Programming Languages and Techniques (CIS120)

Lecture 35

Swing III: Adapters, Mushroom of Doom, and Paint Revisited

Chapter 30

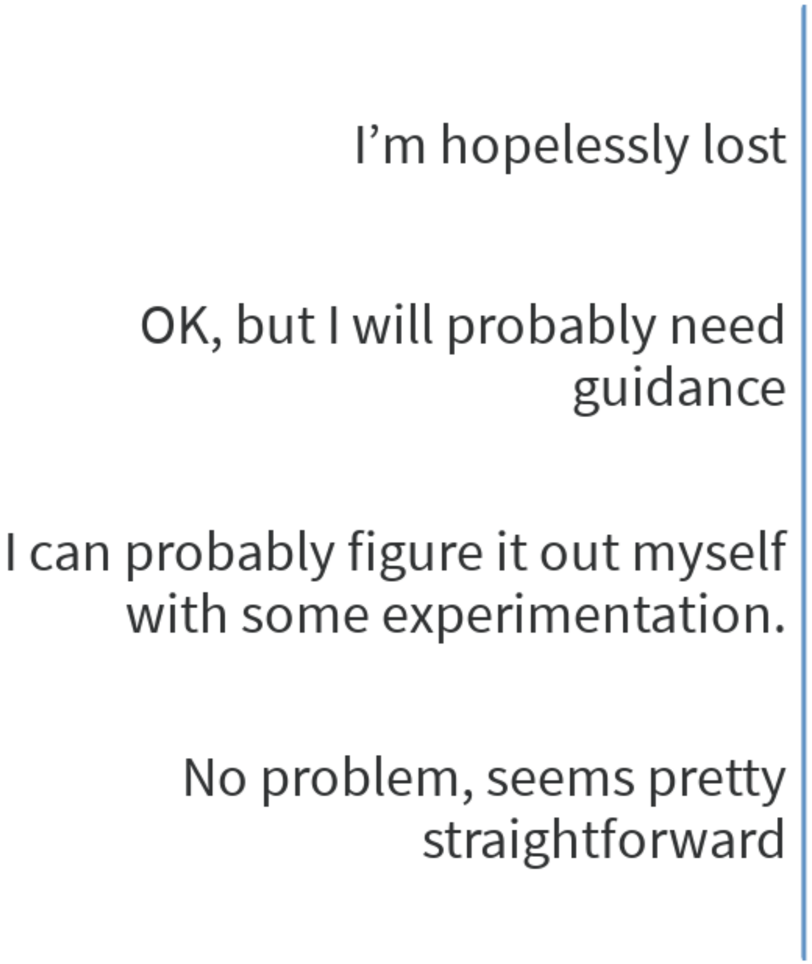
Announcements

- HW8: TwitterBot
  - Due: tomorrow at 11:59pm

- HW9: Game – Due Monday, December 9th at 11:59pm

- Wednesday, November 27th – Bonus Lecture
  - Only 11:00 AM class
  - Material is not needed for HW or Exams
  - Should be fun!

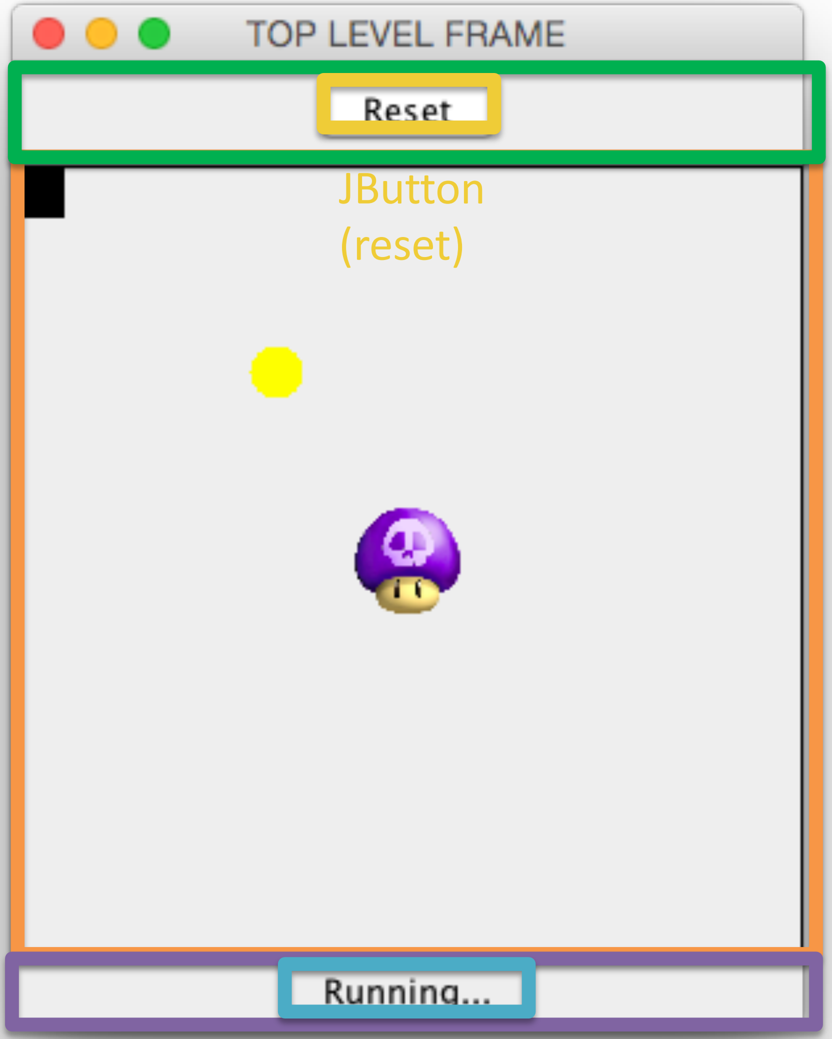
After the lectures so far, how confident are you in your ability to work with Swing?



