Java Refresher
Part II

Alexandre Bergel
http://bergel.eu
07/08/2017

5 mn exercise

Define a class Point with three constructors

Define two methods:

- distFrom(Point)
- distFrom(x, y)

Put your name and your rut on your paper sheet

Goal of this lecture

Understand some important concepts related to *polymorphism* and *class inheritance*

See some *particularities* of Java

Note that we are not discussing about appropriate usage of inheritance. We will do this in the coming weeks

Outline

Defining Inheritance

- example in the JDK
- constructors
- abstract classes
- method overriding and overloading

Using class inheritance

We will pick an example from the standard Java class library

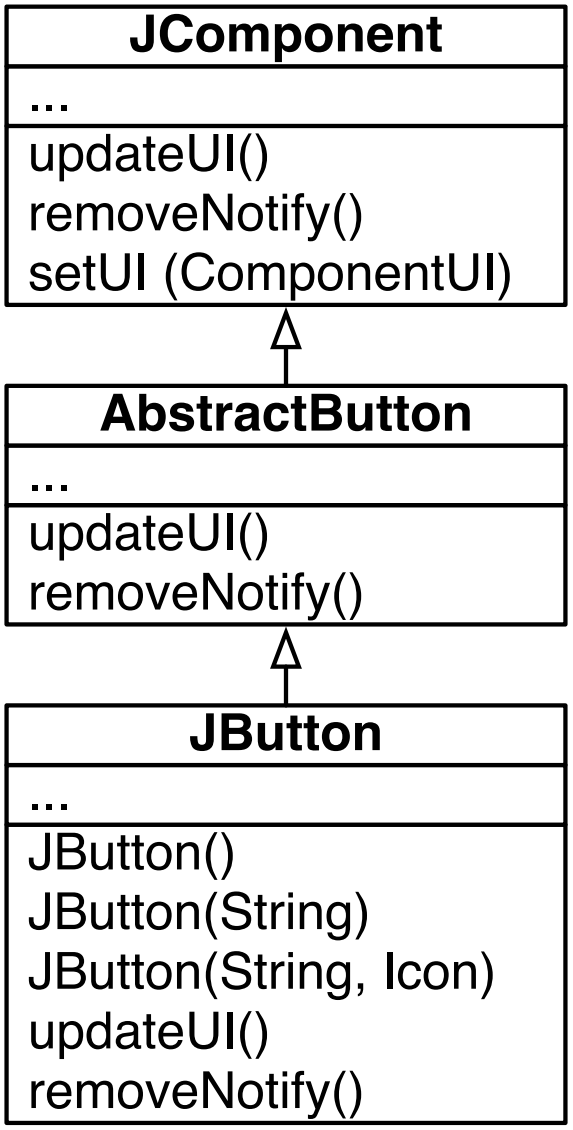
The class documentations are available online

http://docs.oracle.com/javase/8/docs/api/

Source code is freely available

Java is now open source

Example in the JDK 1.6

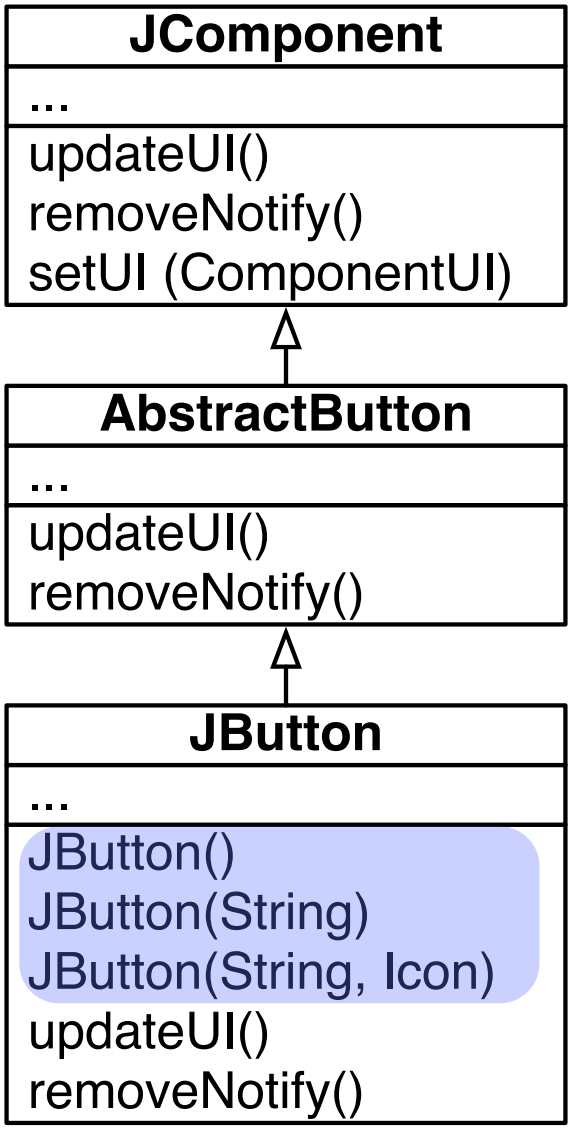


5471 LOC

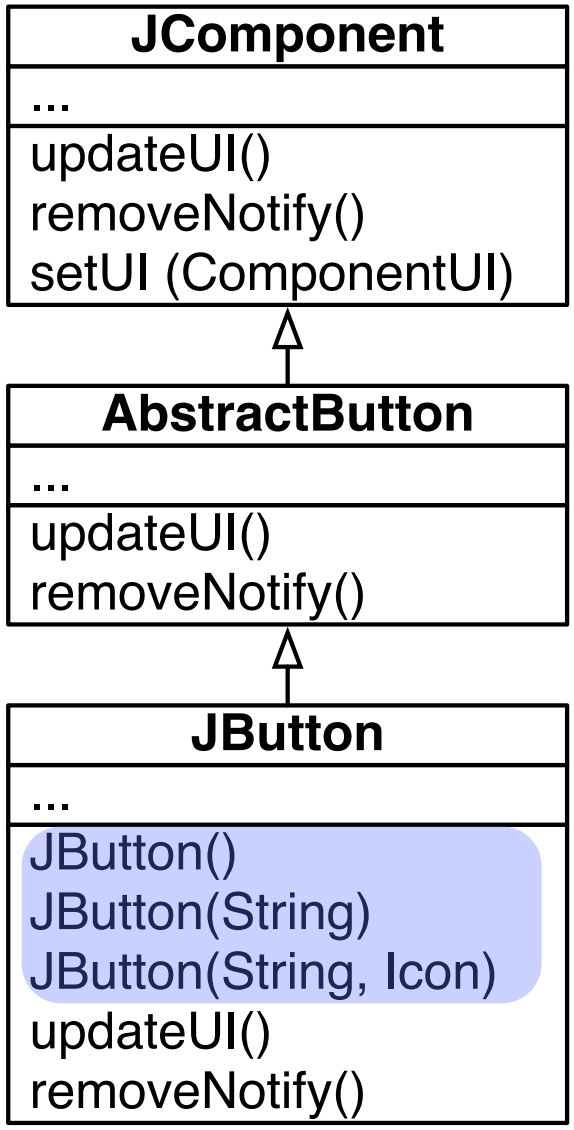
3079 LOC

305 LOC

Class constructor



Class constructor

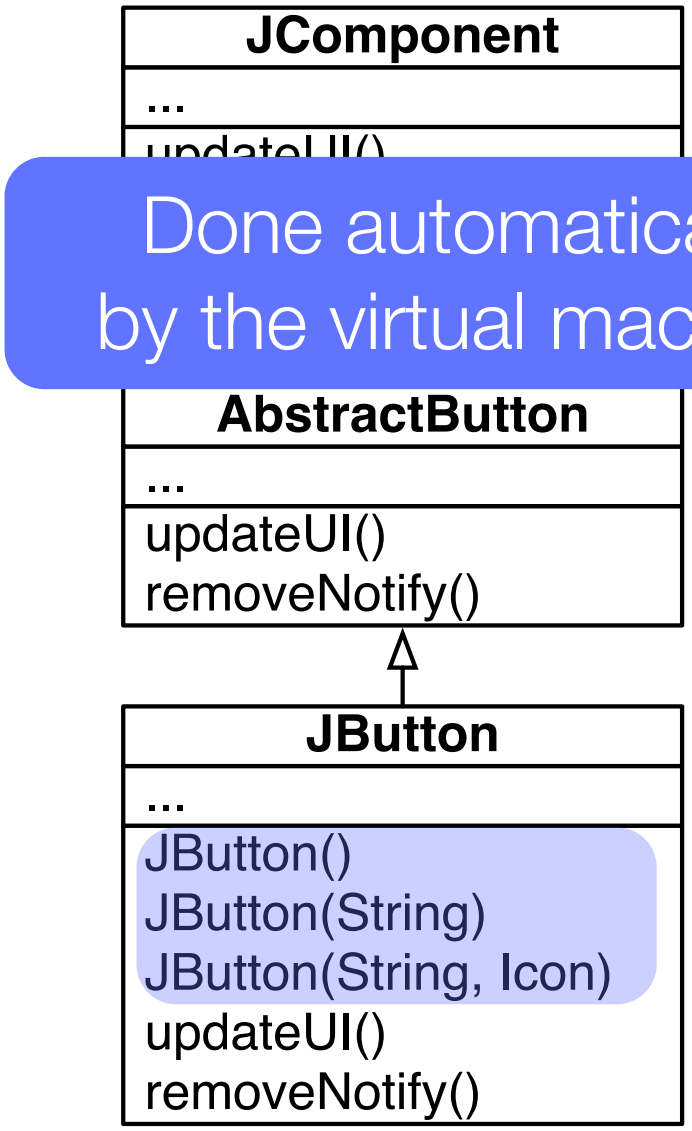


A constructor is responsible to properly initialize an object

When you write new JButton("OK"):
1 - the memory is allocated (object creation)
2 - the new object is initialized

Pay attention that having a construction does not mean your object will be well initialized.

