Object Oriented Programming

Week 1 Part 1
An introduction to Java, Objects and JUnit

Object Oriented Programming with Java

Syllabus

- This class teaches Object Oriented Programming using Java
- We will focus on the practical aspects of OO programming
  - We will use Scrum and Test Driven Development
  - We will use the Eclipse IDE augmented with
    - JUnit for unit testing
    - Git for version control.

Lectures

- Lectures will introduce new material
- You are required to attend lecture
  - Roll will be taken and you will be detained at the final if you miss too many classes. (Please do not let that happen.)
- Use the time in lecture to gain the knowledge you will need for the tutorials and labs.
  - Lectures give us the opportunity to efficiently disseminate the information you will need.

Tutorials

- Before the tutorial you will be given a list of questions pertaining to the lectures from the previous week.
  - These questions give you the opportunity to test your understanding.
- Objective questions on the test will be selected from the tutorial questions.
  - If you understand the tutorial questions, you will do well on the objective part of the tests

Labs

- Labs make the theoretical knowledge presented in lectures and tutorial practical.
- Labs are run as demos
  - You will show the teacher the programming you completed over the week.
  - You work on your programming for the following week while waiting your turn.
  - Most of the work you do will be done outside of class.

Lab Resources

- You will be given an account on an Amazon Web Services (AWS) server on which you should keep your work.
- You will work on your own computer.
- Your computer should be set up with Eclipse Mars running the Java Development Environment including JUnit and eGit.
  - If you do not have this set up see your teacher as soon as possible for help getting it set up.

Lab Resources (cont.)

- The Lab itself is yours: keep it running well.
  - There is a report sheet in the lab where you can note any problem with the computers.
  - Keep watch for anyone who might damage your lab
- You may use the lab whenever the University is open.
  - If there is no class, go to the server room and sign up to use it.
  - You may let others use the lab, but you will be asked if anything happens.
  - If others are using the lab and you want to leave, ask one of them to sign up to watch it.
  - Check with the teachers to see if you can use the lab when there is a class.

Learning to Program

- You learn to program only by programming.
  - Lectures and Tutorials can get your started and give you things to teach you tools and tricks.
  - But only through writing programs will you learn to do it.
- Computer Science is more than programming, but you cannot do it without programming.
  - Literature is more than letters, but if you do not know the letters, Literature is inaccessible.

Today's Lecture

- Java syntax is mostly like C
- Defining Object Oriented programming
- Example of a Java Class
- Java Formatting
- Java Packages
- Java main()

Java

Java is based on C

- You already know most of Java.
- The difference is that Java is based on Objects and Classes.
  - These differences have some impact on other aspects, but most of what you know from C will transfer.
- However, because Java is object oriented, it leads you to think differently
  - This course will help you learn to think in an object oriented manner.

Java Output differs from C

- C
  - #include <stdio.h>
  - printf(“...”, var1, var2 …)
- Java
  - import java.io.*
  - System.out.println(“...”);
  - System.out.printf(“...”, var1, var2, …);

You can add strings in Java

- int a = 5; “Here are ” + a + “ things.”
  - Produces “Here are 5 things.”
- Adding strings together is how you build up messages to print in Java.
- string name = “Nat”;

  System.out.println(“Hello ” + name);
  - Writes “Hello Nat” on the console.
- System.out.println always ends with a newline.

Input is different in Java

- C
  - #include <stdio.h>
  - int a; scanf(“%d”, &a);
- Java
  - import java.io.*
  - int a; a = StdIn.readInt();

Java has references

- Java references are like pointers except
  - All objects are stored in references.
  - References are created with the keyword new
  - References are automatically deleted when no longer needed.
  - You can only refer to elements of the object referred to only using the dot notation. (i.e., there is no pointer arithmetic)
  - Since objects are always stored in references, when you pass an object, you can access the elements of the object passed.

Minor differences

- C “NULL” is “null” in java
- In Java, you can define variables and methods as “private” meaning they can only be used in the object, or “public” meaning they can be used anywhere.
- In Java, you can use the comment character “//” to turn a line into a comment. You can still use “/* */” to surround arbitrary text.

