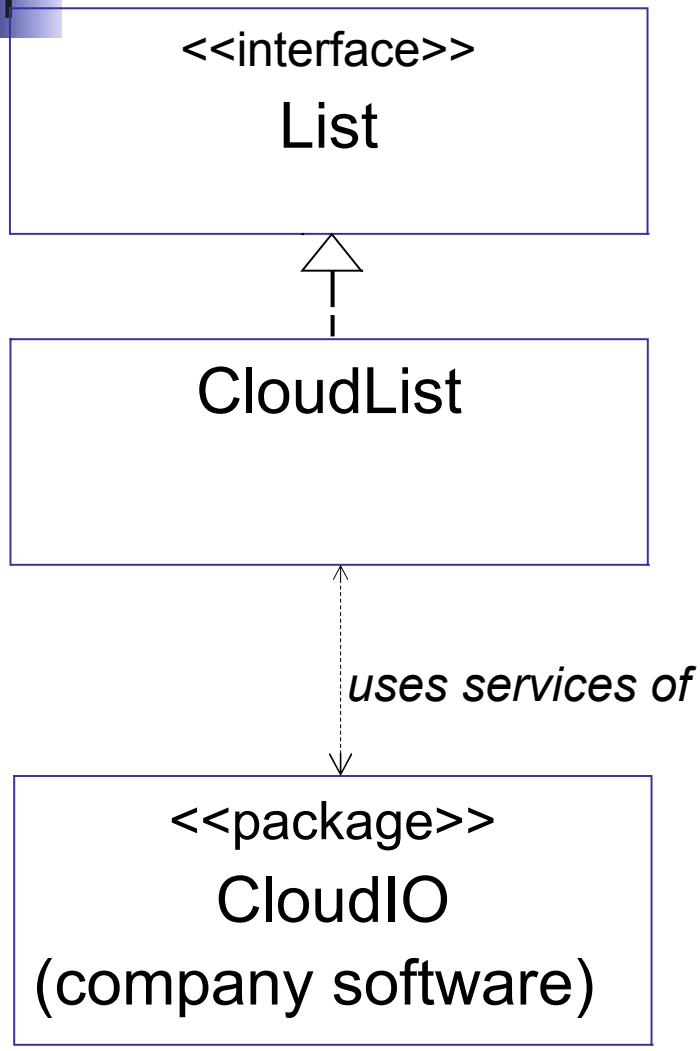
Your Boss: I want you to write a List that stores elements in the Cloud. Call it "CloudList".

You: *No problem.*

Your Boss: We need it *tomorrow*.



At work in your cubicle...



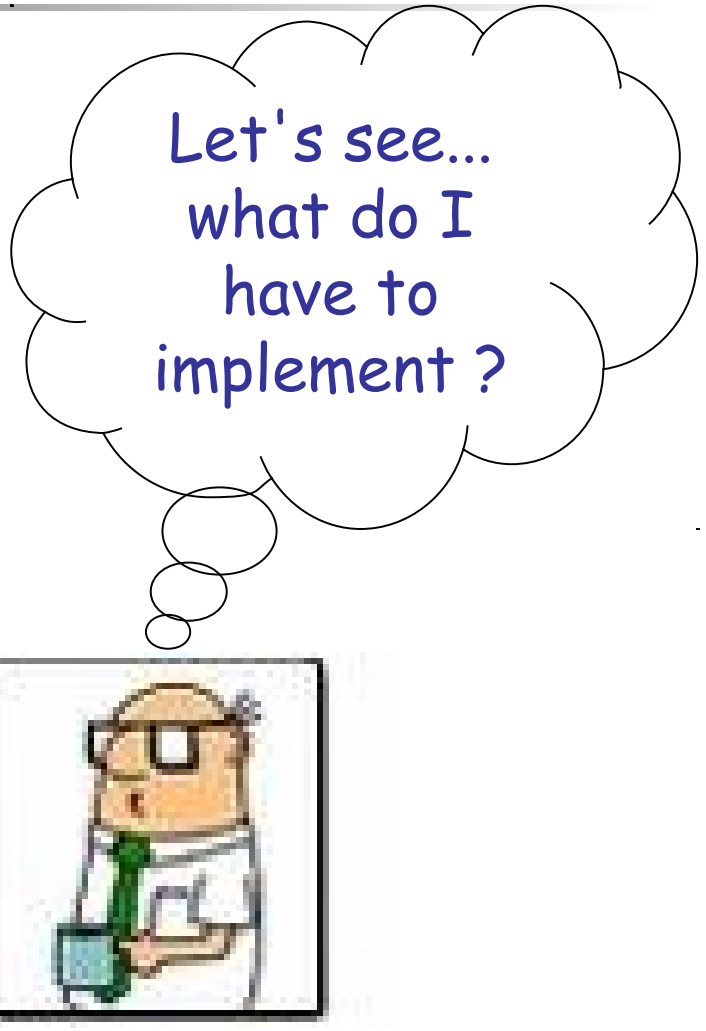
Open up the *List* API doc ...