Class constructor



constructor is responsible to properly initialize an object

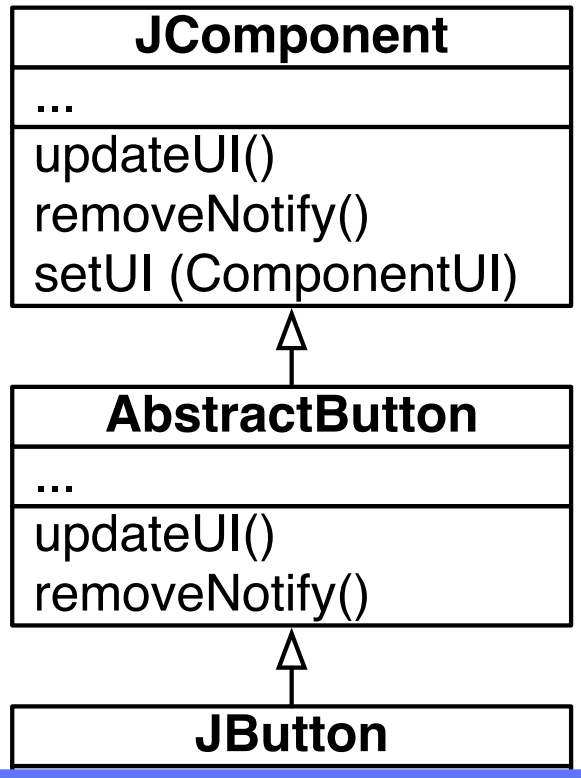
When you write new JButton("OK"):

1 - the memory is allocated (object creation)

2 - the new object is initialized

Pay attention that having a construction does not mean your object will be well initialized.

Class constructor



A constructor is responsible to properly initialize an object

When you write new JButton("OK"):

1 - the memory is allocated (object creation)

2 - the new object is initialized

Specified by the programmer (author of JButton and its superclasses)

ention that having a construction
ot mean your object will be well initialized.

Example of incomplete initialization

```
public class ColorPoint {
  private double x, y;
  private Color color;

  public ColorPoint(double xt, double yt) {
    x = xt; y = yt;
  }

  public void setColor(Color aColor) {
    color = aColor;
  }
}
```

Example of incomplete initialization

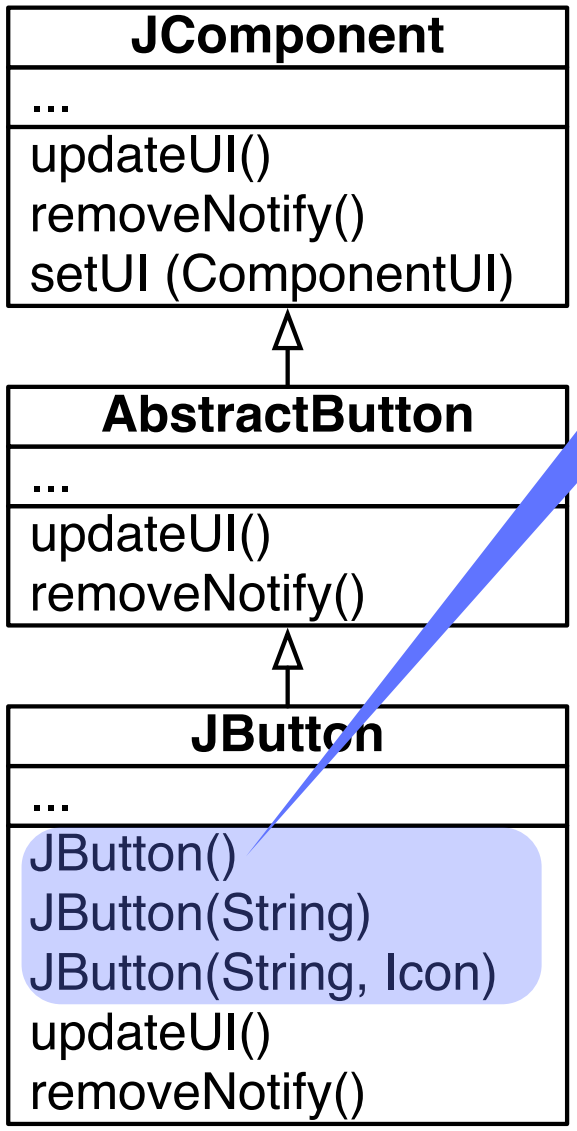
```
public class ColorPoint {
  private double x, y;
  private Color color;

  public ColorPoint(double xt, double yt) {
    x = xt; y = yt;
  }

  public void setColor(Color aColor) {
    color = aColor;
  }
}
```