Java Objects

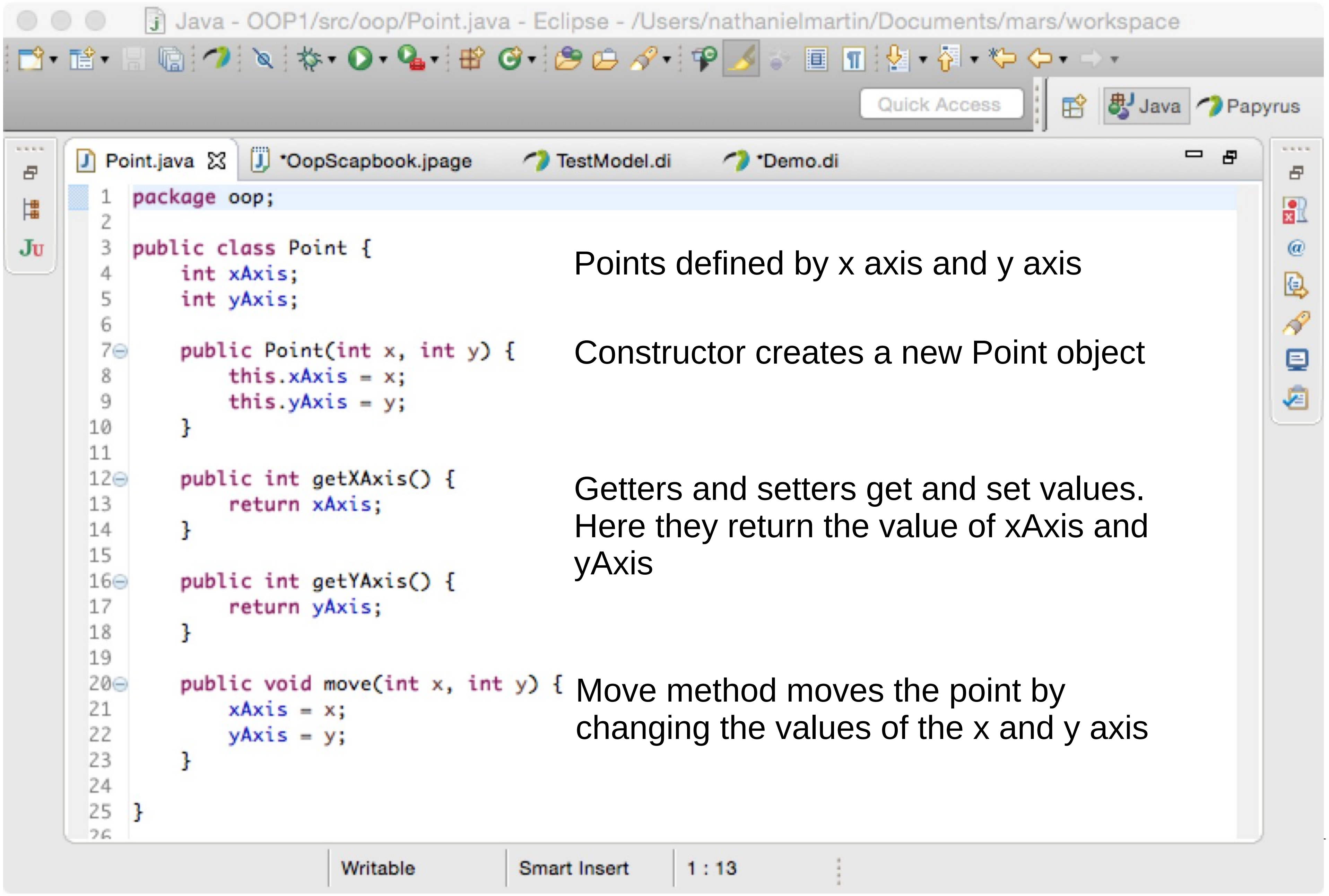
What is Object Oriented?

