Dealing with objects

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Goal of this lecture

This lecture will essentially be a *Java refresher*

Understand *what an object is*

Understanding *some important* particularities of Java

Outline

1. Java refresher
    1. Small illustrative scenario with the class Point
    2. Extending Point into PositivePoint
2. Class inheritance
3. Terminology

Outline

1. **Java refresher**
    1. **Small illustrative scenario with the class Point**
    2. **Extending Point into PositivePoint**
2. Class inheritance
3. Terminology

Defining point as a first example...

We will model points as a first example

A point, is a particular entity that represents a spacial location

It contains two values, x and y

Defining point as a first example...

It answers to four messages

- moveTo(newX, newY) - move the point to a new location
- moveBy(deltaX, deltaY) - incrementally move the point
- getX() - return the X value
- getY() - return the Y value

What do we need next?

We know the *principal character* (the point), but this is *not enough to make a movie*! We still need:

- The point needs to be created by a factory
  - **P**oint will be the name of the factory
- An execution scenario
  - PointExample will be the name of the scenario

A simple execution scenario

It will probably not be as good as Avatar, but we can imagine a small story:

1 - PointExample creates the hero of our story, a point called myLittlePoint.

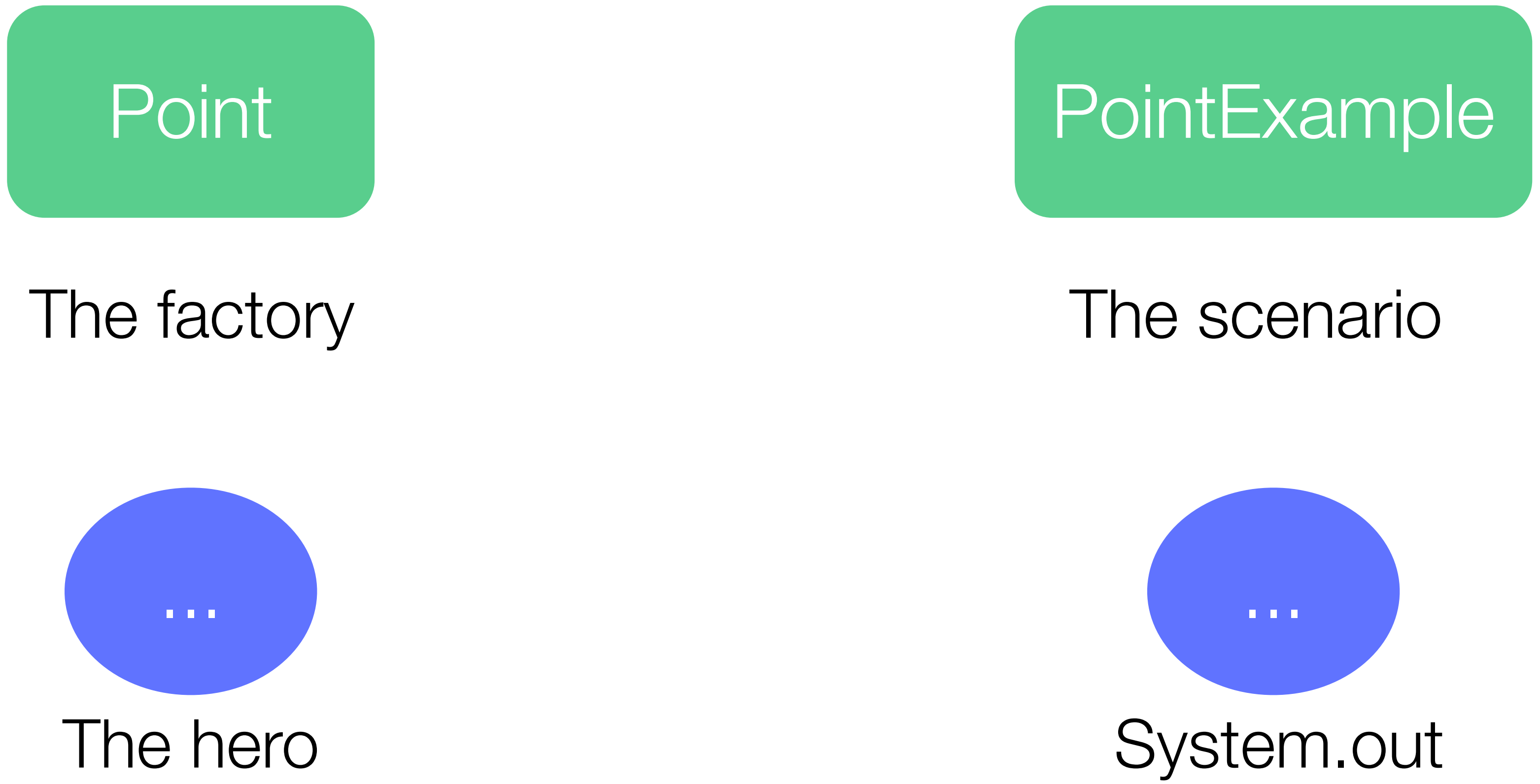
2 - PointExample tells to the World where myLittlePoint is

3 - myLittlePoint, who wants to discover the World, jumps to a position

4 - He/She then does a little step

5 - End of the movie!