Total Results

Mushroom of Doom

How do we put Swing components together to make a complete game?



JPanel (control_panel)

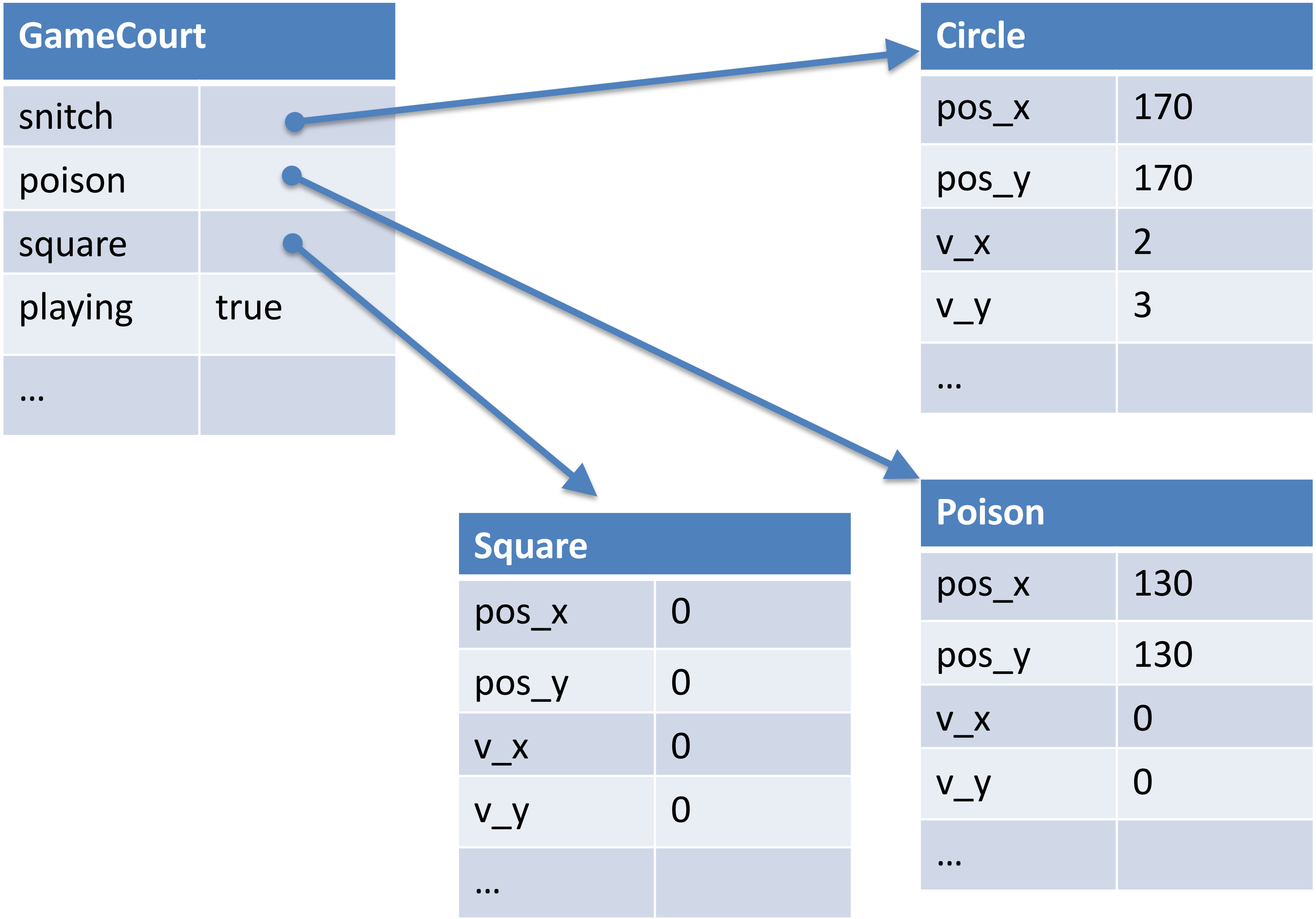
JButton (reset)

GameCourt, subclass of JPanel (court)

JPanel (status_panel)

JLabel (status)