- Programs are build from *objects*
  - One can reason able programs as the interaction of objects
- Objects are defined by
  - Properties
    - Represented by *fields*.
      - Fields are like constants and variables in C.
  - Behaviors
    - Represented by *methods.*
      - Methods are like functions in C

Objects are created from classes

- A *class* defines are kind of objects.
- An object is created from a class by defining its properties.
  - I.e., setting its *instance variables*
  - A *constructor* creates new objects from a class
- All objects of a particular class have the same behaviors.
  - i.e., they all have the same methods

Example Java Class (Point)



```java
package oop;

public class Point {
    int xAxis;
    int yAxis;

    public Point(int x, int y) {
        this.xAxis = x;
        this.yAxis = y;
    }

    public int getXAxis() {
        return xAxis;
    }

    public int getYAxis() {
        return yAxis;
    }

    public void move(int x, int y) {
        xAxis = x;
        yAxis = y;
    }

}
```

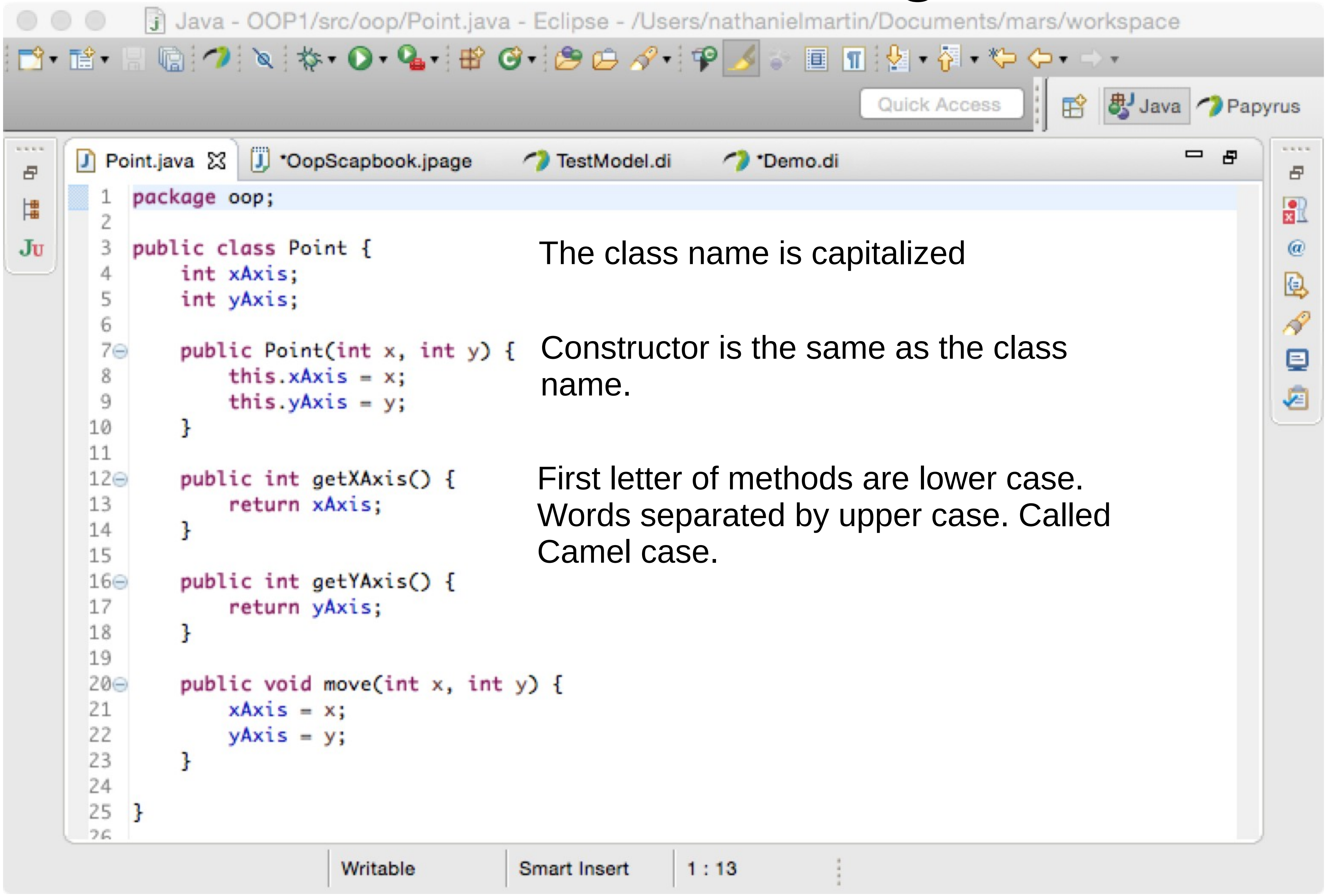
Points defined by x axis and y axis

Constructor creates a new Point object

Getters and setters get and set values. Here they return the value of xAxis and yAxis

Move method moves the point by changing the values of the x and y axis

Java Formatting



```java
package oop;

public class Point {
    int xAxis;
    int yAxis;

    public Point(int x, int y) {
        this.xAxis = x;
        this.yAxis = y;
    }

    public int getXAxis() {
        return xAxis;
    }

    public int getYAxis() {
        return yAxis;
    }

    public void move(int x, int y) {
        xAxis = x;
        yAxis = y;
    }

}
```

The class name is capitalized

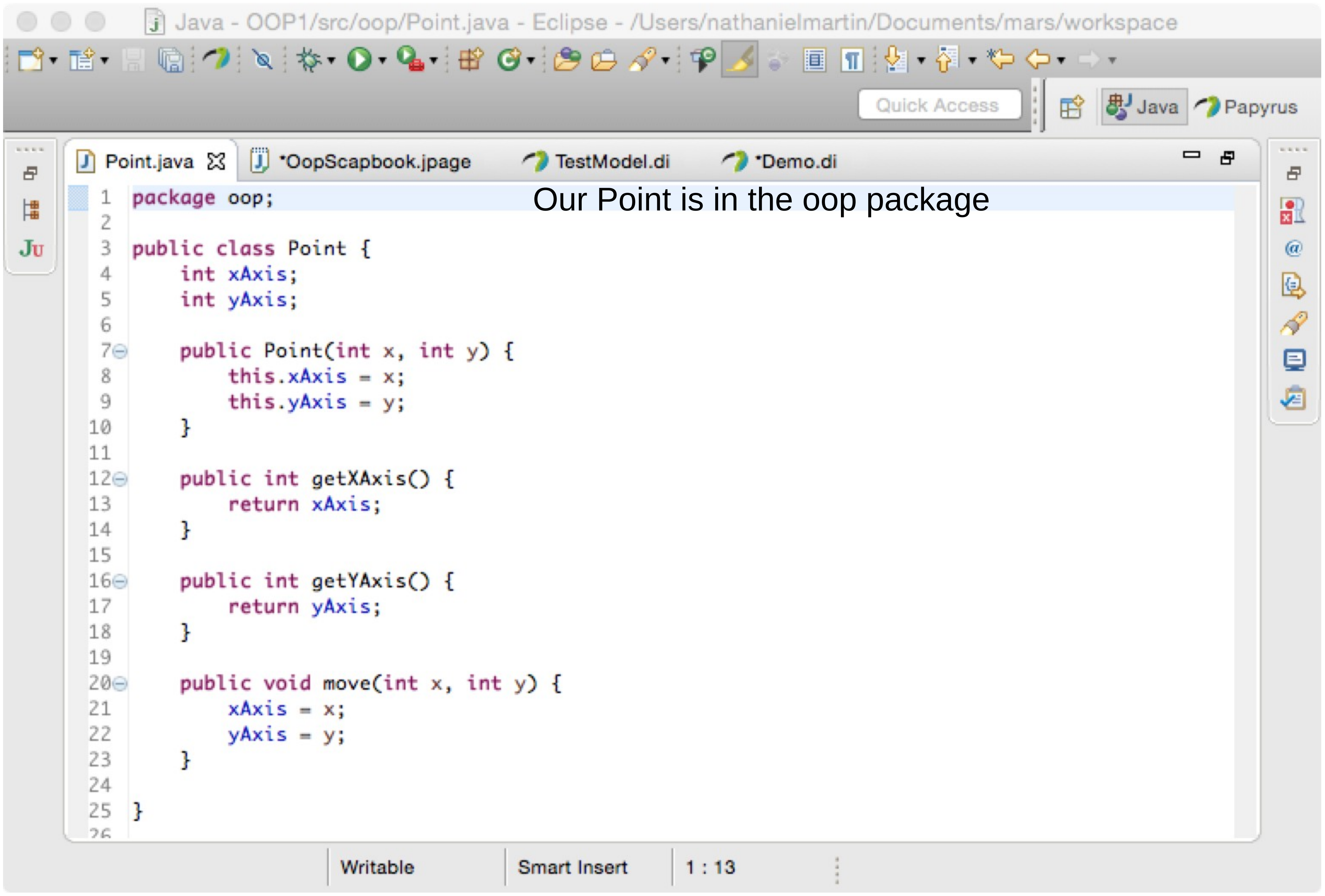
Constructor is the same as the class name.