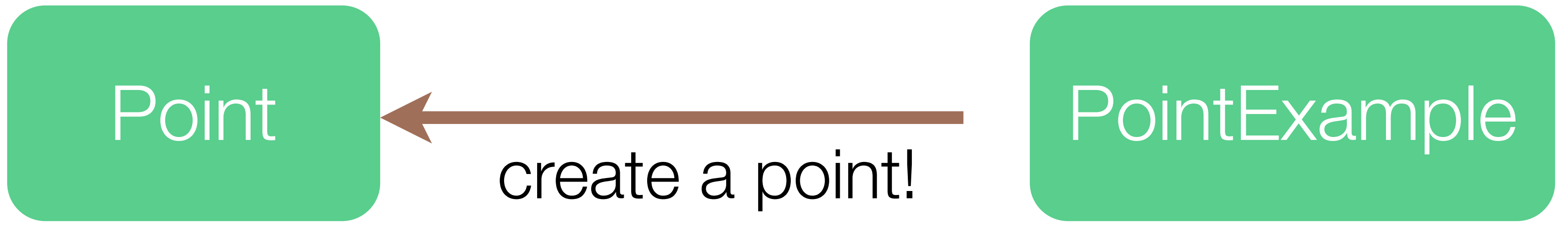
Screen-cast


Point
PointExample
The factory
The scenario
...
...
The hero
System.out

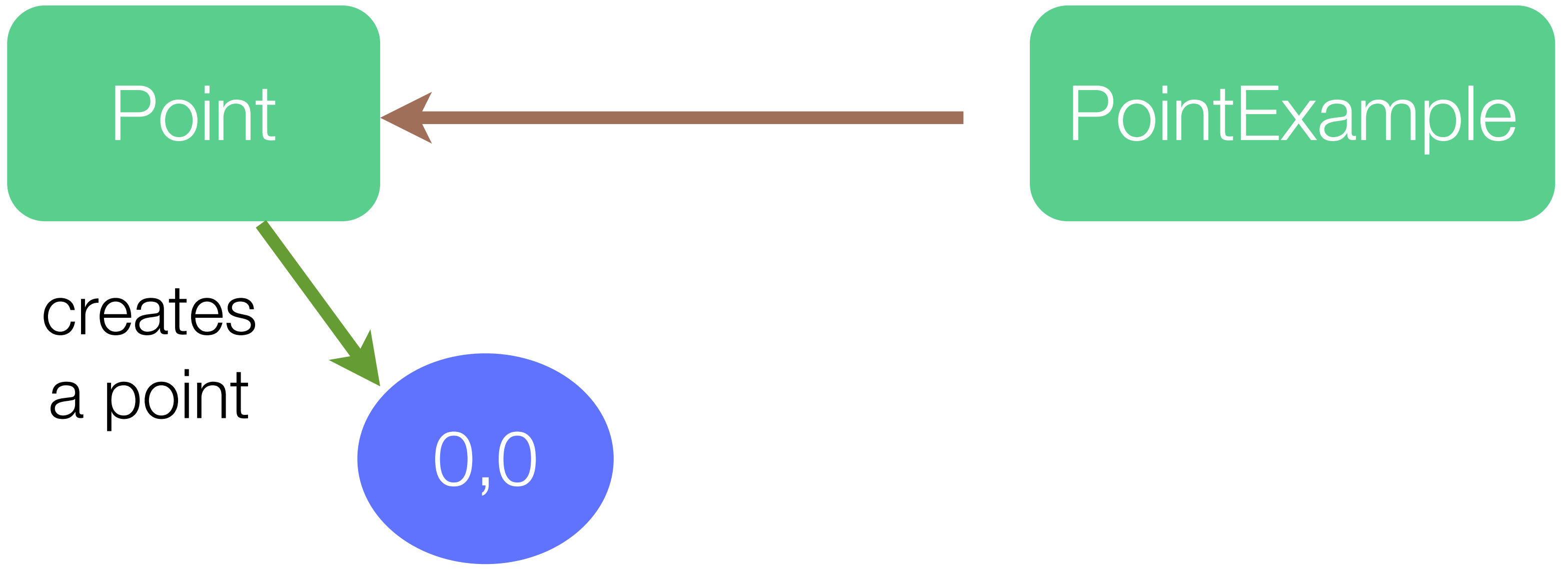
A simple execution scenario

Point
PointExample

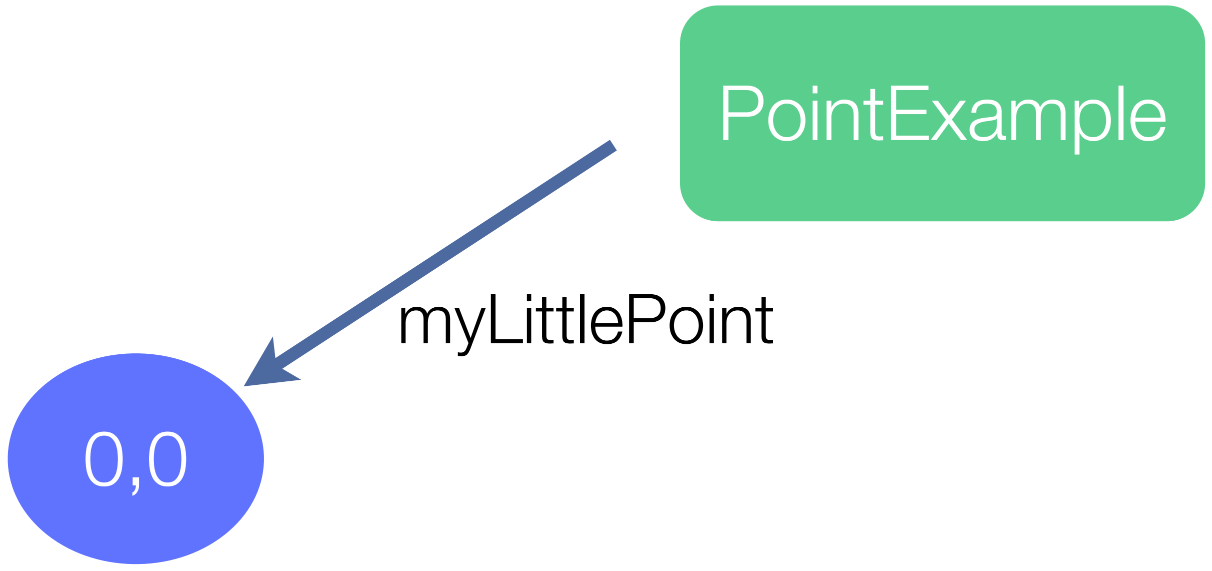
PointExample asks the factory to create our hero