Game State

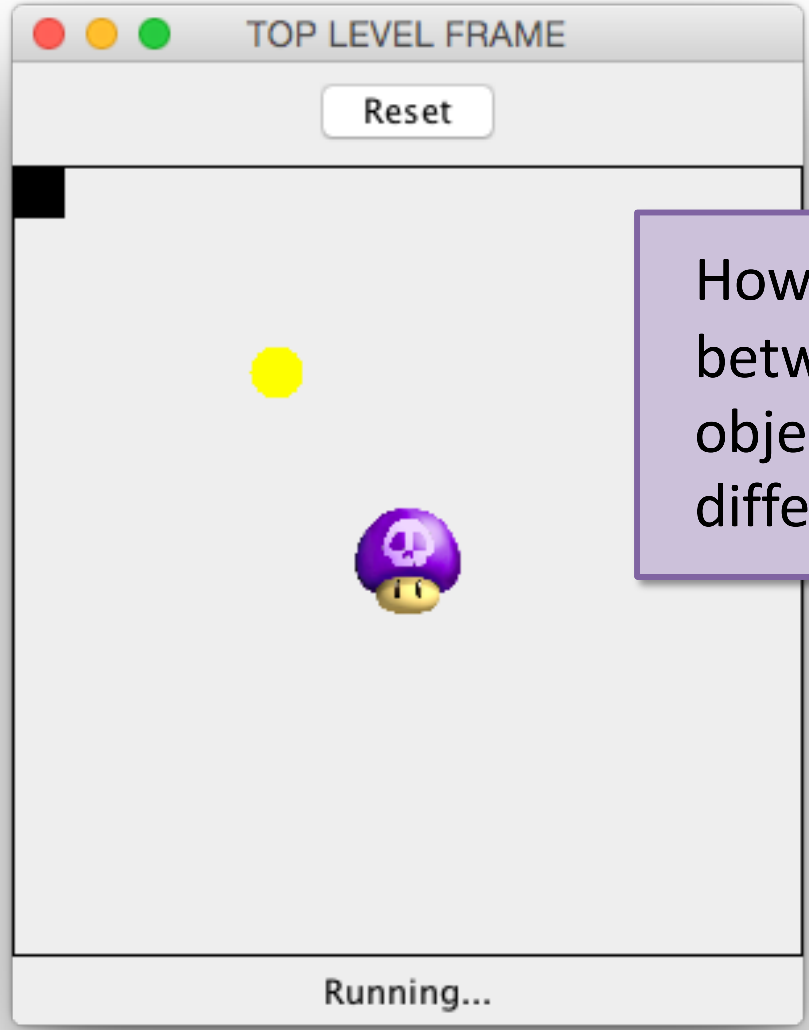


GameCourt	
snitch	
poison	
square	
playing	true
…	

Circle	
pos_x	170
pos_y	170
v_x	2
v_y	3
…	

Square	
pos_x	0
pos_y	0
v_x	0
v_y	0
…	

Poison	
pos_x	130
pos_y	130
v_x	0
v_y	0
…	



How can we share code between the game objects, but show them differently?

Abstract Classes

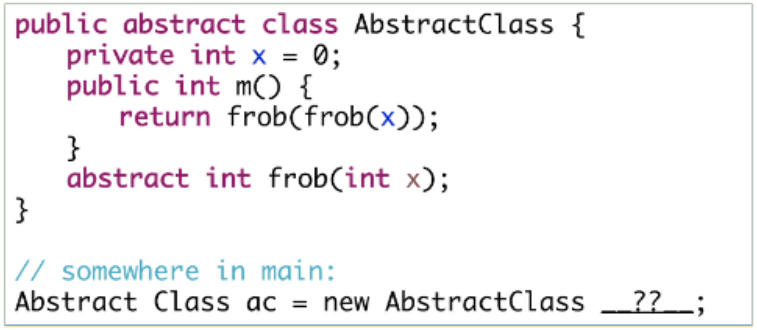
- An abstract class provides an *incomplete* implementation:
  - some methods are marked as abstract
  - those methods must be overridden to create instances

```
public abstract class AbstractClass {
    private int x = 0;
    public int m() {
        return frob(frob(x));
    }
    abstract int frob(int x);
}

class ConcreteClass extends AbstractClass {
    @Override
    int frob(int x) {
        return x * 120;
    }
}
```

Keyword "abstract" marks methods without implementations.

A subclass overrides the abstract method with an implementation.

It is possible to fill in __??__ with code so that, when run, the variable ac will contain an object of type AbstractClass.



```
public abstract class AbstractClass {
    private int x = 0;
    public int m() {
        return frob(frob(x));
    }
    abstract int frob(int x);
}

// somewhere in main:
Abstract Class ac = new AbstractClass __??__;
```

True

False

True or False: It is possible to fill in the hole marked __??__ so that, when run, the variable ac will contain a new object of type AbstractClass.

```
public abstract class AbstractClass {
    private int x = 0;
    public int m() {
        return frob(frob(x));
    }
    abstract int frob(int x);
}

// somewhere in main:
Abstract Class ac = new AbstractClass __??__;
```

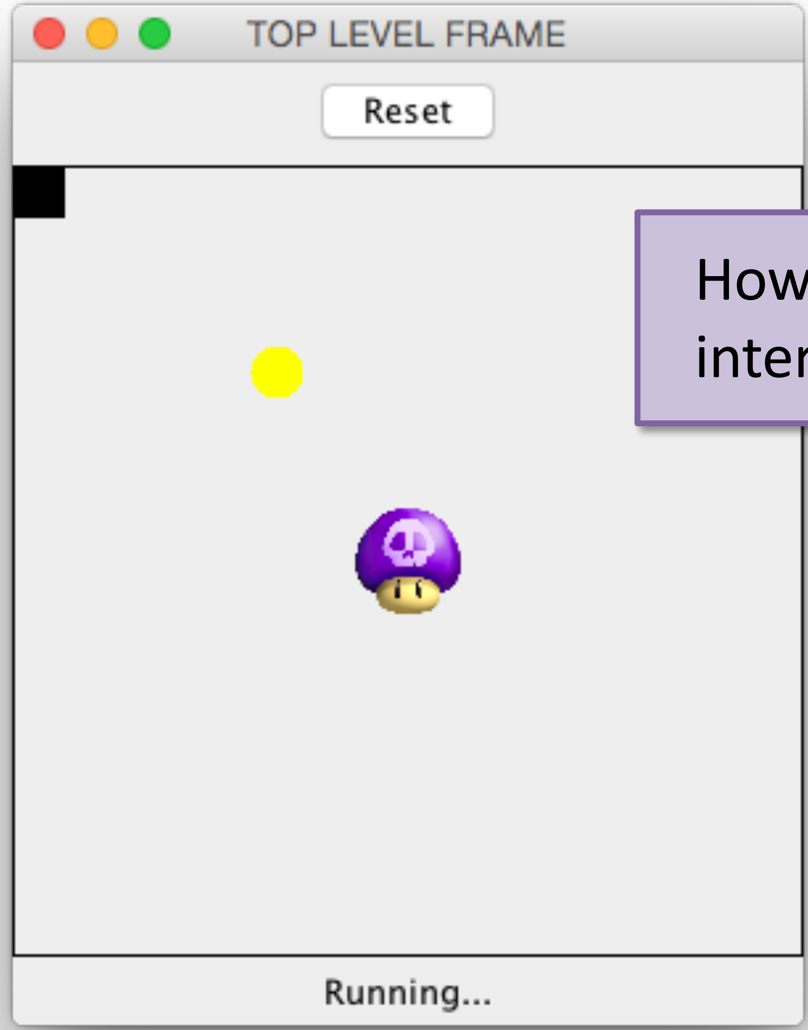
True or False: It is possible to fill in the hole marked __??__ so that, when run, the variable ac will contain a new object of type AbstractClass.

```
public abstract class AbstractClass {
   private int x = 0;
   public int m() {
      return frob(frob(x));
   }
   abstract int frob(int x);
}

// somewhere in main:
Abstract Class ac = new AbstractClass () {
   @Override
   int frob(int x) { return 0; }
};
```

Answer: True – use an anonymous inner class!