First letter of methods are lower case. Words separated by upper case. Called Camel case.

Java Packages

- Packages define a *name space*
  - Name spaces keep similar names separate.
- For Example
  - The AWT package has a Point class
    - Theirs is java.awt.Point
  - Our oop package has a Point class
    - Ours is oop.Point
- We can *import* names from one package into another.

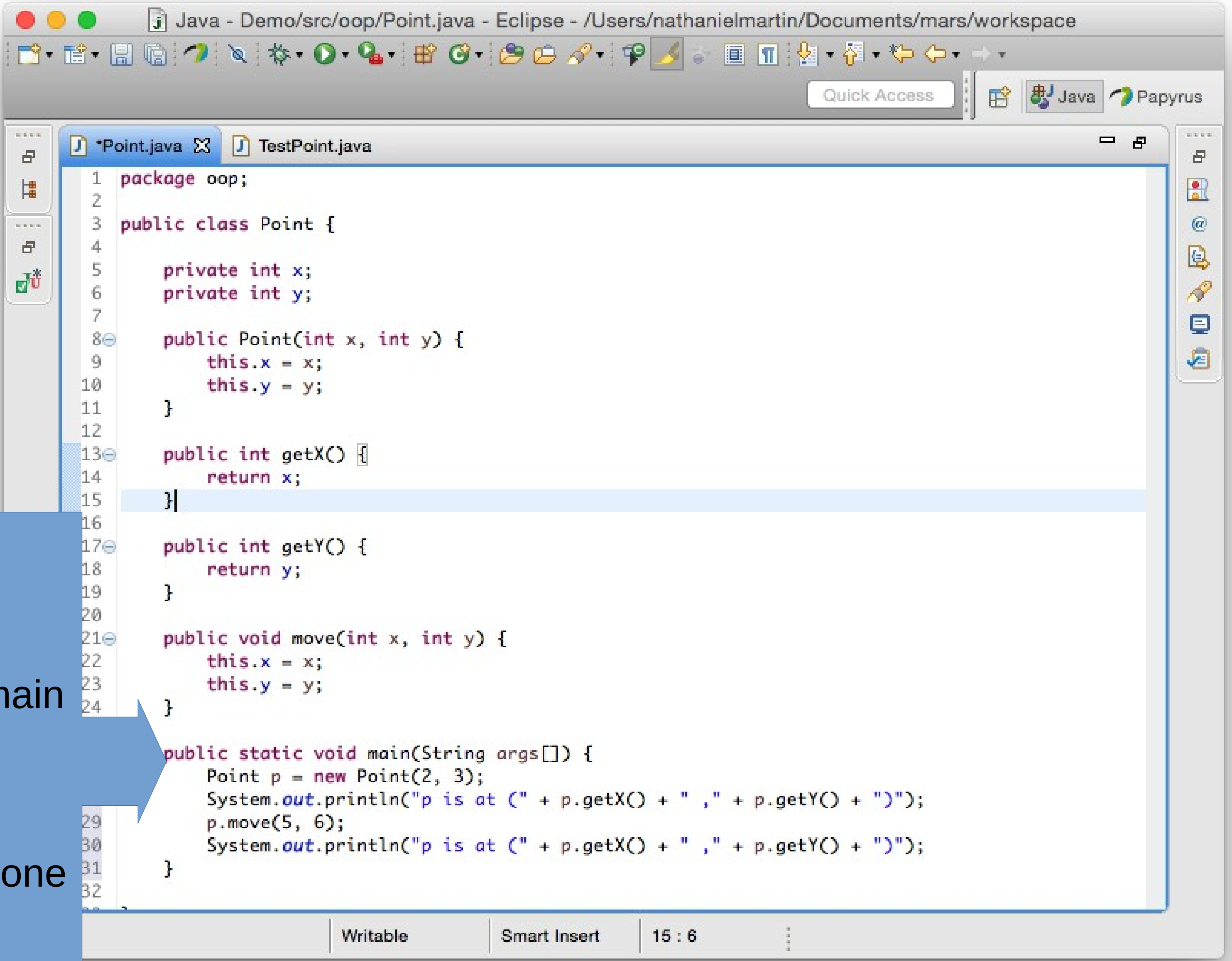
Java Packages



```java
package oop;

public class Point {
    int xAxis;
    int yAxis;

    public Point(int x, int y) {
        this.xAxis = x;
        this.yAxis = y;
    }

    public int getXAxis() {
        return xAxis;
    }

    public int getYAxis() {
        return yAxis;
    }

    public void move(int x, int y) {
        xAxis = x;
        yAxis = y;
    }

}
```