What is the color of new ColorPoint(2, 3) ?
Should probably have a default color

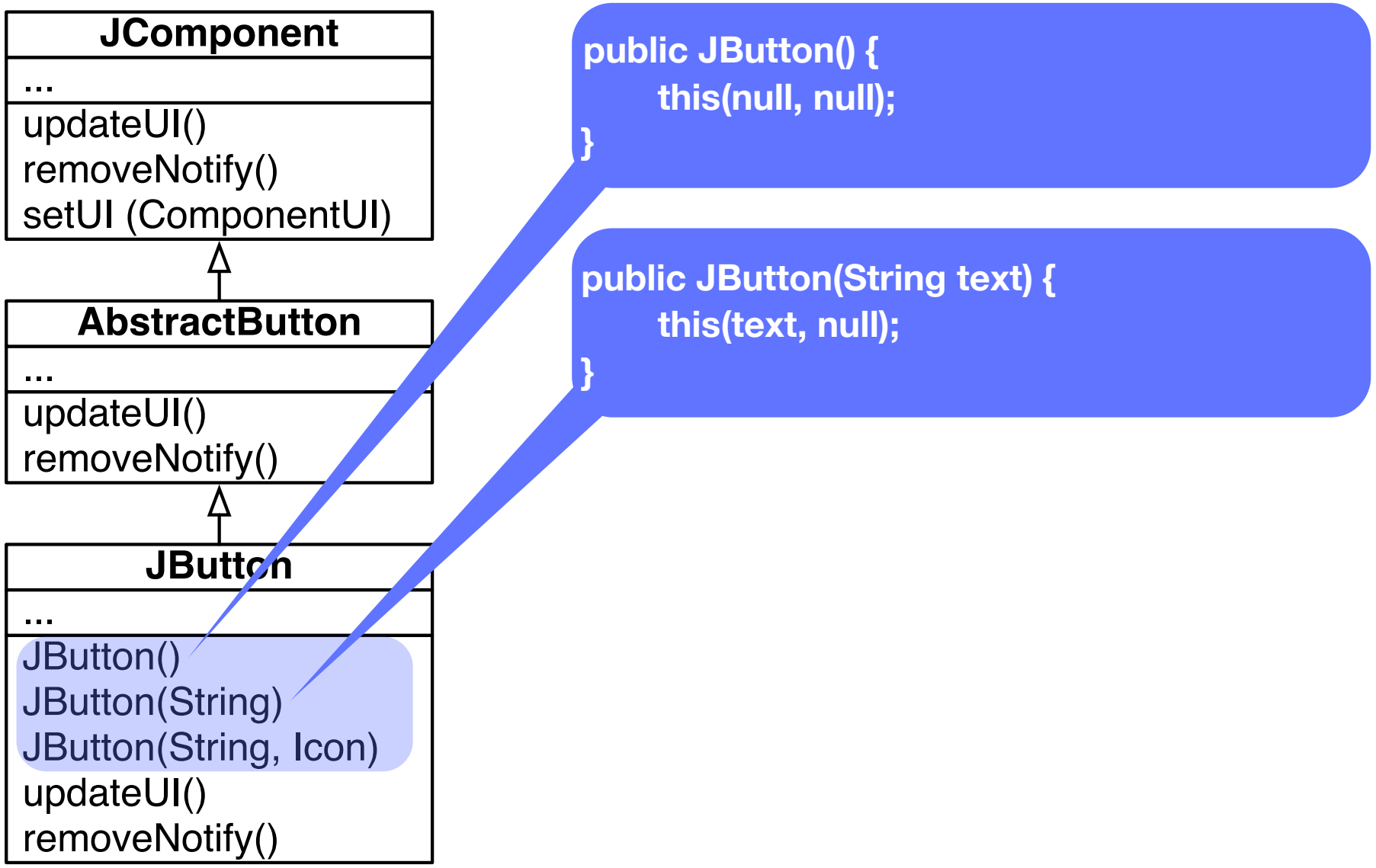
Class constructor



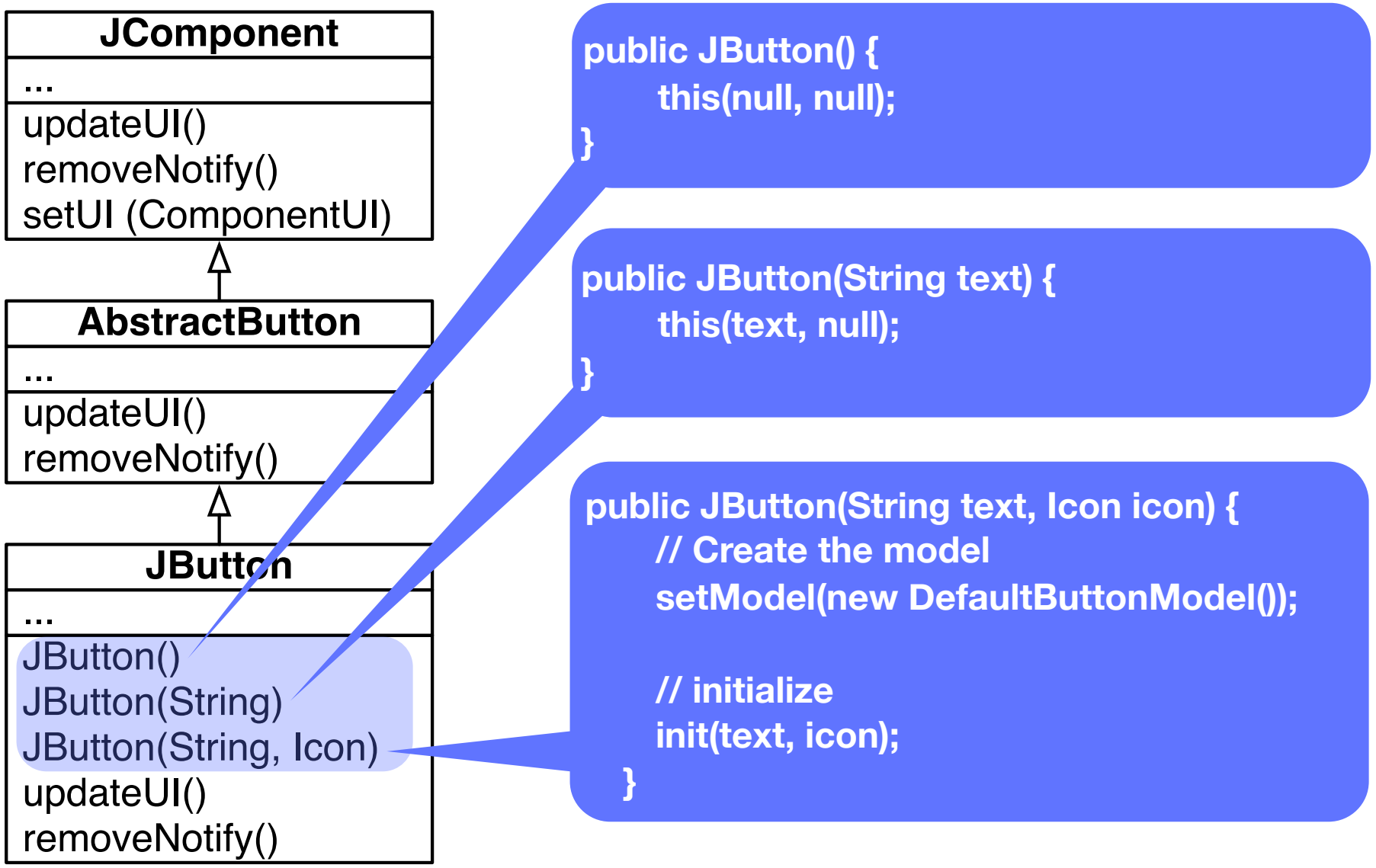

```
public JButton() {
        this(null, null);
}
```

Constructor may invoke each other. The keyword *this* is used for that purpose. Note that this "*this*", used in to invoke constructor, has nothing to do with the "this" pseudo variable we will later see.