Updating the Game State: timer

```
void tick() {
  if (playing) {
    square.move();
    snitch.move();
    snitch.bounce(snitch.hitWall());      // bounce off walls...
    snitch.bounce(snitch.hitObj(poison)); // ...and the mushroom

    if (square.intersects(poison)) {
      playing = false;
      status.setText("You lose!");
    } else if (square.intersects(snitch)) {
      playing = false;
      status.setText("You win!");
    }
    repaint();
  }
}
```



How does the user interact with the game?

1. Clicking Reset button restarts the game
2. Holding arrow key makes square move
3. Releasing key makes square stop

Updating the Game State: keyboard

```
setFocusable(true);
addKeyListener(new KeyAdapter() {
  public void keyPressed(KeyEvent e) {
    if (e.getKeyCode() == KeyEvent.VK_LEFT)
        square.v_x = -SQUARE_VELOCITY;
    else if (e.getKeyCode() == KeyEvent.VK_RIGHT)
        square.v_x = SQUARE_VELOCITY;
    else if (e.getKeyCode() == KeyEvent.VK_DOWN)
        square.v_y = SQUARE_VELOCITY;
    else if (e.getKeyCode() == KeyEvent.VK_UP)
        square.v_y = -SQUARE_VELOCITY;
    }

    public void keyReleased(KeyEvent e) {
        square.v_x = 0;
        square.v_y = 0;
    }
});
```

Allow the court to handle key events

Make square's velocity nonzero when a key is pressed

Make square's velocity zero when a key is released

Adapters

MouseAdapter

KeyAdapter

Two interfaces for mouse listeners

```
interface MouseListener extends EventListener {
  public void mouseClicked(MouseEvent e);
  public void mouseEntered(MouseEvent e);
  public void mouseExited(MouseEvent e);
  public void mousePressed(MouseEvent e);
  public void mouseReleased(MouseEvent e);
}
```

```
interface MouseMotionListener extends EventListener {
   public void mouseDragged(MouseEvent e);

   public void mouseMoved(MouseEvent e);
}
```

Lots of boilerplate

- There are seven methods in the two interfaces.
- We only want to do something interesting for three of them.
- Need "trivial" implementations of the other four to implement the interface…

```
public void mouseMoved(MouseEvent e)   { return; }
public void mouseClicked(MouseEvent e) { return; }
public void mouseEntered(MouseEvent e) { return; }
public void mouseExited(MouseEvent e)  { return; }
```

- Solution: MouseAdapter class…

Adapter classes:

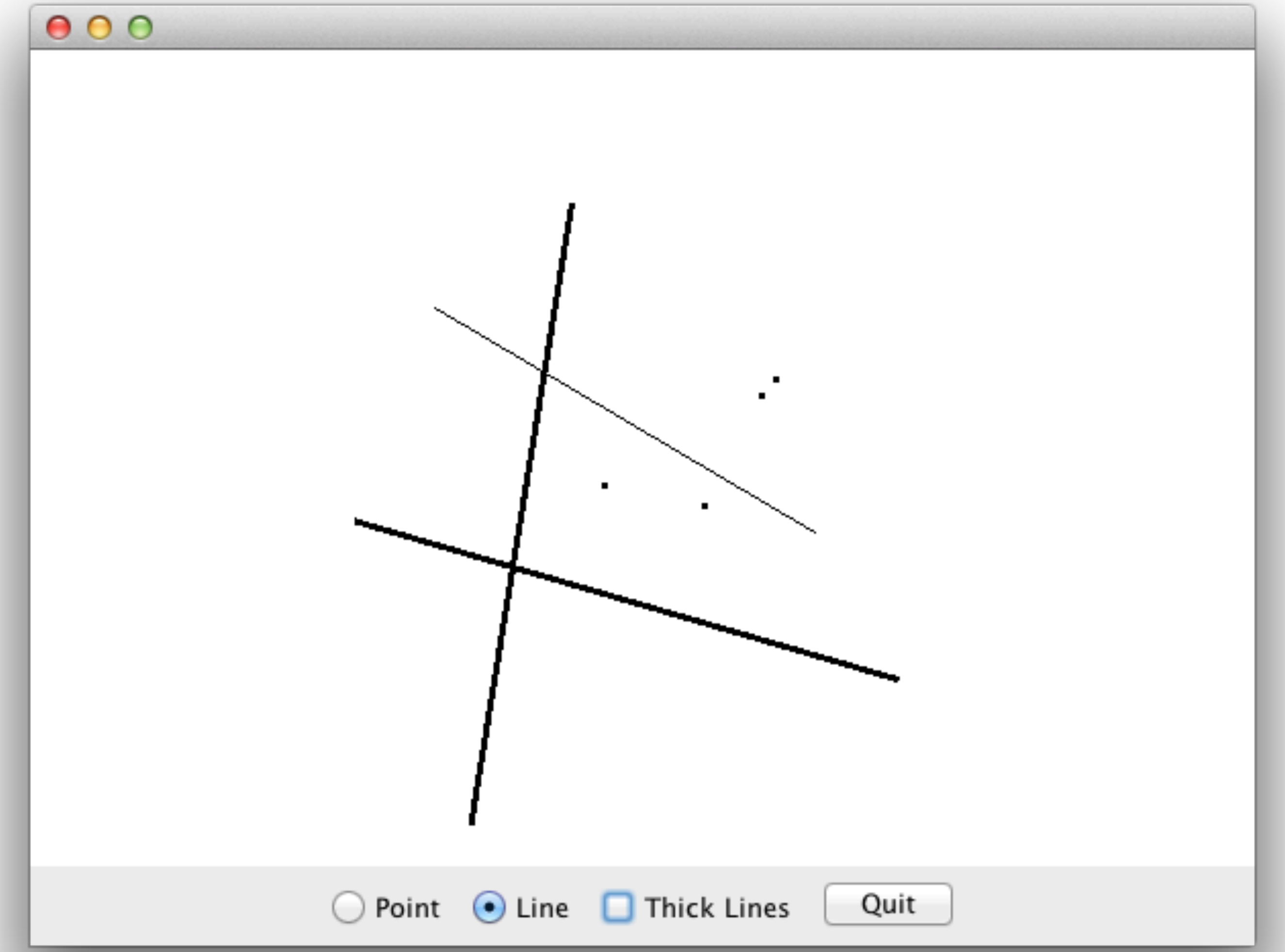
- Swing provides a collection of abstract event adapter classes
- These adapter classes implement listener interfaces with empty, do-nothing methods
- To implement a listener class, we extend an adapter class and override just the methods we need

```
private class Mouse extends MouseAdapter {
   public void mousePressed(MouseEvent e) { … }
   public void mouseReleased(MouseEvent e) { … }
   public void mouseDragged(MouseEvent e) { … }
}
```