Our Point is in the oop package

Java main location



Java - Demo/src/oop/Point.java - Eclipse - /Users/nathanielmartin/Documents/mars/workspace
Quick Access
Java
Papyrus
*Point.java
TestPoint.java
Writable
Smart Insert
15 : 6

```java
package oop;

public class Point {

    private int x;
    private int y;

    public Point(int x, int y) {
        this.x = x;
        this.y = y;
    }

    public int getX() {
        return x;
    }

    public int getY() {
        return y;
    }

    public void move(int x, int y) {
        this.x = x;
        this.y = y;
    }

    public static void main(String args[]) {
        Point p = new Point(2, 3);
        System.out.println("p is at (" + p.getX() + " ," + p.getY() + ")");
        p.move(5, 6);
        System.out.println("p is at (" + p.getX() + " ," + p.getY() + ")");
    }
```

Like C
- Execution starts in main

Unlike C
- Each multiple mains
- One per class
- Must indicate which one

Java main details

```
public static void main(String args[]) {
```

public: visible outside class
static: one per class
String args[]: array of strings

```
    Point p = new Point(2, 3);
```

Create a new Point
Stored in reference p
xAxis = 2; yAxis = 3

```
    System.out.println("p is at (" + p.getX() + " ," + p.getY() + ")");
```

Output: p is at (2, 3)