<<interface>>

List

add(E): bool
add(int, E): void
addAll(Collection)
clear( )
contains(Object)
containsAll(Collection)
equals(Object): bool
get(int): E
hashCode( ): int
indexOf(Object)
isEmpty( )
iterator( ): Iterator<E>
lastIndexOf(Object)
remove(int): E
...

23 Methods



In Eclipse: create a class that implements List. You'll see this for yourself.

Mission IMPOSSIBLE

<<interface>>

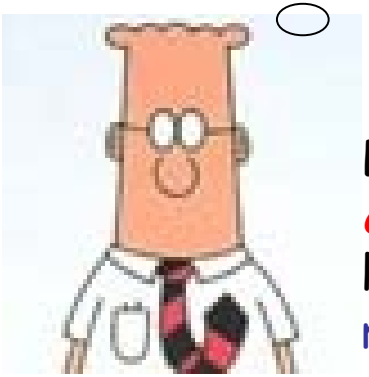
List

add(E): bool
add(int, E): void
addAll(Collection)
clear( )
contains(Object)
containsAll(Collection)
equals(Object): bool
get(int): E
hashCode( ): int
indexOf(Object)
isEmpty( )
iterator( ): Iterator<E>
lastIndexOf(Object)
remove(int): E
...

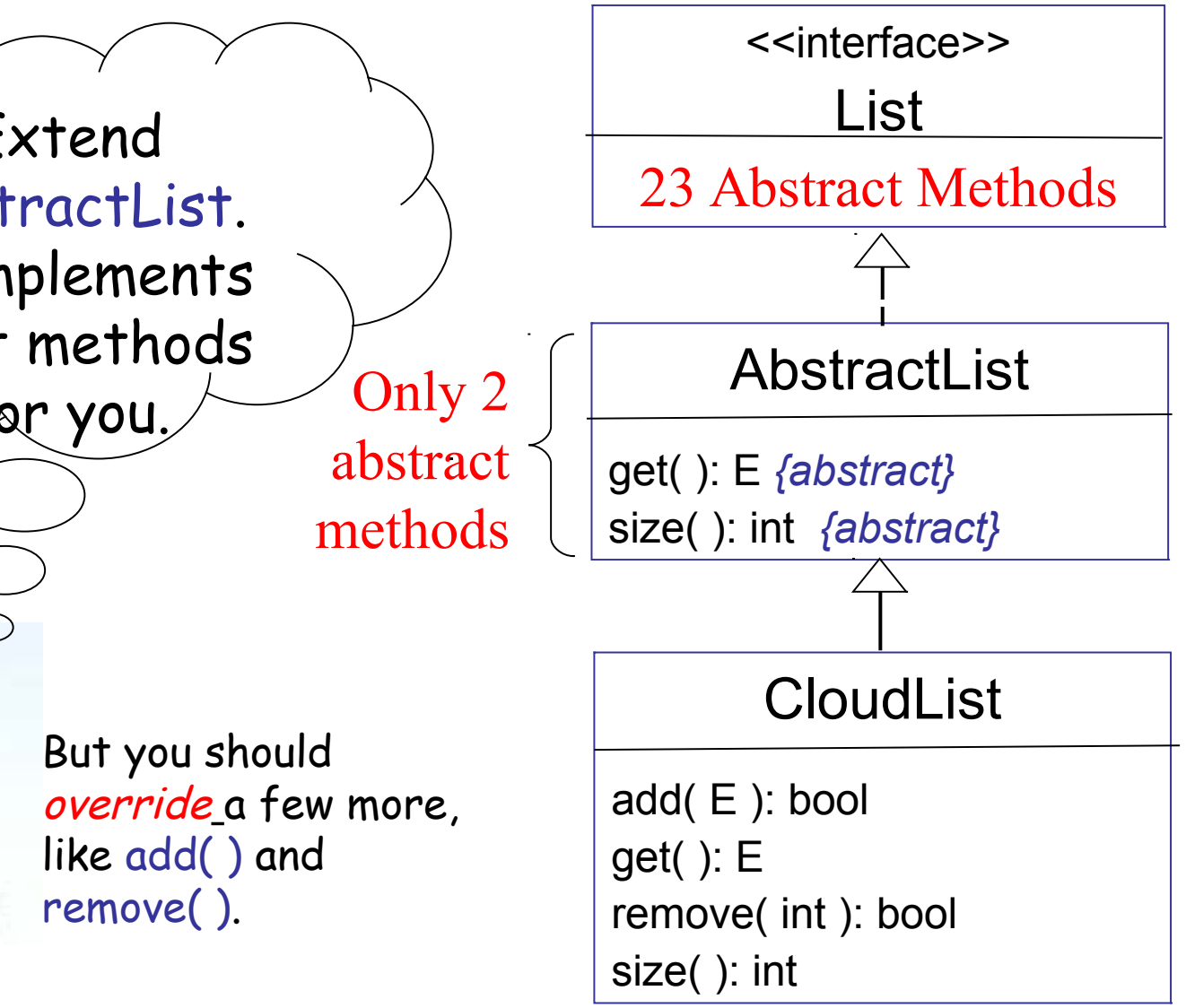
23 Methods

AbstractList to the Rescue

Extend AbstractList. It implements most methods for you.



But you should *override* a few more, like add( ) and remove( ).



Other Examples of Abstract Classes

An *interface* specifies required behavior.

An *abstract class* provides a skeleton or convenience class for implementing the interface.

Interface	Abstract Class that implements it...
MouseListener (5 methods)	*MouseInputAdapter* (0 abstract methods)
Set (15 methods)	*AbstractSet* (2 abstract methods)
Action (6 methods)	*AbstractAction* (1 abstract method)

Interface versus Abstract Class

Q: What is the advantage of using an interface instead of an Abstract Class to specify behavior?

```
abstract class AbstractFunction {
   /** function specification: no implementation */
   abstract public double f( double x ) ;
}
```