Paint Revisited

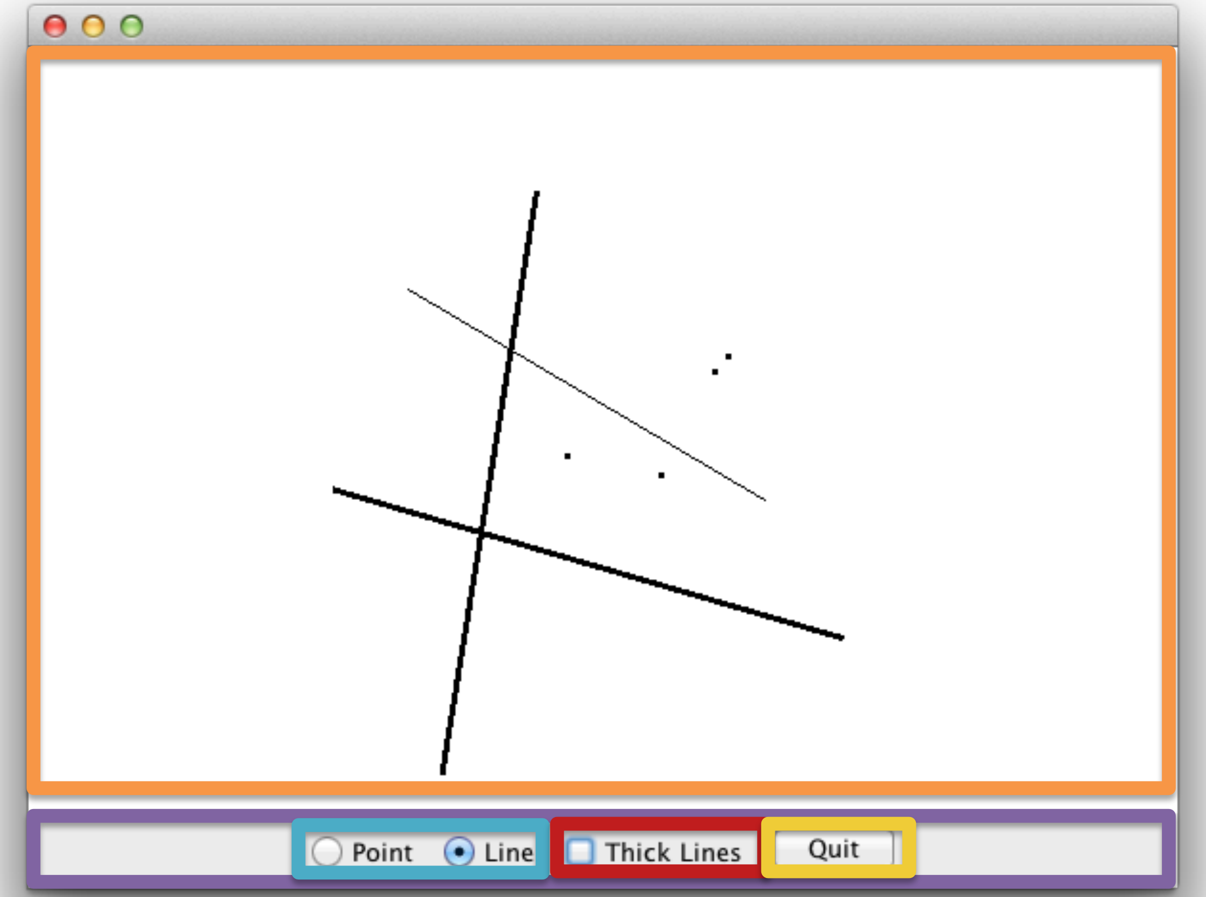
Using Anonymous Inner Classes

Refactoring for OO Design



What layout would you use for this app? What components would you use?