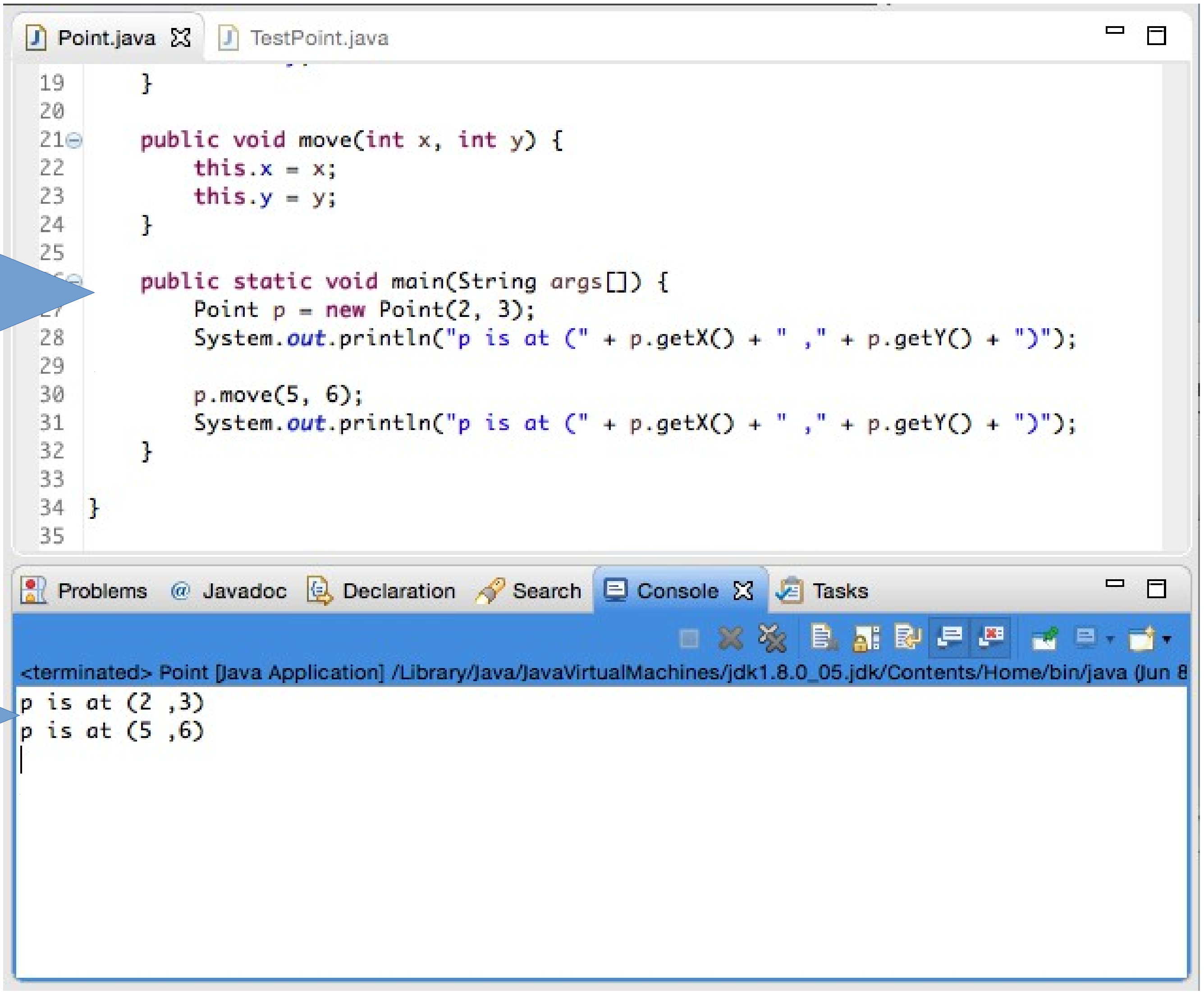
```
    p.move(5, 6);
```

Move to (5, 6)

```
    System.out.println("p is at (" + p.getX() + " ," + p.getY() + ")");
}
```

Output: p is at (5, 6)

Executing the Class



```
    }

    public void move(int x, int y) {
        this.x = x;
        this.y = y;
    }

    public static void main(String args[]) {
        Point p = new Point(2, 3);
        System.out.println("p is at (" + p.getX() + " ," + p.getY() + ")");

        p.move(5, 6);
        System.out.println("p is at (" + p.getX() + " ," + p.getY() + ")");
    }

}
```

```
<terminated> Point [Java Application] /Library/Java/JavaVirtualMachines/jdk1.8.0_05.jdk/Contents/Home/bin/java (Jun 8
p is at (2 ,3)
p is at (5 ,6)
```

Main function

Output