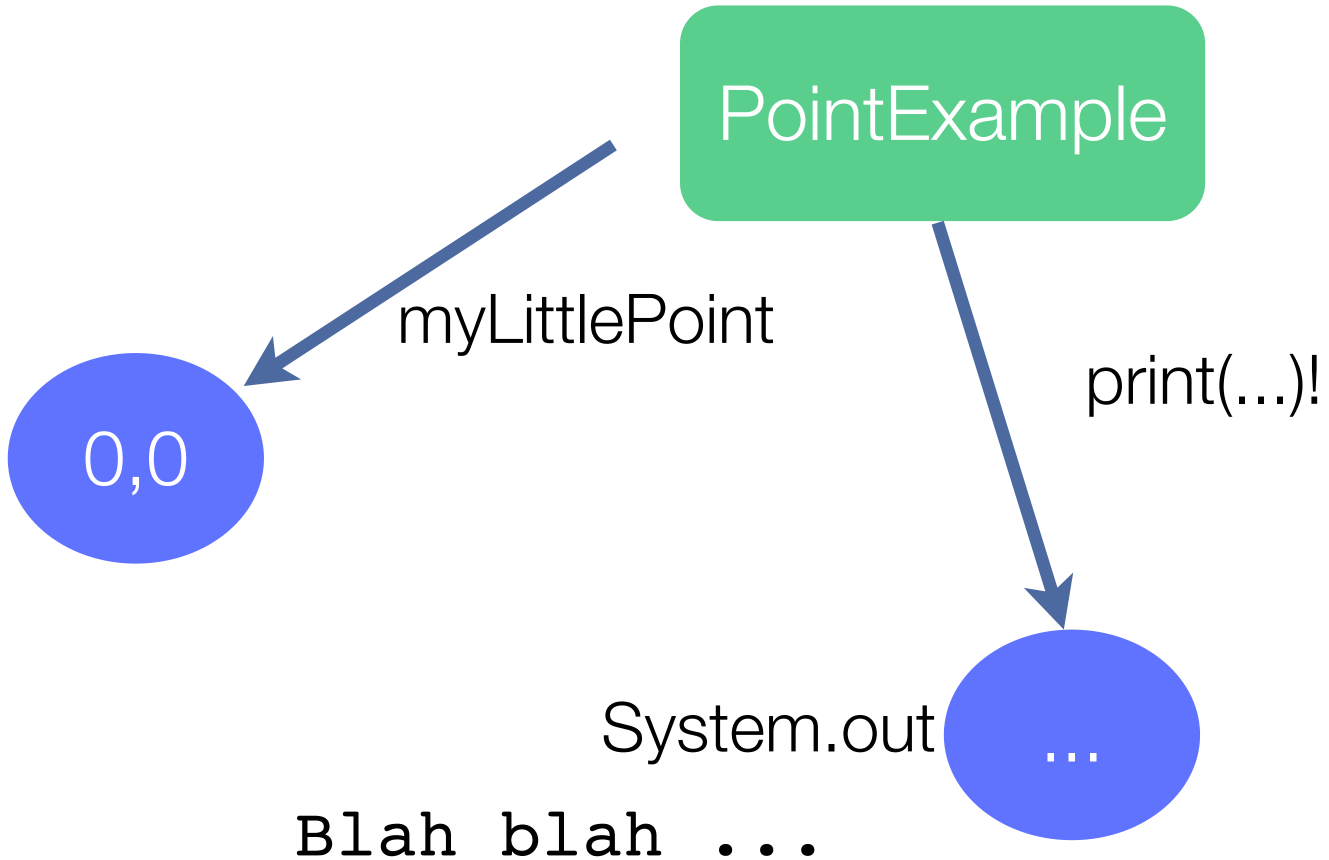
PointExample asks the factory to create our hero



PointExample gives a name to our hero

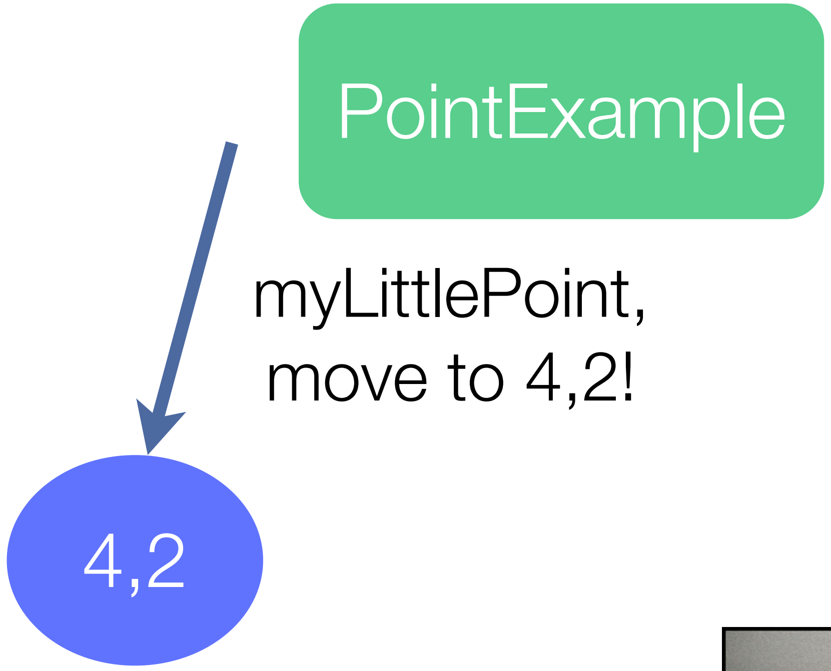


PointExample says to the World where our hero is

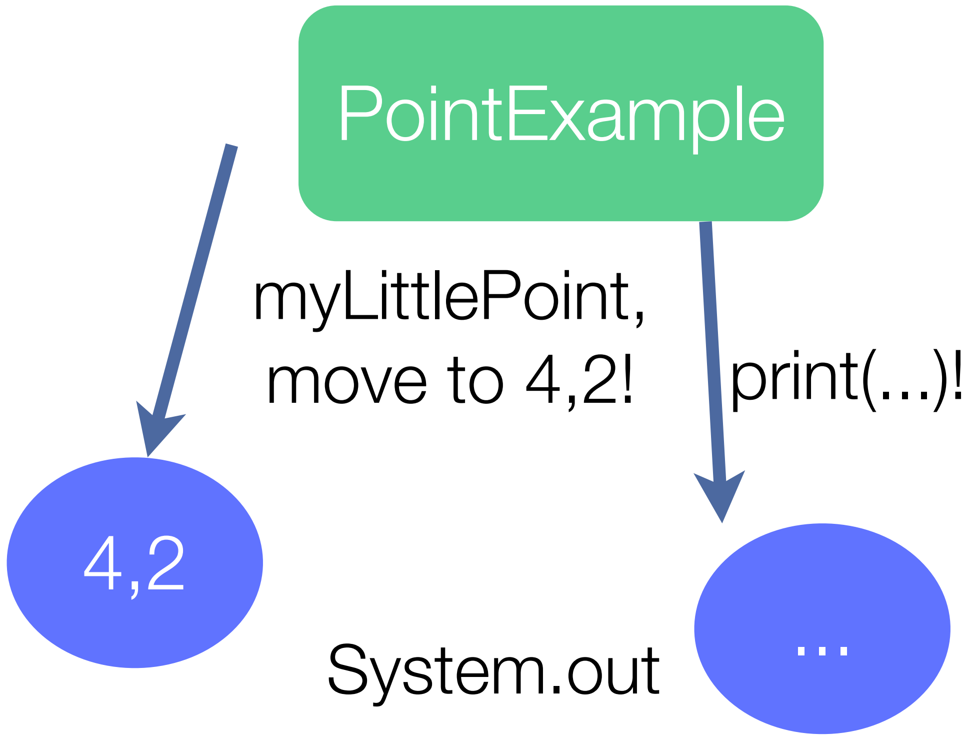


```
Blah blah ...
My initial position is 0,0
```