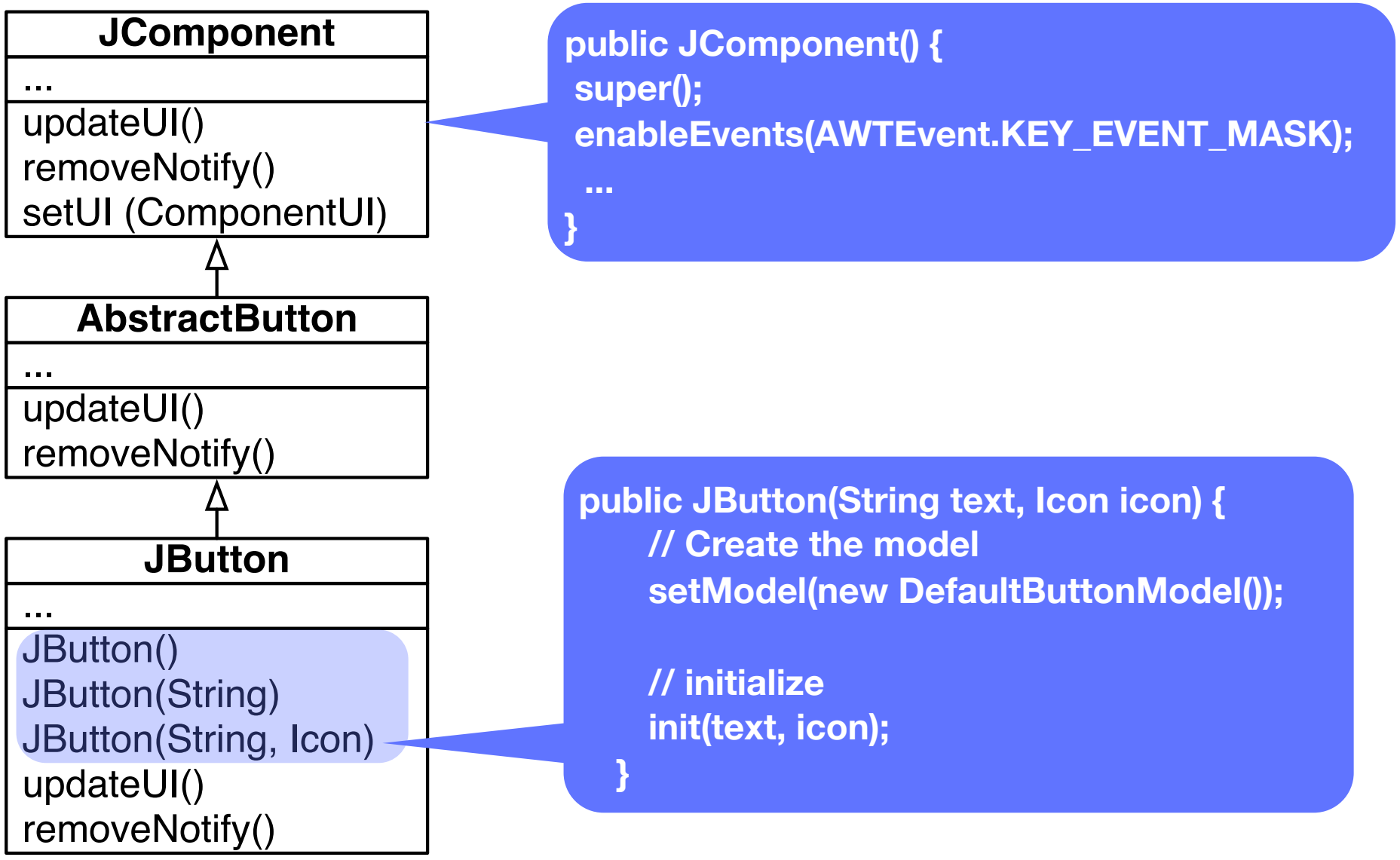
Class constructor



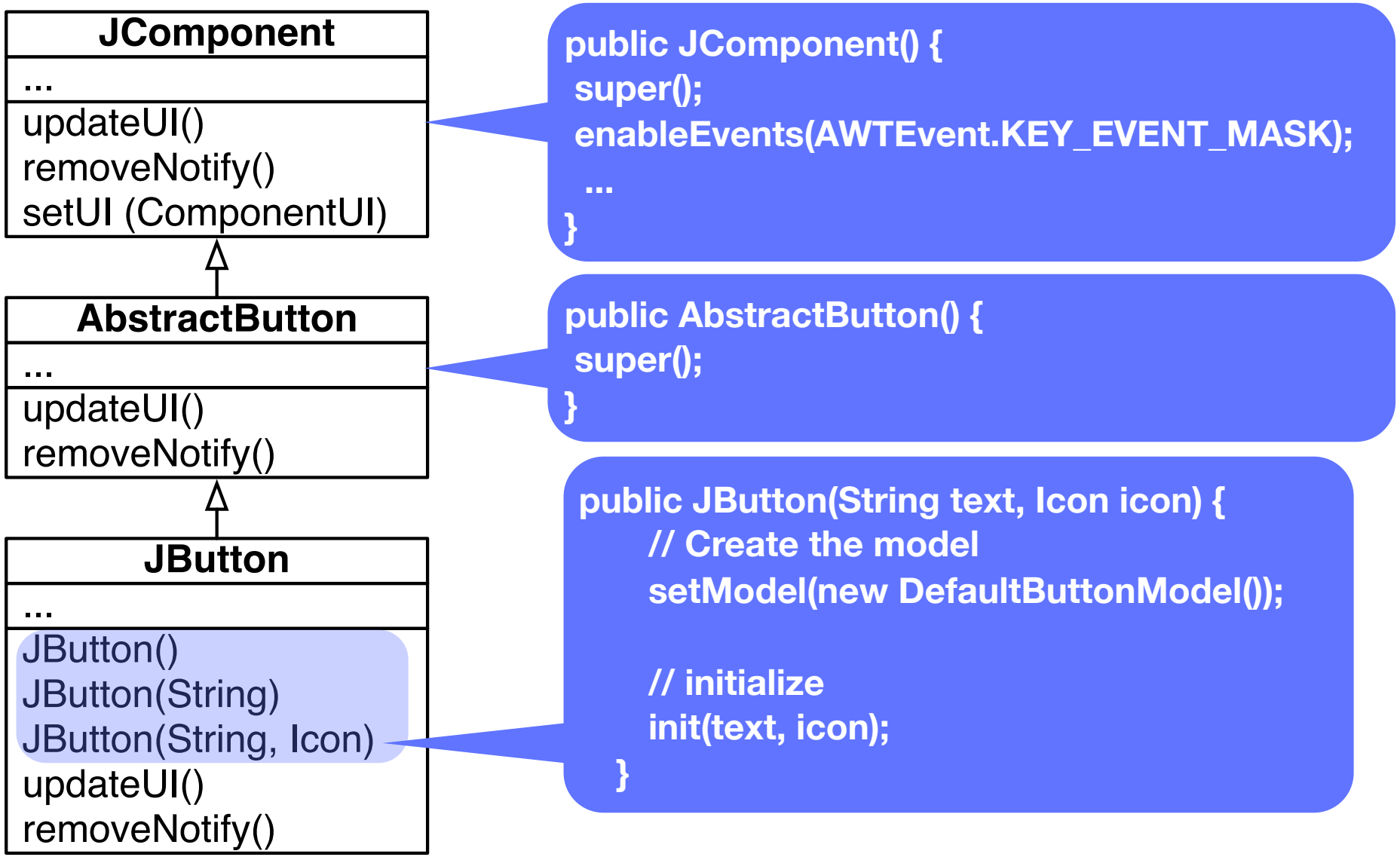
Class constructor



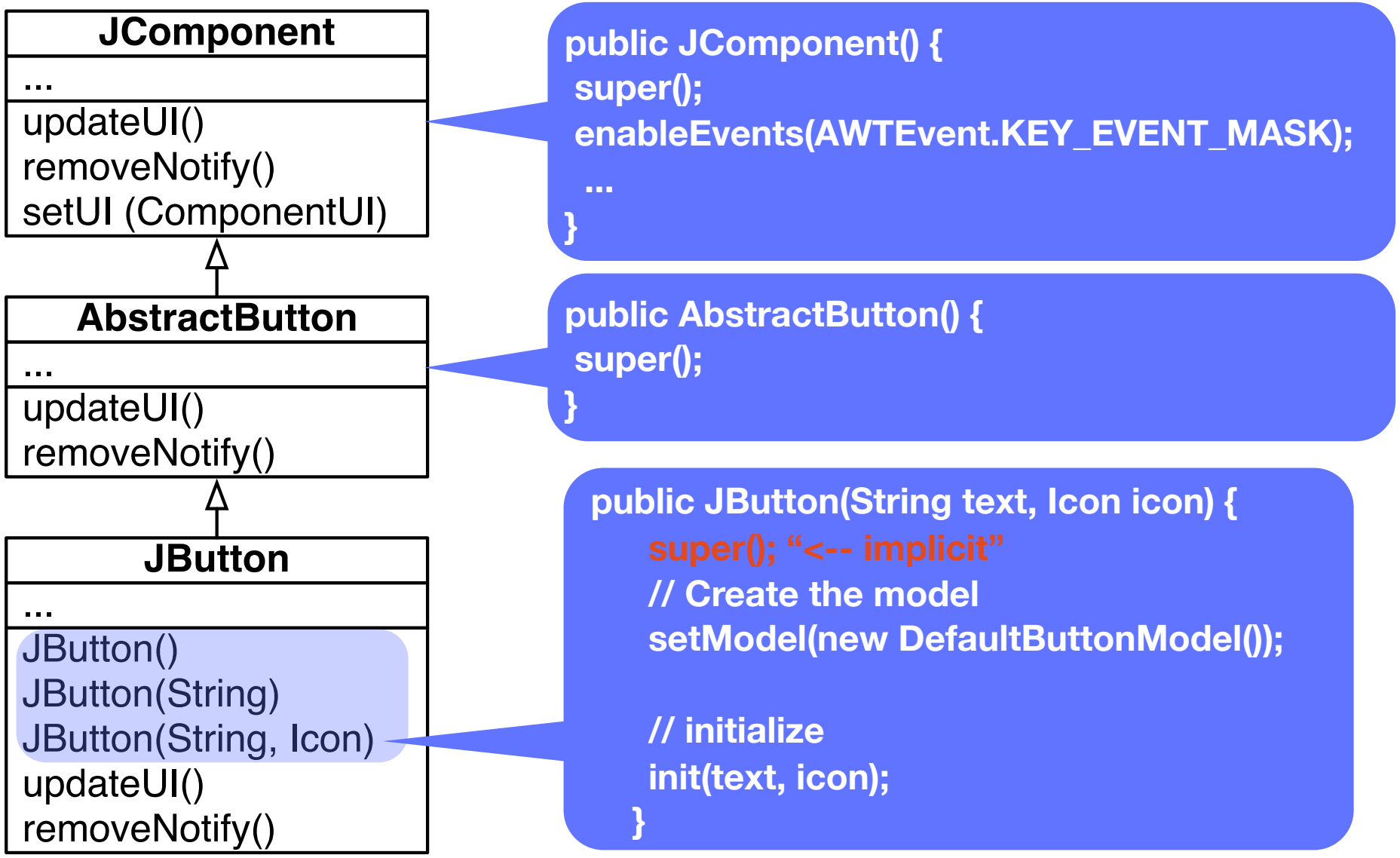
Class constructor



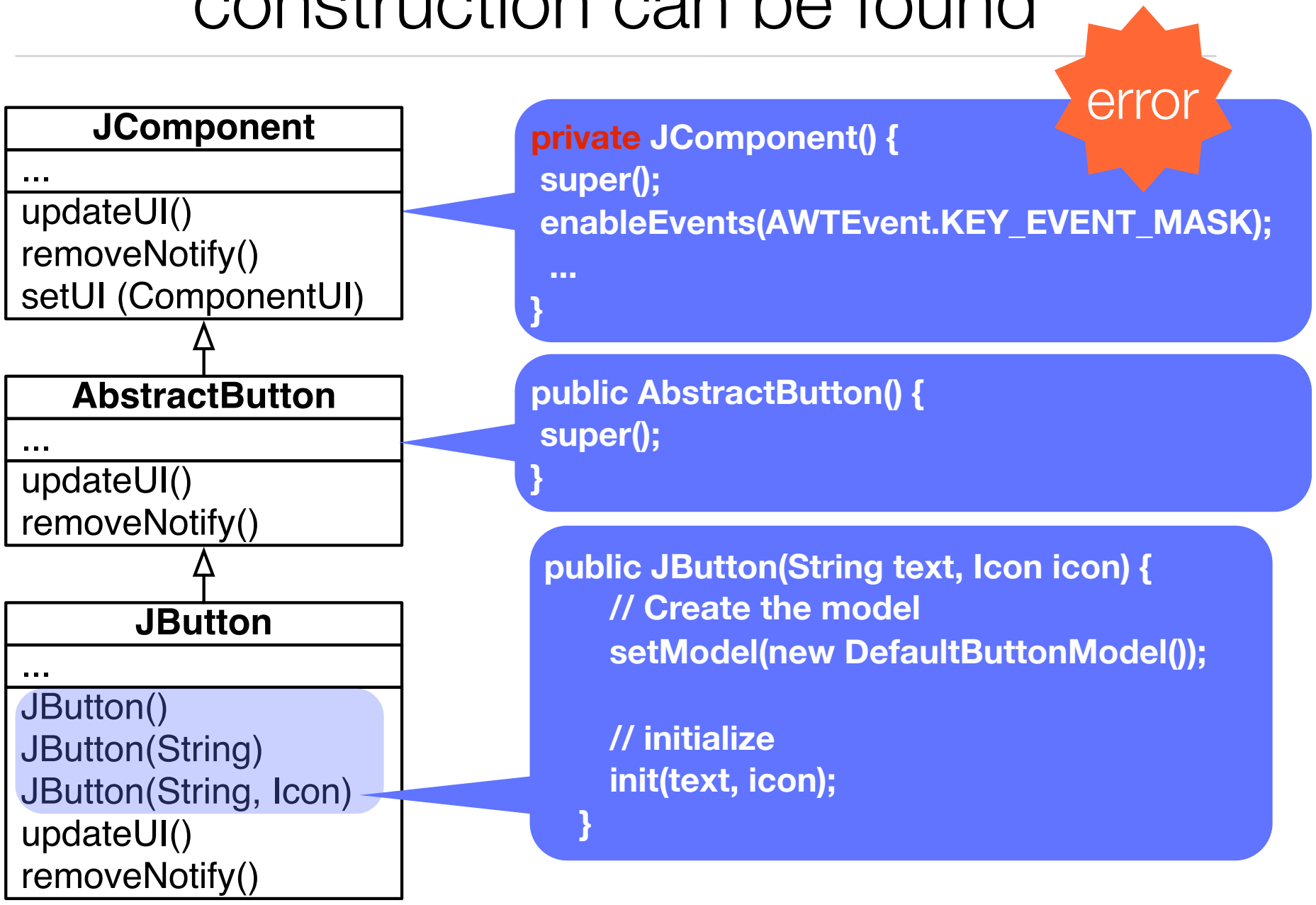
Class constructor



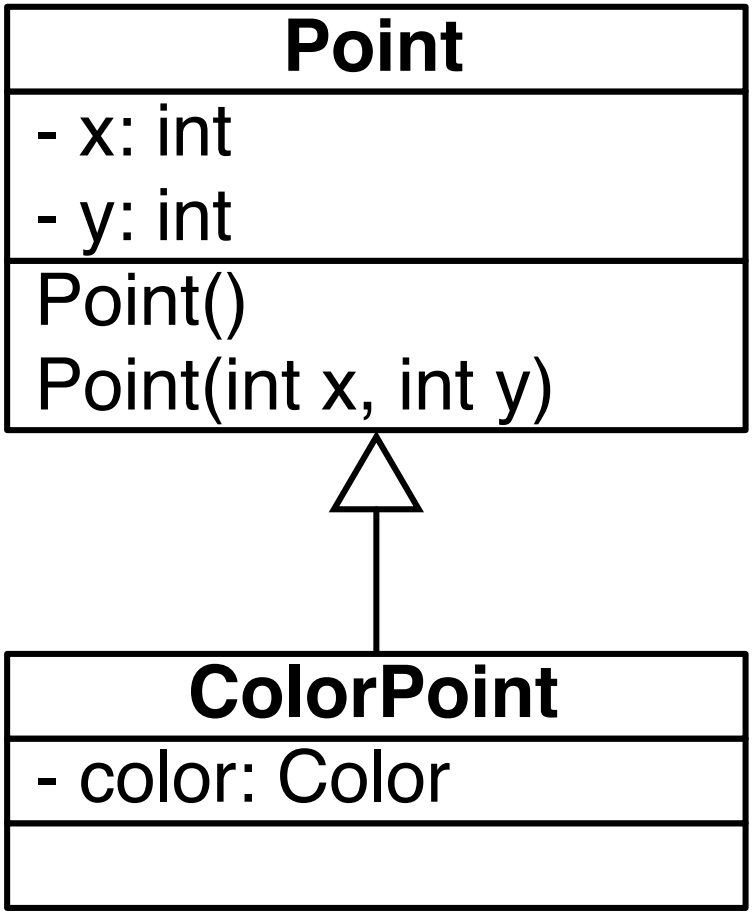
Superclass constructors are sequentially executed



Error at compilation if no parent construction can be found



Constructor are not inherited!

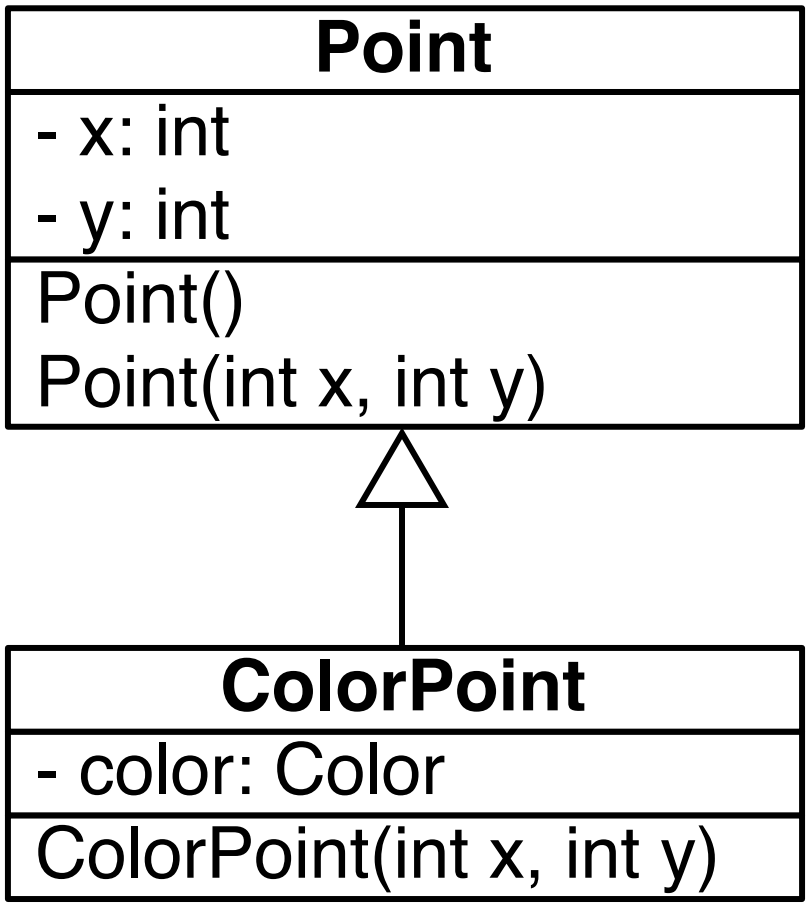



```
new Point()
new Point(2, 3)
=> Okay
```

```
new ColorPoint()