Canvas subclass of JPanel (canvas)



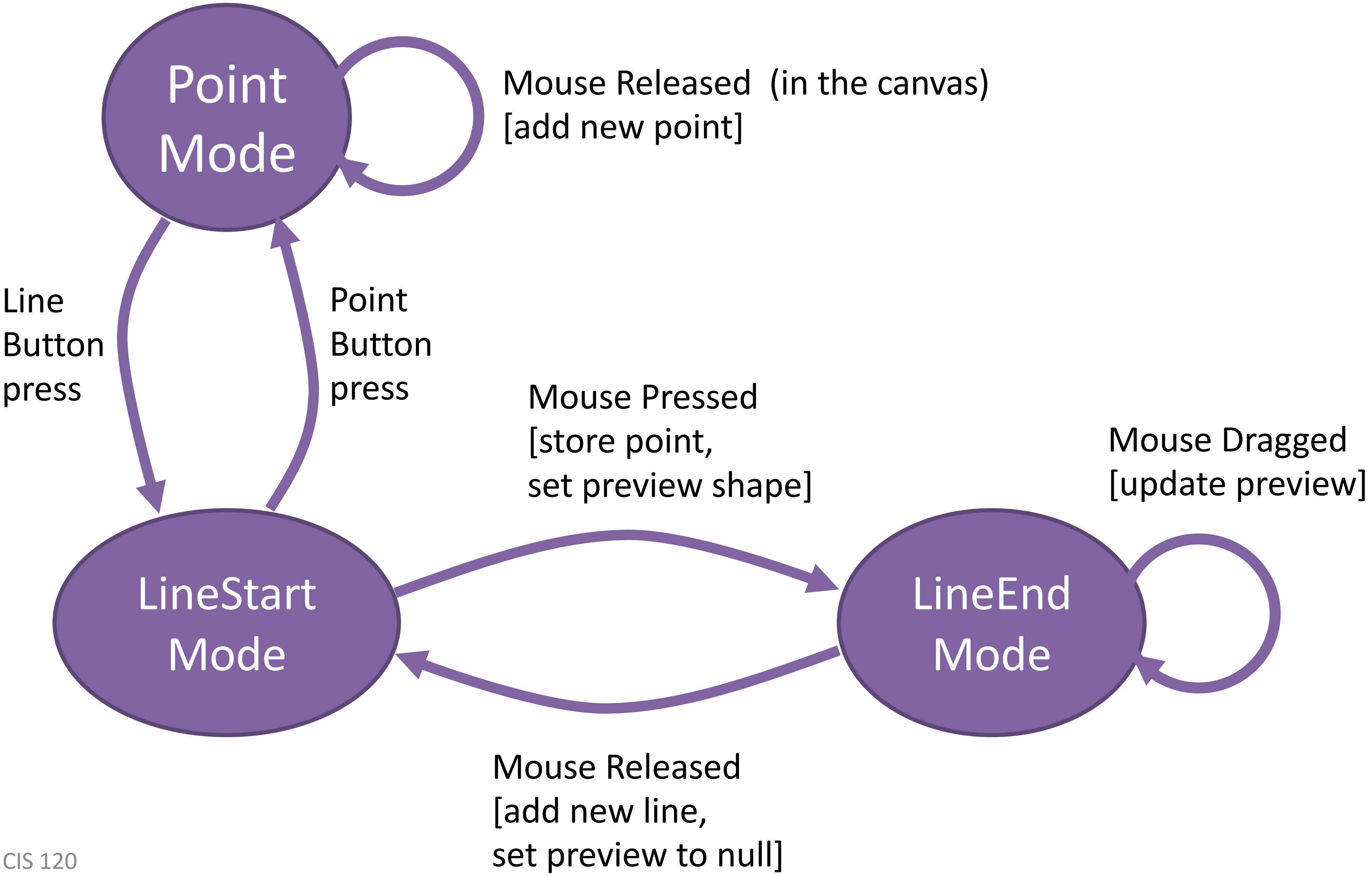
JPanel (toolbar)

JRadioButton (point, line)

JCheckbox (thick)

JButton (quit)

Mouse Interaction in Paint



Paint Revisited (thoroughly discussed in Chap 31)