PointExample asks our hero to jump to a new location

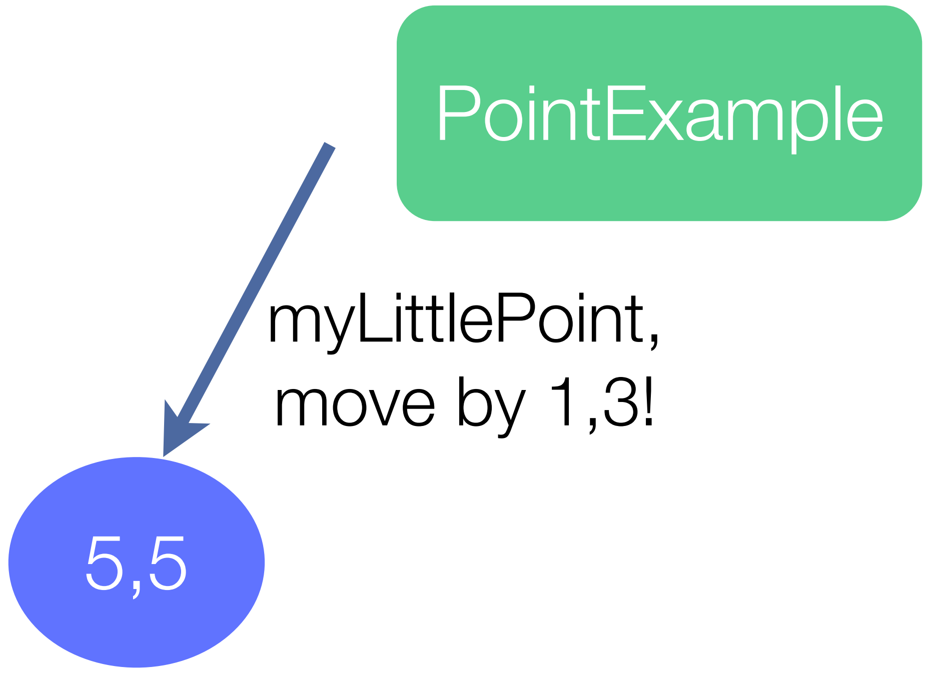


... say to the World where the hero is...

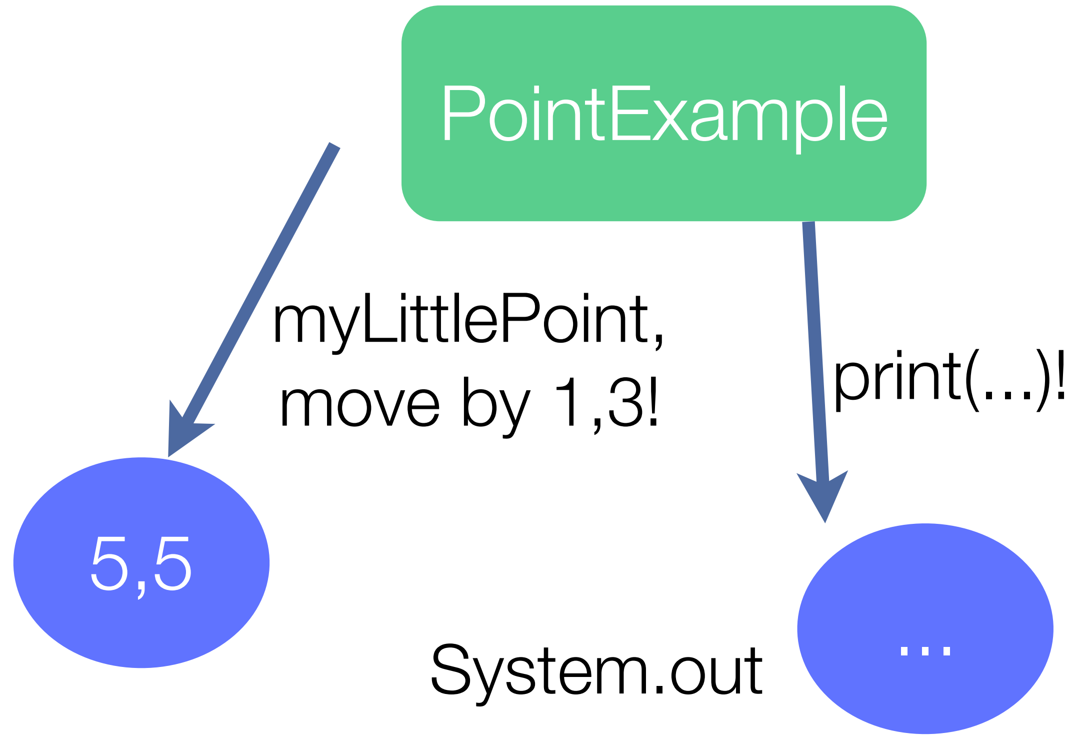


```
My initial position is 0,0
My position after a moveTo is 4,2
```