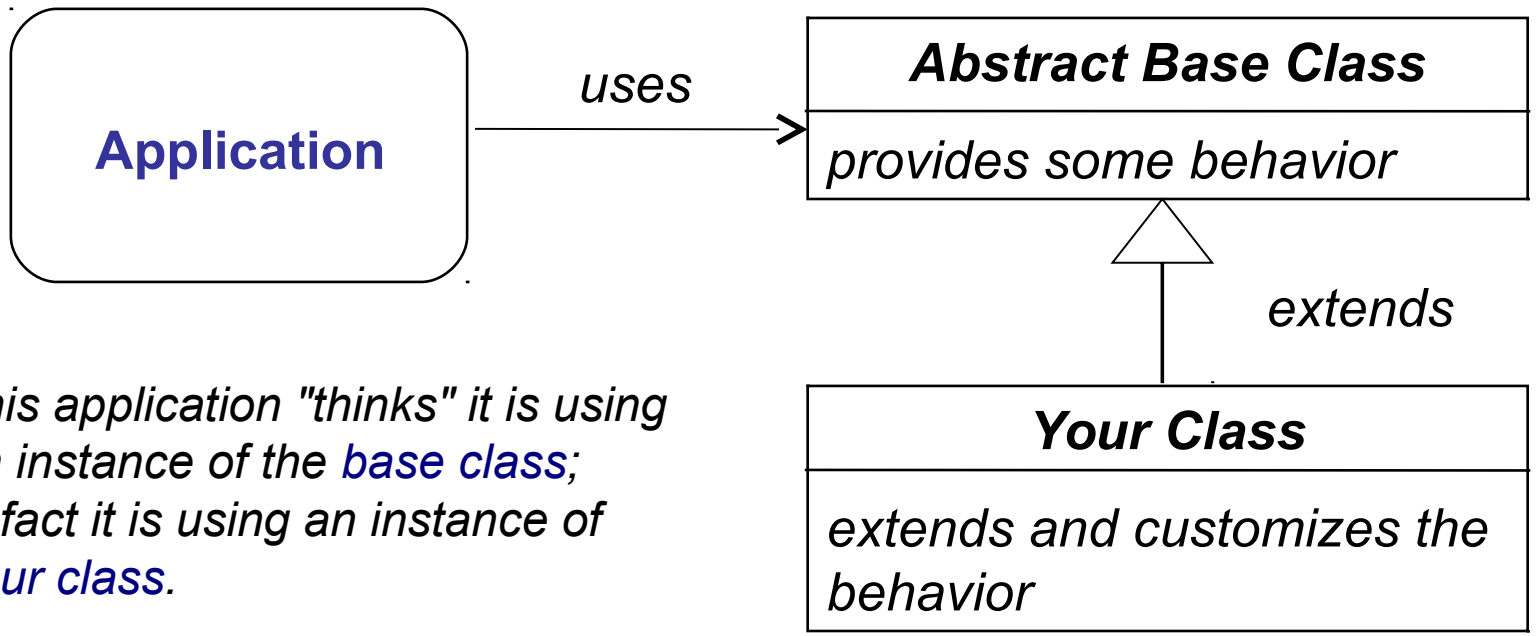
Abstract method does not have a body.

```
public class MyApplication extends AbstractFunction {
   /** implement the method */
   public double f( double x ) { return x/(x+1); }
   ...
}
```

Why Use Abstract Classes?

Many applications are designed to work with objects of many different classes.