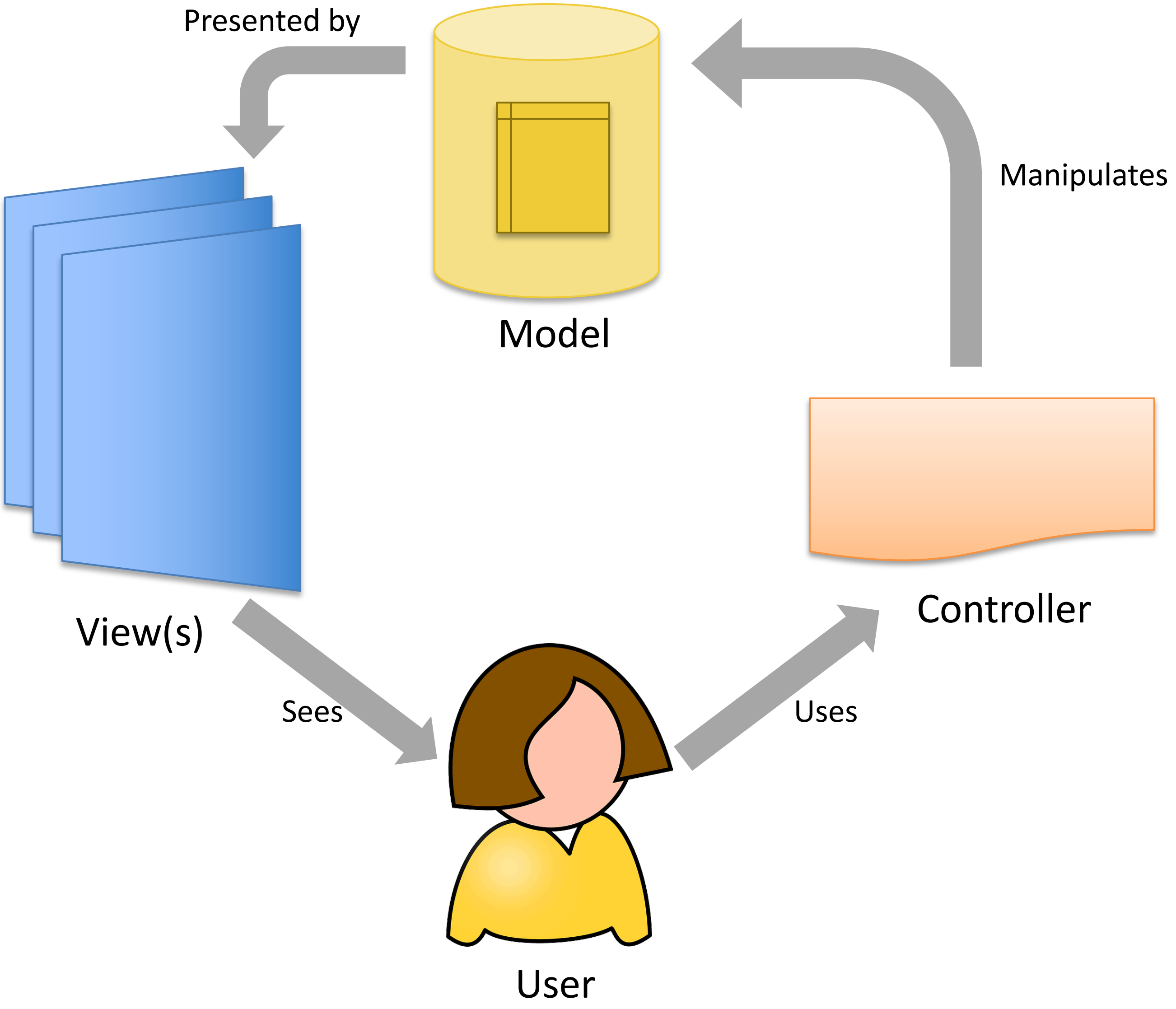
Using Anonymous Inner Classes

Refactoring for OO Design

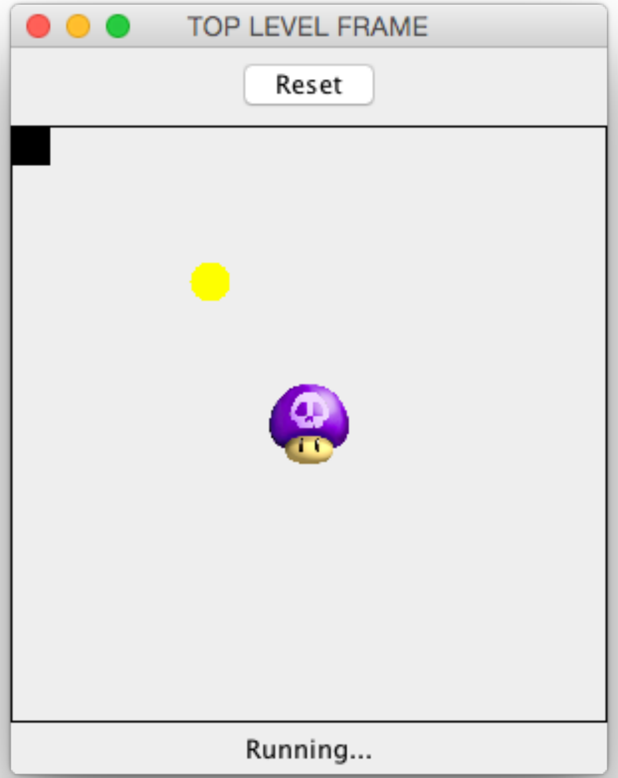
(See PaintA.java … PaintE.java)

Model View Controller Design Pattern

MVC Pattern


Presented by
Model
Manipulates
View(s)
Controller
Sees
Uses
User

Example 1: Mushroom of Doom



Example: MOD Program Structure

- GameCourt, GameObj + subclass local state
  - object location & velocity
  - status of the game (playing, win, loss)
  - how the objects interact with eachother (tick)

Model

- Draw methods
  - paintComponent in GameCourt
  - draw methods in GameObj subclasses
  - status label

View

- Game / GameCourt
  - Reset button (updates model)
  - Keyboard control (updates square velocity)

Controller

Example: Paint Program Structure

- Main frame for application (class Paint)
  - List of shapes to draw
  - The current color
  - The current line thickness

Model

- Drawing panel (class Canvas, inner class of Paint)

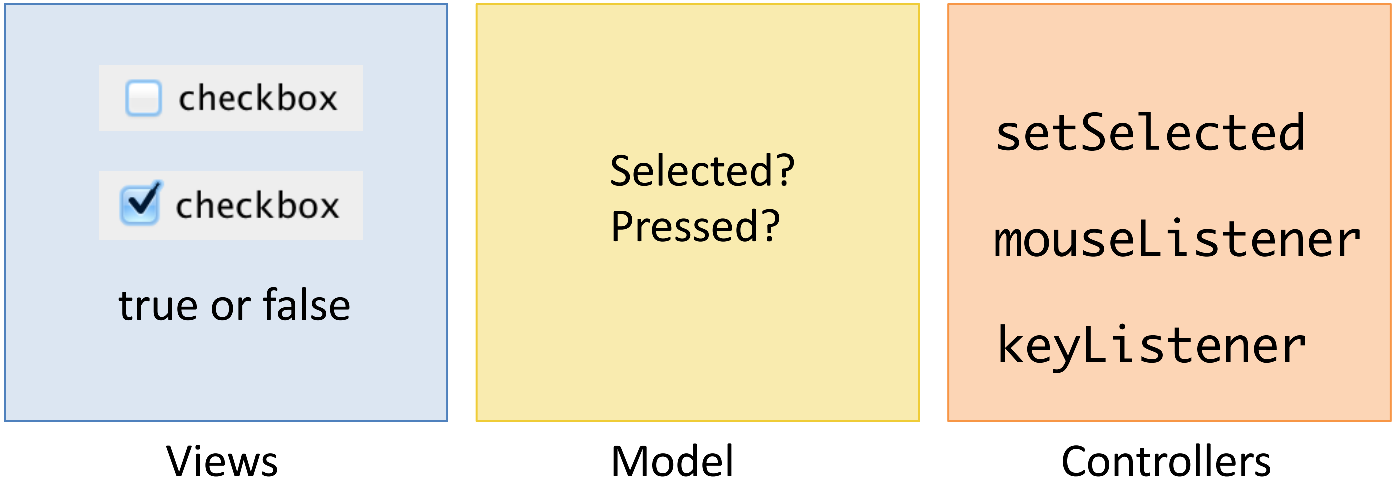
View

- Control panel (class JPanel)
  - Contains radio buttons for selecting shape to draw
  - Line thickness checkbox, undo and quit buttons