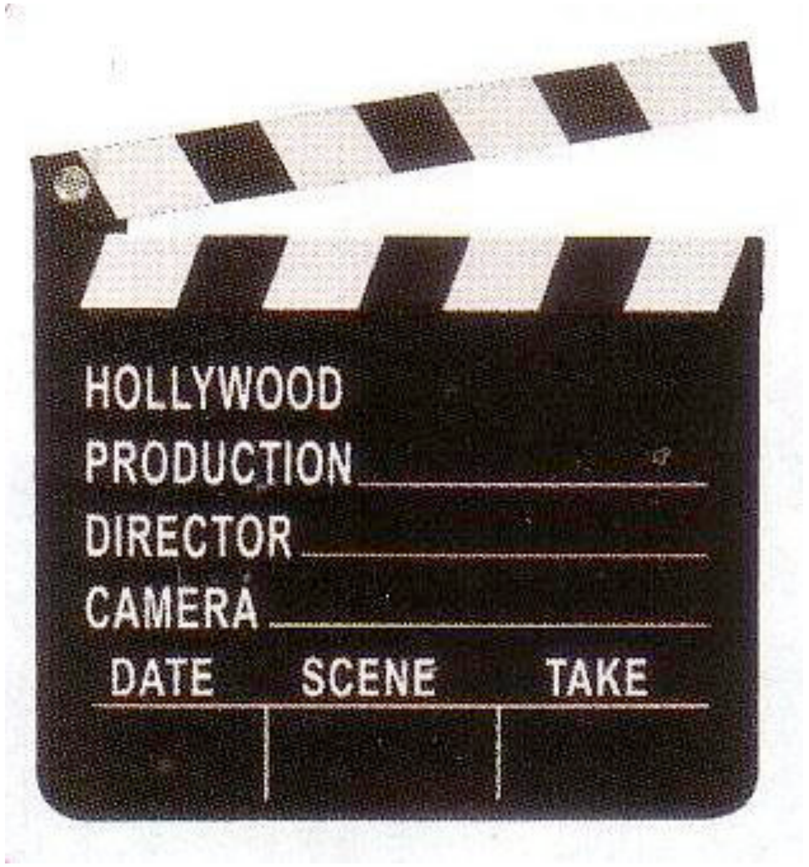
... now a little step...



... and finally, tell to the World where our hero is!



```
My initial position is 0,0
My position after a moveTo is 4,2
My position after a moveBy 5,5
```


HOLLYWOOD
PRODUCTION
DIRECTOR
CAMERA
DATE
SCENE
TAKE

Some of the important parts that you should not have missed! ...

- Point is the only character who knows what myLittlePoint looks like and how it behaves
  - Point knows how to interpret the orders given to myLittlePoint
- myLittlePoint only knows
  - the value of X and the value of Y
  - who created it
- Only PointExample knows that the hero is named myLittlePoint
  - Other character, if any, can call the hero as they wished

Some of the important parts that you should not have missed!

PointExample *sends* to myLittlePoint some orders, defined in term of *messages*

PointExample cannot move myLittlePoint directly, *it has to ask myLittlePoint* to do it

Only myLittlePoint can do the job to move to a new location

PointExample *cannot send a message not* understood by myLittlePoint

A first example, the code Definition of Point

```
package cc3002;

public class Point {

   protected int x;

   protected int y;

   ...
```

Initialize point creation

```
...
  public Point() {
      x = 0;
      y = 0;
 }
...
```

moveTo and moveBy

```
...

public void moveTo(int newX, int newY) {

   x = newX;

   y = newY;

}

public void moveBy(int deltaX, int deltaY) {

  x = x + deltaX;

   y = y + deltaY;

}

...
```

getting the location

```
   ...
      public int getX() {
          return x;
     }
     public int getY() {
          return y;
      }
}
```

Definition of PointExample

```
package cc3002;

public class PointExample {

    public static void main(String[] argv) {

     Point myLittlePoint = new Point();

     System.out.println("My initial position " +

          myLittlePoint.getX()+ ","+ myLittlePoint.getY());

     myLittlePoint.moveTo(4, 2);

     System.out.println("My position after a moveTo " +

          myLittlePoint.getX()+ ","+ myLittlePoint.getY());

   ...
```

Magic invocation, we will see that later

```
package cc3002;

public class PointExample {

   public static void main(String[] argv) {

     Point myLittlePoint = new Point();

     System.out.println("My initial position " +

          myLittlePoint.getX()+ ","+ myLittlePoint.getY());

     myLittlePoint.moveTo(4, 2);

     System.out.println("My position after a moveTo " +

          myLittlePoint.getX()+ ","+ myLittlePoint.getY());

   ...
```

Creation of an unnamed point

```
package cc3002;

public class PointExample {

    public static void main(String[] argv) {

     Point myLittlePoint = new Point();

     System.out.println("My initial position " +

           myLittlePoint.getX()+ ","+ myLittlePoint.getY());

     myLittlePoint.moveTo(4, 2);

     System.out.println("My position after a moveTo " +

           myLittlePoint.getX()+ ","+ myLittlePoint.getY());

   ...
```

Give the name of the new point

```
package cc3002;

public class PointExample {

    public static void main(String[] argv) {

     Point myLittlePoint = new Point();

     System.out.println("My initial position " +

          myLittlePoint.getX()+ ","+ myLittlePoint.getY());

     myLittlePoint.moveTo(4, 2);

     System.out.println("My position after a moveTo " +

          myLittlePoint.getX()+ ","+ myLittlePoint.getY());

   ...
```

Ask to myLittlePoint for its position

```
package cc3002;

public class PointExample {

    public static void main(String[] argv) {

     Point myLittlePoint = new Point();

     System.out.println("My initial position " +

          myLittlePoint.getX()+ ","+ myLittlePoint.getY());

     myLittlePoint.moveTo(4, 2);

     System.out.println("My position after a moveTo " +

          myLittlePoint.getX()+ ","+ myLittlePoint.getY());

   ...
```

Show it in a standard output stream

```
package cc3002;

public class PointExample {

    public static void main(String[] argv) {

     Point myLittlePoint = new Point();

     System.out.println("My initial position " +

          myLittlePoint.getX()+ ","+ myLittlePoint.getY());

     myLittlePoint.moveTo(4, 2);

     System.out.println("My position after a moveTo " +

          myLittlePoint.getX()+ ","+ myLittlePoint.getY());

   ...
```

Ask the hero to move to a new location

```
package cc3002;

public class PointExample {

    public static void main(String[] argv) {

     Point myLittlePoint = new Point();

     System.out.println("My initial position " +

          myLittlePoint.getX()+ ","+ myLittlePoint.getY());

     myLittlePoint.moveTo(4, 2);

     System.out.println("My position after a moveTo " +

          myLittlePoint.getX()+ ","+ myLittlePoint.getY());

   ...
```

Ask the location once more

```
package cc3002;

public class PointExample {

    public static void main(String[] argv) {

     Point myLittlePoint = new Point();

     System.out.println("My initial position " +

           myLittlePoint.getX()+ ","+ myLittlePoint.getY());

     myLittlePoint.moveTo(4, 2);

     System.out.println("My position after a moveTo " +

           myLittlePoint.getX()+ ","+ myLittlePoint.getY());

   ...
```