=> Okay (because of the
default constructor)
```

```
new ColorPoint(2, 3)
=> Does not compile
```

Missing default constructor

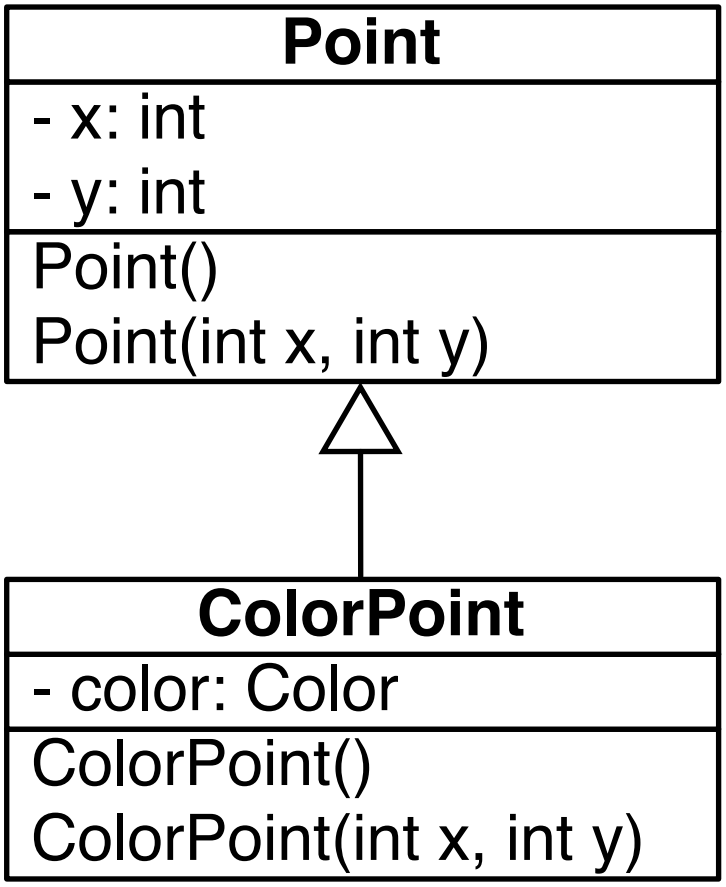



```
new Point()
new Point(2, 3)
=> Okay


new ColorPoint()
=> Does not compile
(because there is no
default constructor)

new ColorPoint(2, 3)
=> Okay
```

Missing default constructor

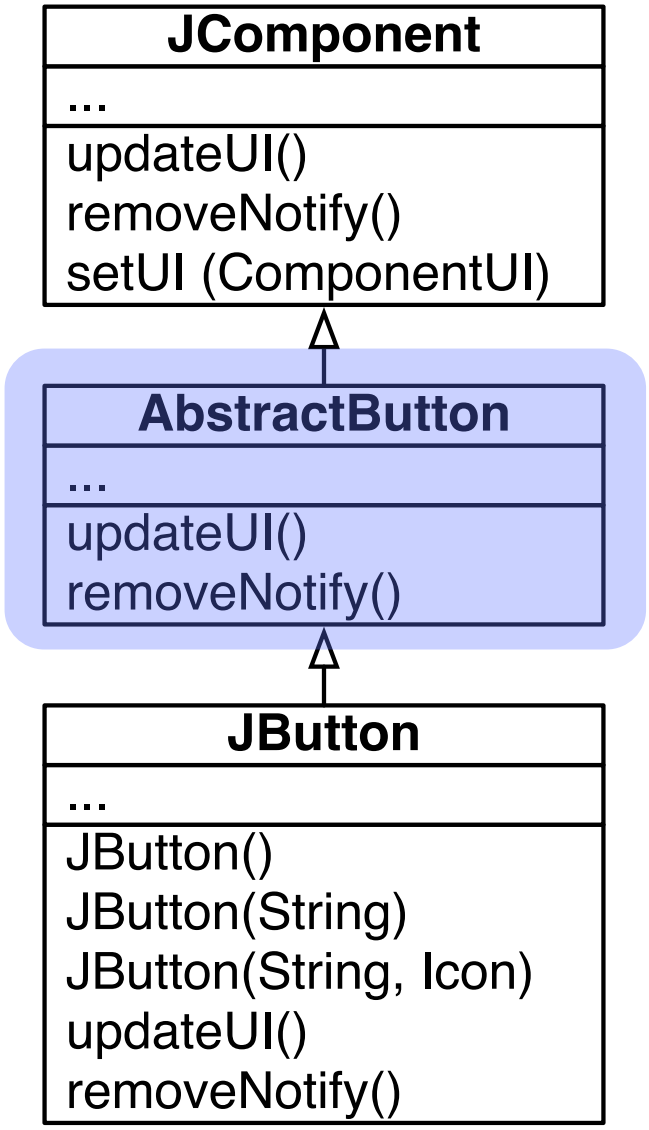



```
new Point()
new Point(2, 3)
=> Okay
```

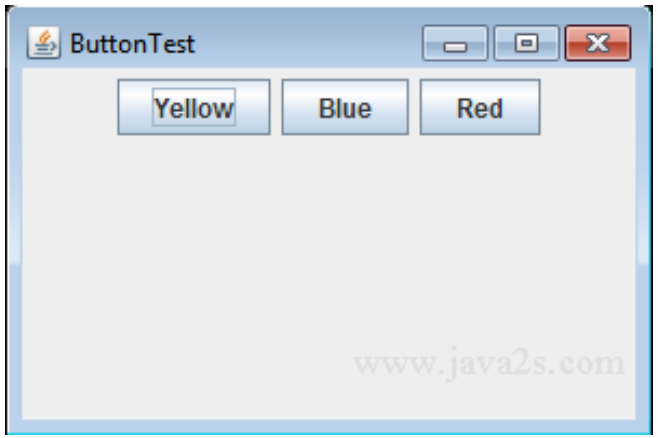
```
new ColorPoint()
=> Okay
```

```
new ColorPoint(2, 3)
=> Okay
```