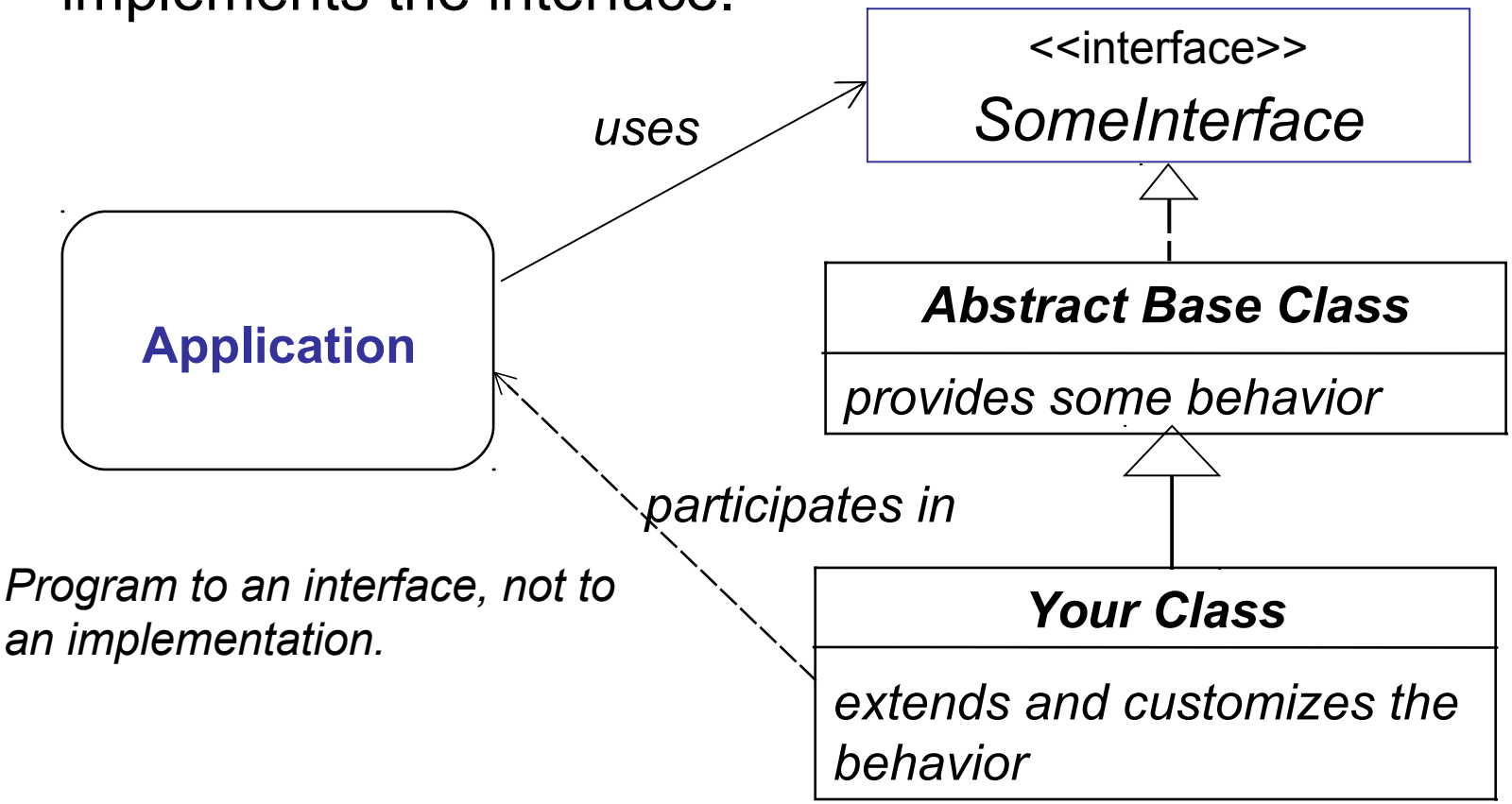
The application (or framework) accepts objects of the base class as parameter.



This application "thinks" it is using an instance of the base class; in fact it is using an instance of your class.

Depend on Interfaces

A more typical design is for application to depend on interfaces, but also provide abstract base class that implements the interface.



Program to an interface, not to an implementation.

Example of Abstract Classes

A Java GUI application is built using objects of a class named *java.awt.Component*.

- *Component* is an abstract base class
- real components (Buttons, Boxes, ...) are subclasses of *Component*
- Containers that manage components "think" that all components look & behave like *Component*.

```
//API: Container.add( Component c )
       container.add( new JButton("Press me") );
       container.add( new JLabel("Get a life.") );
       container.add( new JComboBox( array ) );
```

Swing & Abstract Classes

Each real component *extends* Component and overrides the behavior that it wants to *specialize*.

Benefit:

1) any Component can be put in any Container (like JPanel)

2) we can create our own component by *extending* Component. We don't need to rewrite most methods from Component.