Print the result in the output standard stream

```
package cc3002;

public class PointExample {

    public static void main(String[] argv) {

     Point myLittlePoint = new Point();

     System.out.println("My initial position " +

          myLittlePoint.getX()+ ","+ myLittlePoint.getY());

     myLittlePoint.moveTo(4, 2);

     System.out.println("My position after a moveTo " +

          myLittlePoint.getX()+ ","+ myLittlePoint.getY());

   ...
```

myLittlePoint is asked to move by 1,3

```
    myLittlePoint.moveBy(1, 3);

    System.out.println("My position after a moveBy " +

          myLittlePoint.getX()+ ","+
       myLittlePoint.getY());

   }

}
```

The location is asked once more

```
        myLittlePoint.moveBy(1, 3);

        System.out.println("My position after a moveBy " +

                myLittlePoint.getX()+ ","+
           myLittlePoint.getY());

      }

  }
```

The position is displayed

```
     myLittlePoint.moveBy(1, 3);

     System.out.println("My position after a moveBy " +

             myLittlePoint.getX()+ ","+
         myLittlePoint.getY());

    }

}
```

Running the example

```
> java -cp bin cc3002.PointExample
My initial position 0,0
My position after a moveTo 4,2
My position after a moveBy 5,5
```

Java particularities

Java is essentially *object-based*

... but not completely

- *object instantiation is not done through message sending*, but with an *operator*
- Java contains primitive types, which are not objects

Static methods are not looked up

- we will come back on that point in the future

Defining a positive point...

```
package cc3002;


public class PositivePoint extends Point {

     public void moveBy(int deltaX, int deltaY) {

         super.moveBy(deltaX, deltaY);

         x = (x < 0) ? 0 : x;

         y = (y < 0) ? 0 : y;

     }

      ...
```

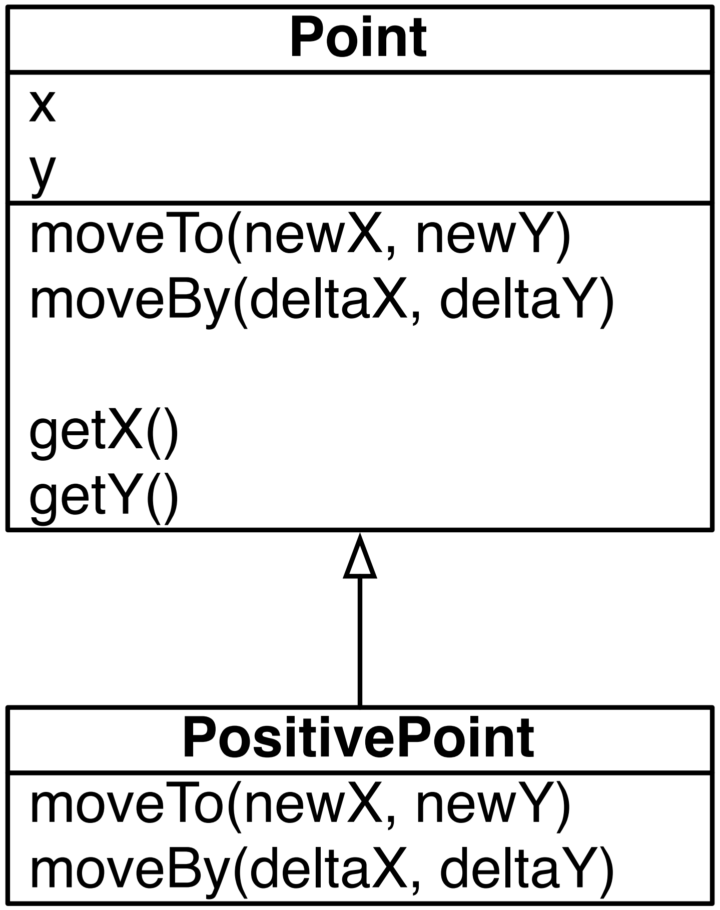
Defining a positive point

```
        ...
       public void moveTo(int newX, int newY) {
          if (newX < 0) { newX = 0; }
          if (newY < 0) { newY = 0; }
          super.moveTo(newX, newY);
       }
   }
```