Abstract class



AbstractButton is superclass of 3 classes:

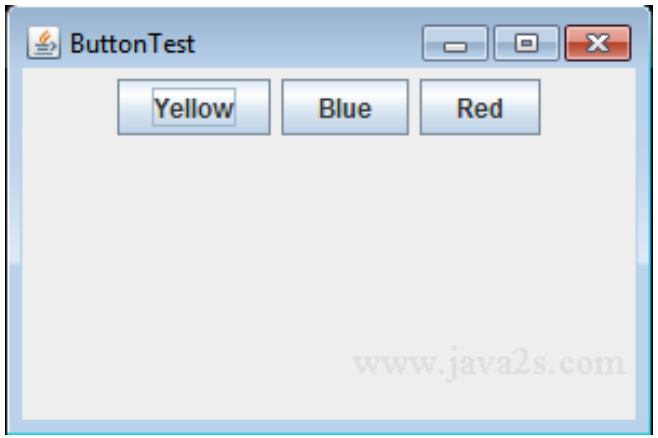


JButton

JMenuItem

JToggleButton

AbstractButton is superclass of 3 classes:



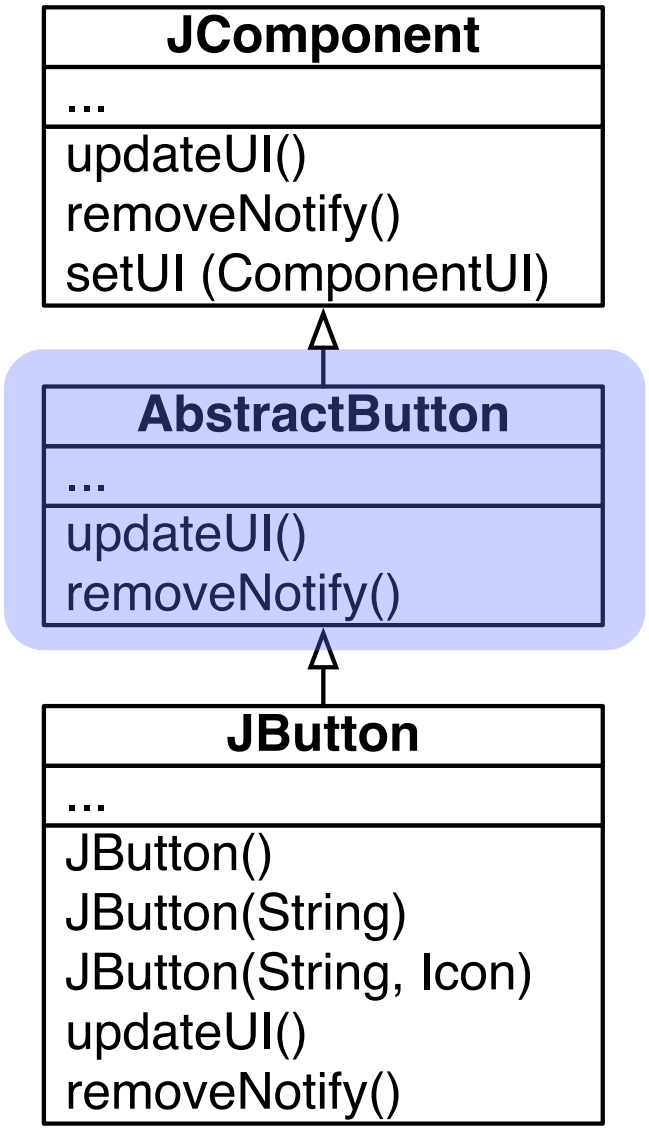
JButton

JMenuItem

AbstractButton is abstract, and each subclass specializes it

JToggleButton

Abstract class

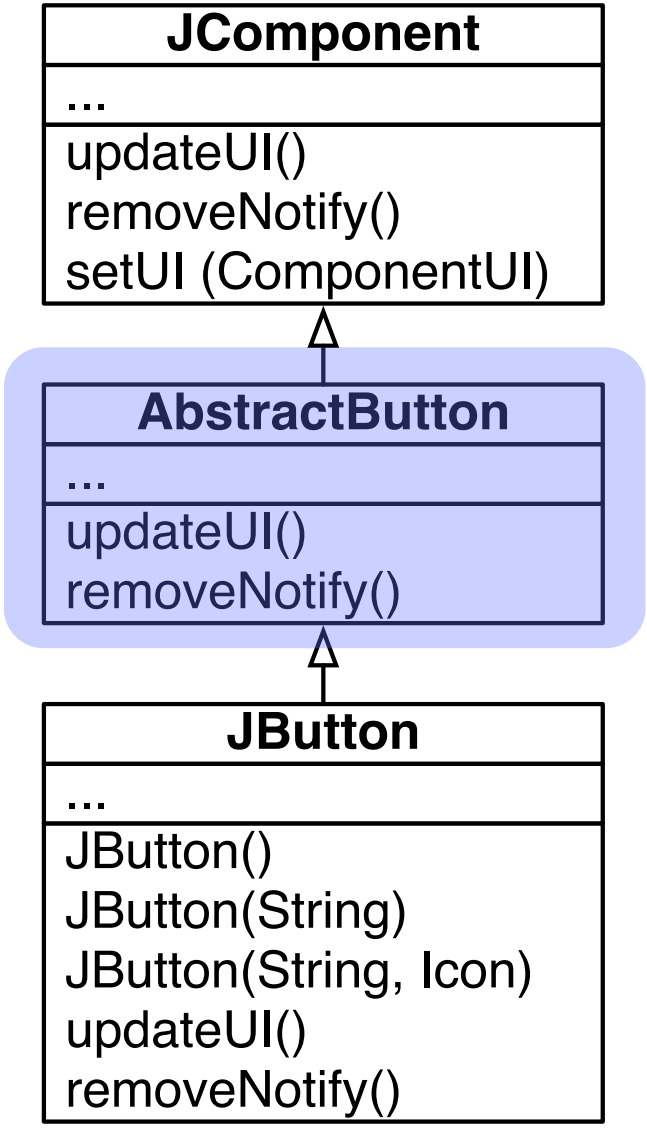


An abstract class is an incomplete class.
It cannot be instantiated therefore.

It is declared as abstract, and may contains abstract methods.

Note on design: abstract classes are not meant to be used as a type. Use interfaces for that purpose!

Abstract class



An abstract class is an incomplete class.
It cannot be instantiated therefore.

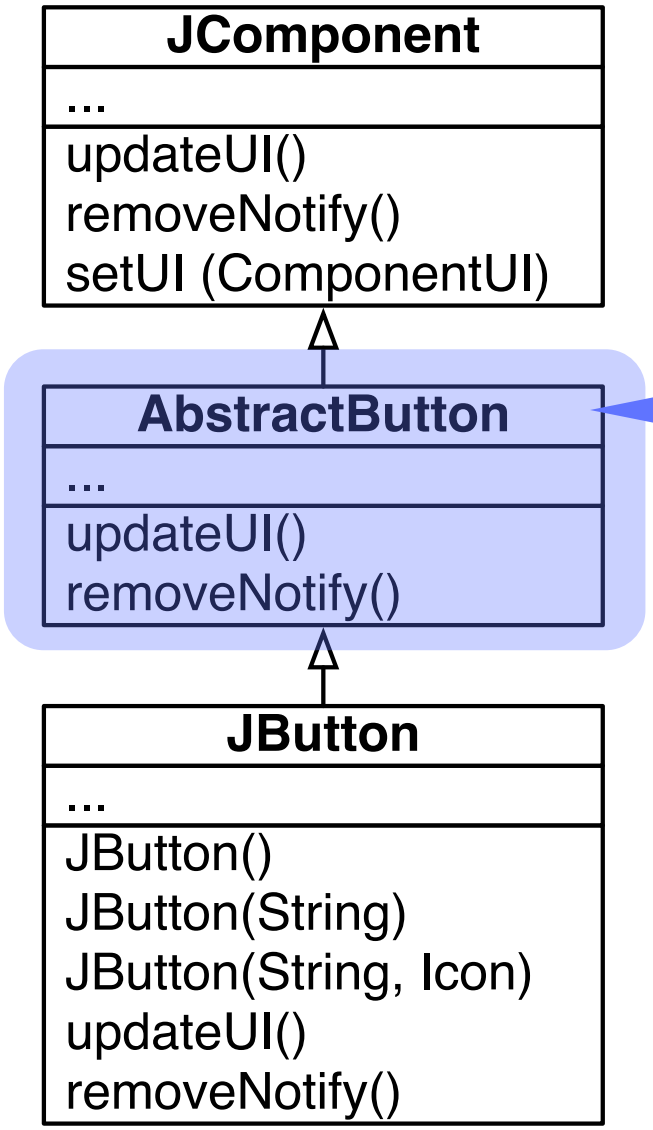
It is declared as abstract, and may contains abstract methods.

Note on design: abstract classes are not meant to be used as a type. Use interfaces for that purpose!