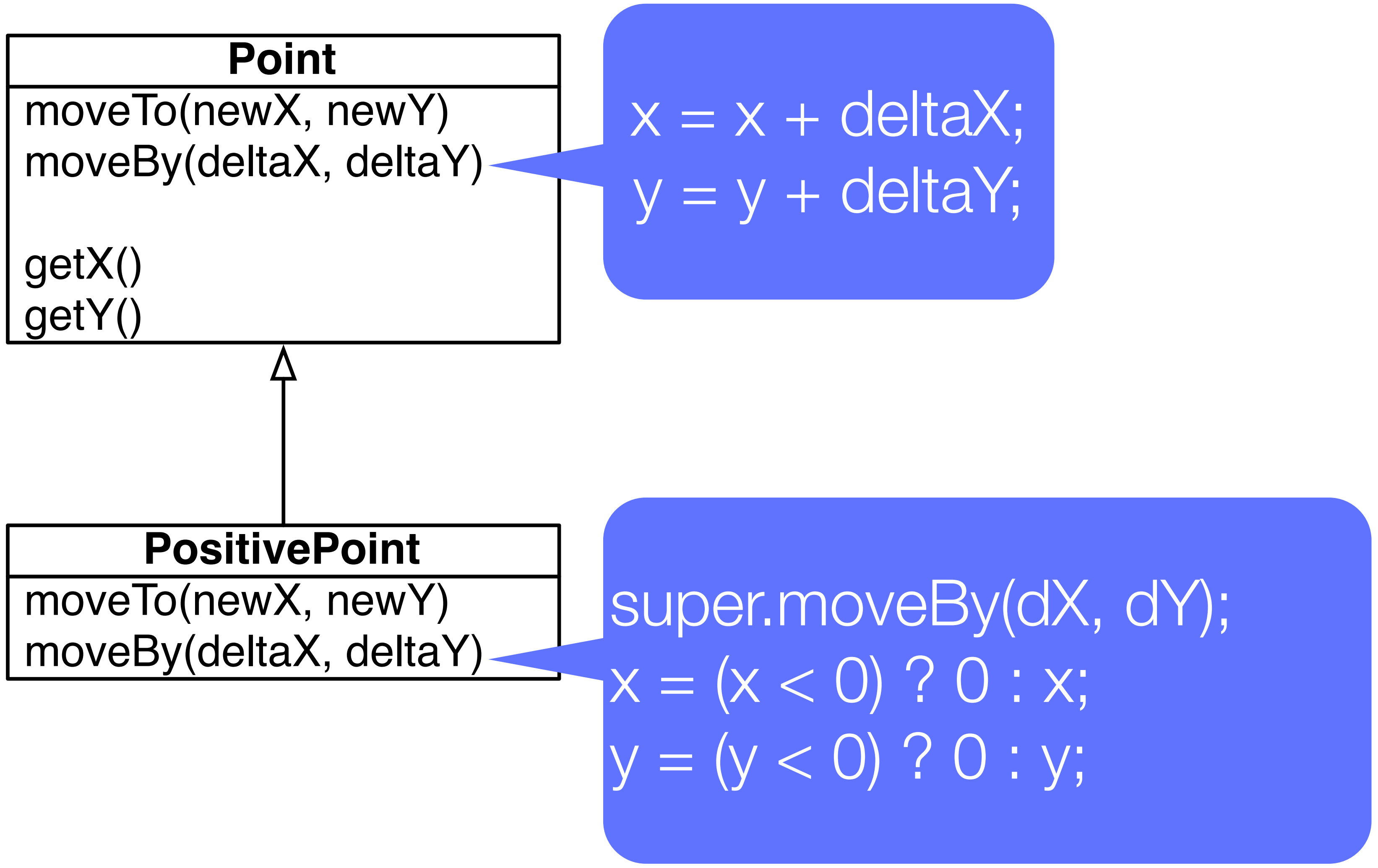
Outline

1. Java refresher
    1. Small illustrative scenario with the class Point
    2. Extending Point into PositivePoint
2. **Class inheritance**
3. Terminology

Class inheritance



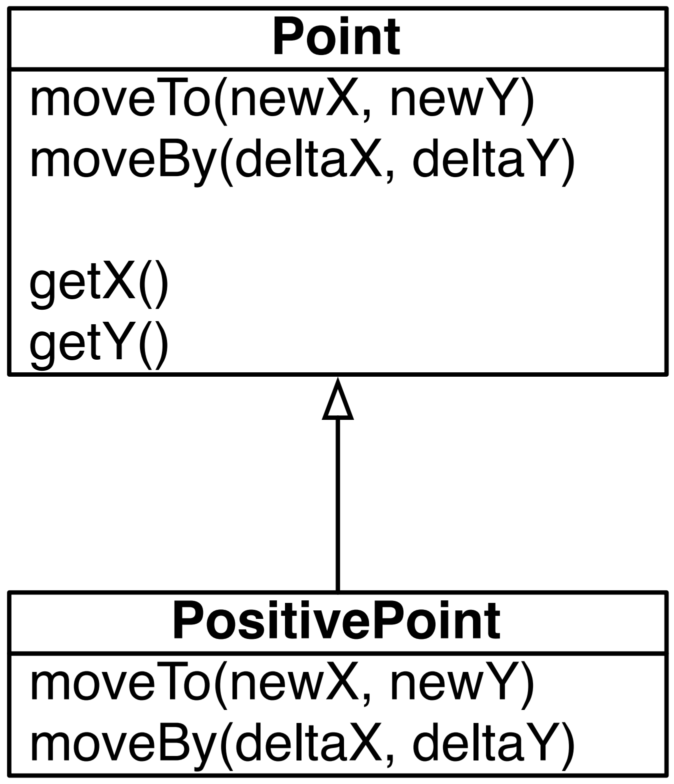
Defining a positive point



```
x = x + deltaX;
y = y + deltaY;
```

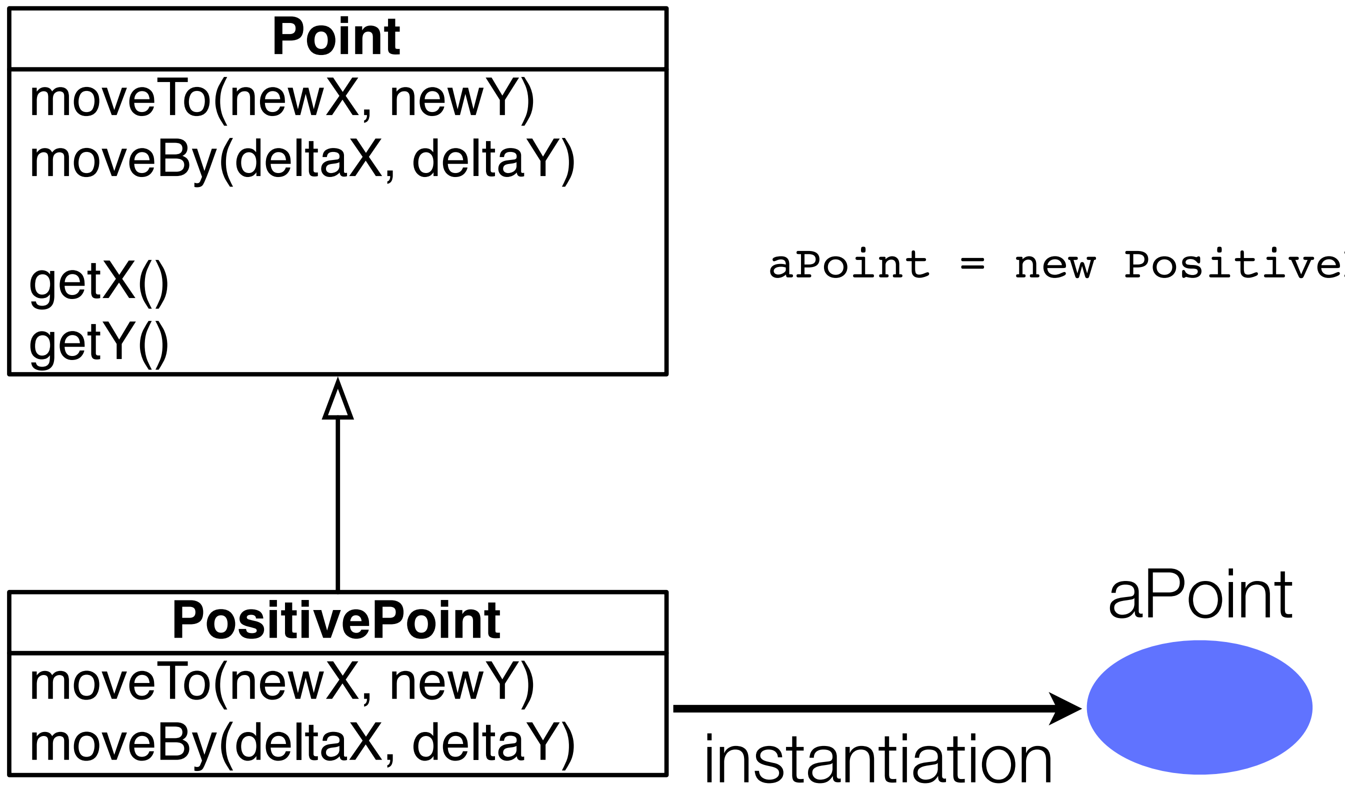
```
super.moveBy(dX, dY);
x = (x < 0) ? 0 : x;
y = (y < 0) ? 0 : y;
```