*You should **not** write:*

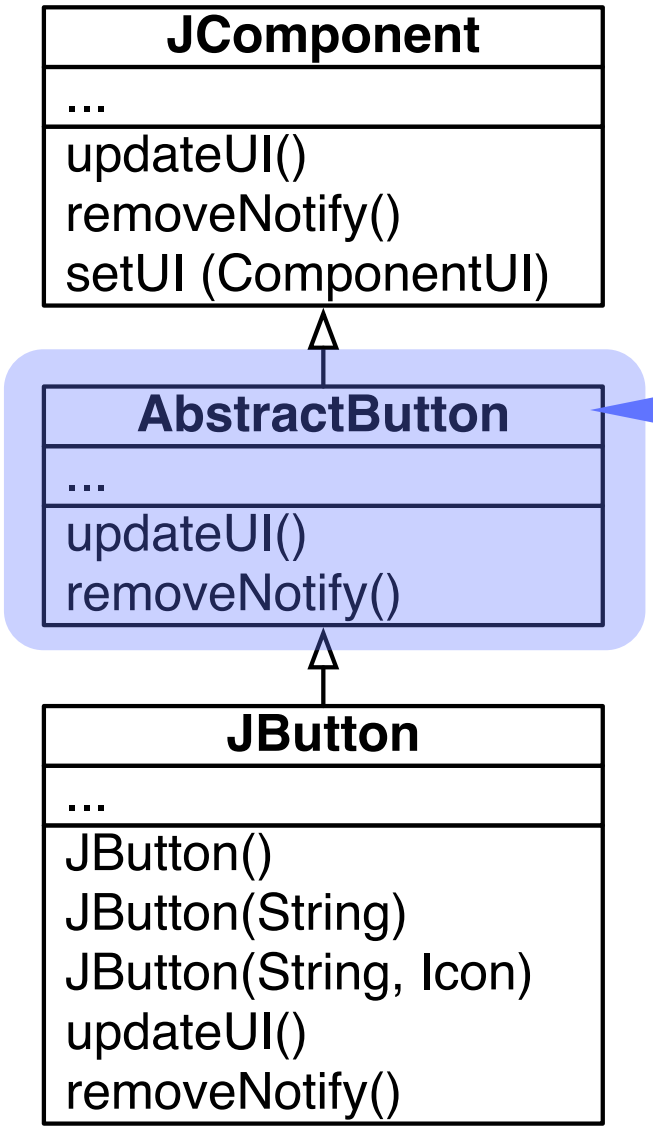
```
AbstractButton button = new JButton();
```

Abstract class




```
public abstract class AbstractButton
    extends JComponent
    implements ItemSelectable, SwingConstants {
...
}
```

Abstract class

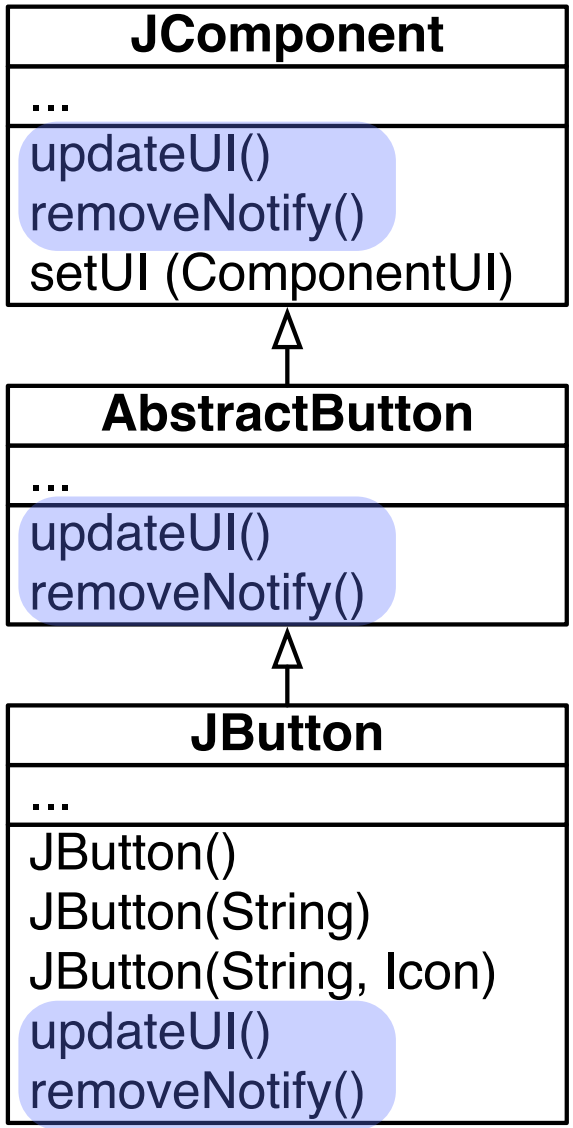



```
public abstract class AbstractButton
    extends JComponent
    implements ItemSelectable, SwingConstants {
...
}
```

But we can write:

```
JButton button = new JButton();
ItemSelectable button = new JButton();
```

Method overriding



Method signature =
name + number of parameters +
type of its parameters

method overriding =
An instance method in a subclass with the *same signature* as an instance method in the superclass *overrides* the superclass's method.

A *message send* is always associated to a method signature. The signature is used to find the method to execute.

Method overloading

JComponent
...
repaint(long tm, int x, int y, int w, int h) repaint(Rectangle r)

Two methods defined in a hierarchy
can have the same name
but different signatures

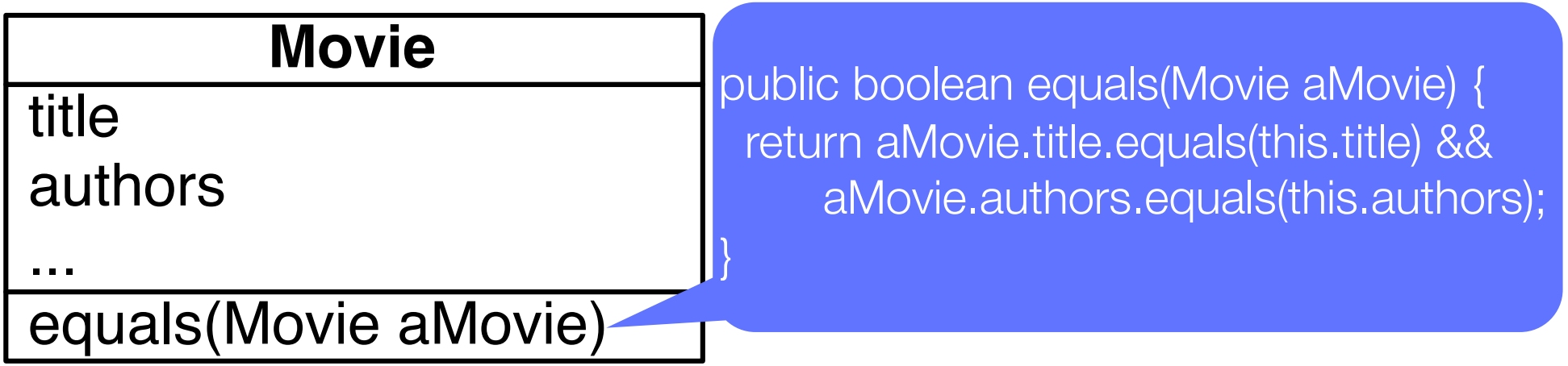
Method overloading

JComponent
...
repaint(long tm, int x, int y, int w, int h) repaint(Rectangle r)

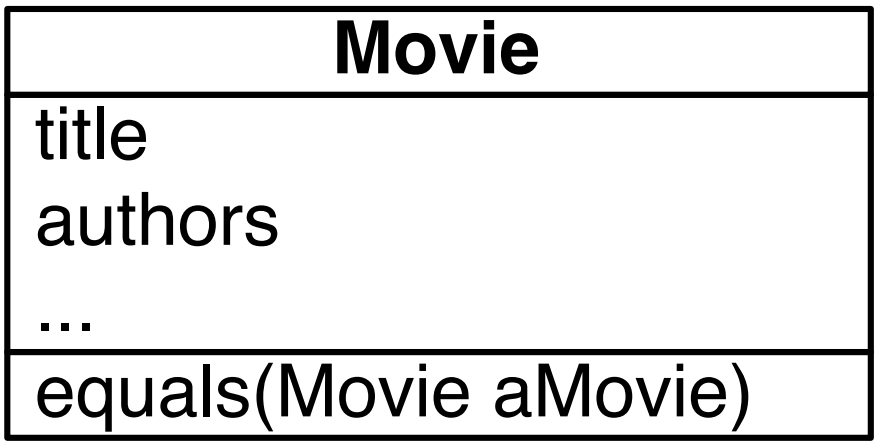
Two methods defined in a hierarchy
can have the same name
but different signatures

Could generate complicated bugs

A typical situation



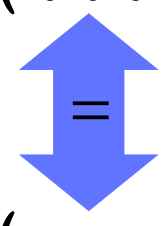
A typical situation



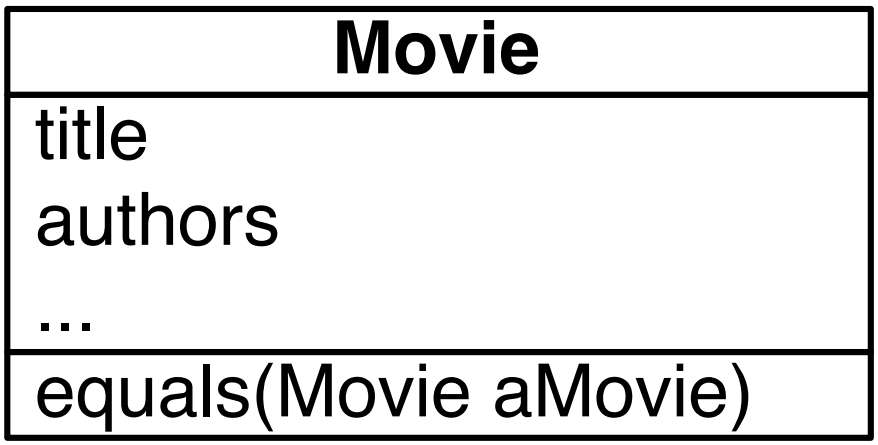

```
Movie avatar =
          new Movie(...);

Movie aMovie =
          new Movie(...);

avatar.equals(aMovie);
```



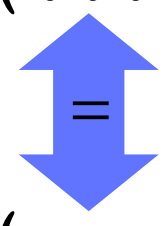
A typical situation



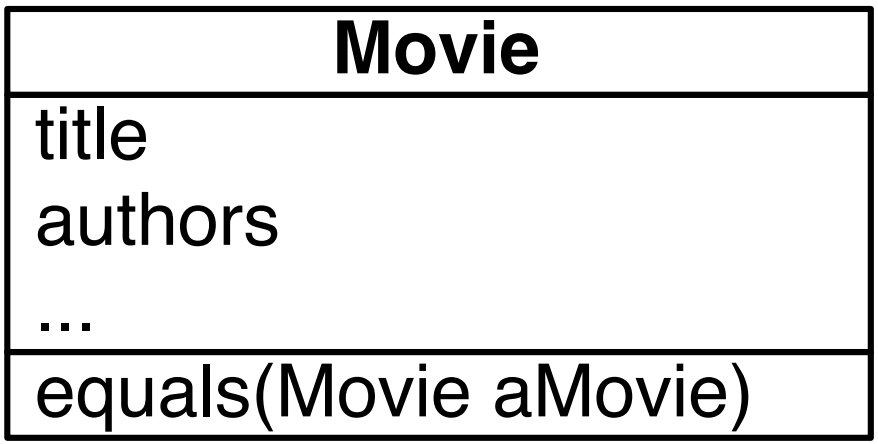

```
Movie avatar =
          new Movie(...);

Movie aMovie =
          new Movie(...);

avatar.equals(aMovie);
=> true
```



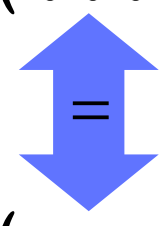
A typical situation



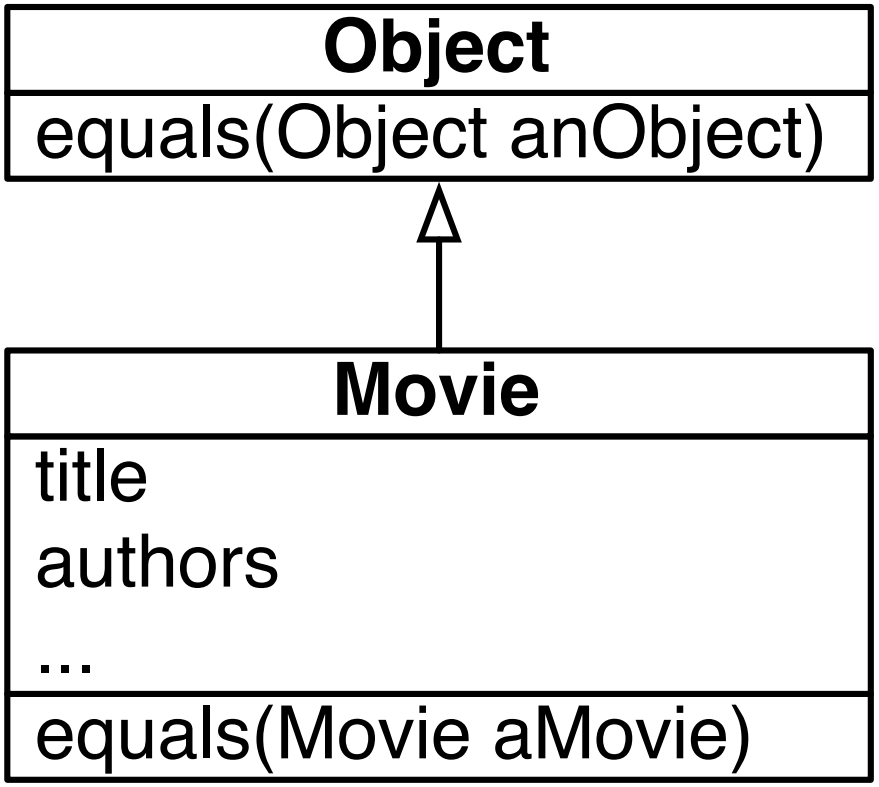

```
Movie avatar =
          new Movie(...);

Object aMovie =
          new Movie(...);

avatar.equals(aMovie);
=> false
```



Method signature are looked up!



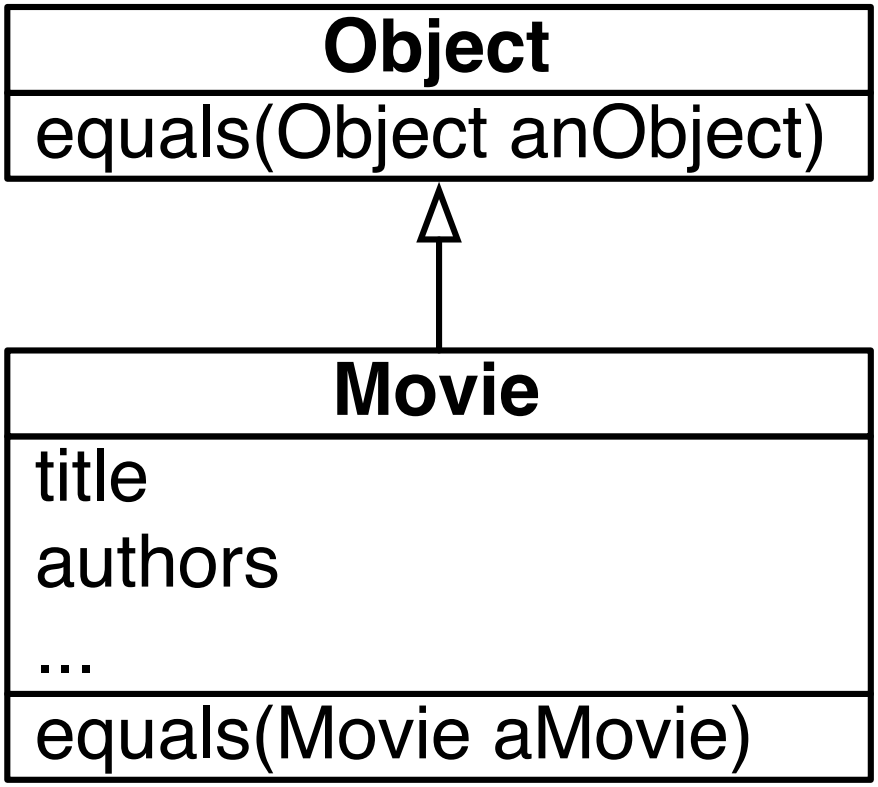

```
Movie avatar =
          new Movie(...);

Object aMovie =
          new Movie(...);

avatar.equals(aMovie);
=> false
```

=

Method signature are looked up!



equals(Object)

```
Movie avatar
          new Movie(...);

Object aMovie =
          new Movie(...);

avatar.equals(aMovie);
=> false
```

=

An acceptable version of equals

```
public class Movie {
  private String title;
  private String author;

  public Movie(String title, String author) {
    this.title = title;
    this.author = author;
  }

  @Override
  public boolean equals(Object o) {
    if (o instanceof Movie) {
      return ((Movie)o.title).equals(this.title) &&
             ((Movie)o.author).equals(this.author);
    }
    return false;
  }
}
```

Use method overloading with care!

The example presented earlier shows a typical situation where

- defining equals(Movie) is not an *overriding*, but an *overloading*
- *two different methods* are therefore accessible
- the method signature to lookup is statically determined (by the compiler)
- In Java, the overloading is statically resolved

Method overloading is complex and should be used with care

@Override

This problem of accidental overloading is so important that it is recommended to explicitly declare overriding methods:

```
@Override public boolean equals(Object other) {...}
```

What we have seen today

- Constructors
  - May invoke themselves
  - Constructor of the superclass is always executed before
  - super() implicit (if not provided, then the system does it for you)
  - If no constructor is provided, then the system defines one
- Abstract class
  - Incomplete class
  - used to be specialized when subclassed
- Instance methods (i.e., a method without `static`)
  - May be overridden (same signature in a subclass)
  - May be overloaded (different signature, but same name)

What we have seen today

A signature is always determined from a method call

The signature is used to look for a method during the program execution

What you should know

How the *method lookup* works

How the *object initialization* works

When should you *use method overloading*

The difference between *overloading* and *overriding*

What an *abstract class* is for

Can you answer to this questions?

Why *method overloading* may be difficult to use?

What are the condition to have *super.getClass() == this.getClass()* return true?

Why *frameworks* provides some *abstract classes*?

What is the difference between a *constructor* and a *method*?

Why a *constructor* always *call* a *parent constructor*?

License

http://creativecommons.org/licenses/by-sa/2.5

creative commons

COMMONS DEED

Attribution-ShareAlike 2.5

You are free:

- to copy, distribute, display, and perform the work
- to make derivative works
- to make commercial use of the work

Under the following conditions:

Attribution. You must attribute the work in the manner specified by the author or licensor.

Share Alike. If you alter, transform, or build upon this work, you may distribute the resulting work only under a license identical to this one.

- For any reuse or distribution, you must make clear to others the license terms of this work.
- Any of these conditions can be waived if you get permission from the copyright holder.

Your fair use and other rights are in no way affected by the above.