Class inheritance



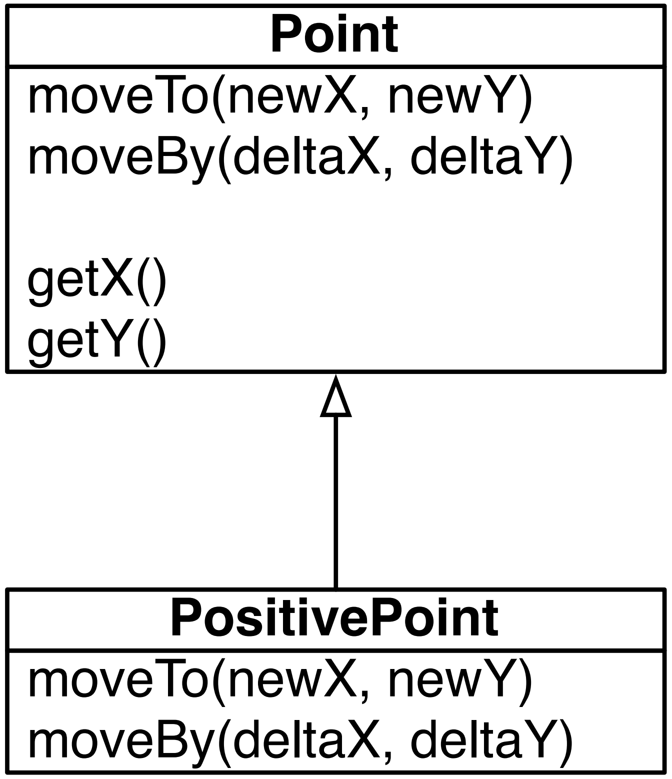
```
Point aPoint = new Point();
aPoint.moveTo(4, 2);

=> execute Point.moveTo(...)
```

Class inheritance



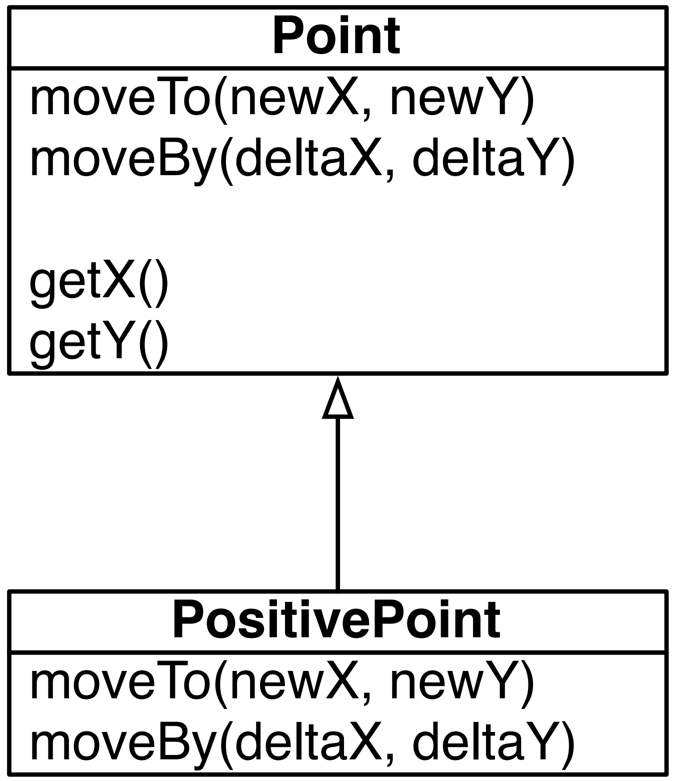
```
aPoint = new PositivePoint();
```

Class inheritance



```
Point aPoint = new PositivePoint();
aPoint.moveTo(4, 2);

=> execute PositivePoint.moveTo(...)
```

Class inheritance



```
Point aPoint = new PositivePoint();
aPoint.getX();

=> execute Point.getX(...)
```

Outline

Terminology

Object

“An object is a software machine allowing programs to access and modify a collection of data” -- Class of Touch, Bertrand Meyer

An object has a *unique identity*, its *reference*

An object knows from which class it has been created from (for class-based object-oriented programming languages like Java, C#, Smalltalk)

An object *understands* the *messages* for the methods defined in its class

Terminology

Class

A *class is an object factory*

It is defined as a set of variable declarations and method definitions

Conceptually: *class = name + variables + methods + superclass*

In Java: *class = name + variables + methods + superclass + interfaces + static methods + ...*

Terminology

Method

Executable piece of code

A method execution ends when no more instruction have to be executed or when a return statement is reached

In that case, the control flow is returned to its caller method

Can access to the *this* and *super* pseudo-variables (restricted to non-static methods in Java)

Terminology

Inheritance

relation of *specialization* between classes

a subclass *inherits attributes* and *behavior* from its superclass

it is considered *bad programming style* to use inheritance for code *reuse*

Terminology

Polymorphism

is the ability of one type A to appear as and be used like another type B

polymorphism plays a key difference between message sending and function invocation

```
Point aPoint = new PositivePoint();
```

What you should know!

What is the difference between an *object* and *class*?

What is the difference between *class reuse* and *class specialization*?

The difference between *function invocation* and *sending messages*

The difference between a *pointer* (à la C/C++) and a *reference*

Can you answer these questions?

Why do objects *“send messages”* instead of *“calling methods”*?

Can you imagine an object model in which a *class is also an object*?

Why *polymorphism* and *class inheritance* are so tightly related?

Why an object name is only known to a particular object?

License