Controller

- Connections between Preview shape (if any…)
  - Preview Shape: View <-> Controller
  - MouseAdapter: Controller <-> Model

Example: CheckBox



□ checkbox

☑ checkbox

true or false

Selected?
Pressed?

setSelected

mouseListener

keyListener

Views

Model

Controllers

`Class JToggleButton.ToggleButtonModel`

`boolean isSelected()`	Checks if the button is selected.
`void setPressed(boolean b)`	Sets the pressed state of the button.
`void setSelected(boolean b)`	Sets the selected state of the button.

Example: Chat Server

```
getChannels
getUsers
getOwner
…
```

Views

Internal Representation

```
owners: Map<Channel,
            Users>
users: Map<Channel,

Set<Users>>
…
```

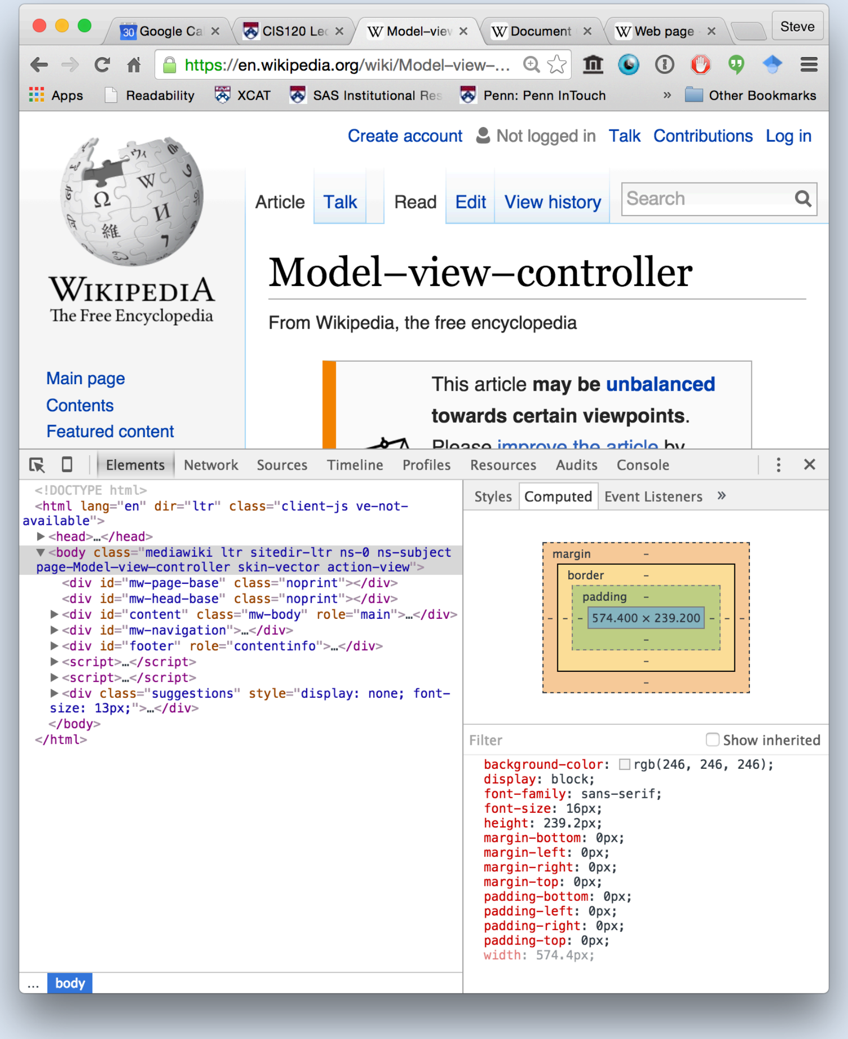
Model

```
createChannel
joinChannel
invite
kick
…
```

Controllers

`ServerModel`

Example: Web Pages



Model–view–controller

From Wikipedia, the free encyclopedia

This article **may be unbalanced towards certain viewpoints**. Please improve the article by

```
<!DOCTYPE html>
<html lang="en" dir="ltr" class="client-js ve-not-
available">
  ▶<head>…</head>
  ▼<body class="mediawiki ltr sitedir-ltr ns-0 ns-subject
  page-Model-view-controller skin-vector action-view">
      <div id="mw-page-base" class="noprint"></div>
      <div id="mw-head-base" class="noprint"></div>
    ▶<div id="content" class="mw-body" role="main">…</div>
    ▶<div id="mw-navigation">…</div>
    ▶<div id="footer" role="contentinfo">…</div>
    ▶<script>…</script>
    ▶<script>…</script>
    ▶<div class="suggestions" style="display: none; font-
    size: 13px;">…</div>
    </body>
</html>
```

```
background-color: □rgb(246, 246, 246);
display: block;
font-family: sans-serif;
font-size: 16px;
height: 239.2px;
margin-bottom: 0px;
margin-left: 0px;
margin-right: 0px;
margin-top: 0px;
padding-bottom: 0px;
padding-left: 0px;
padding-right: 0px;
padding-top: 0px;
width: 574.4px;
```

Views

Internal Representation: DOM (Document Object Model)

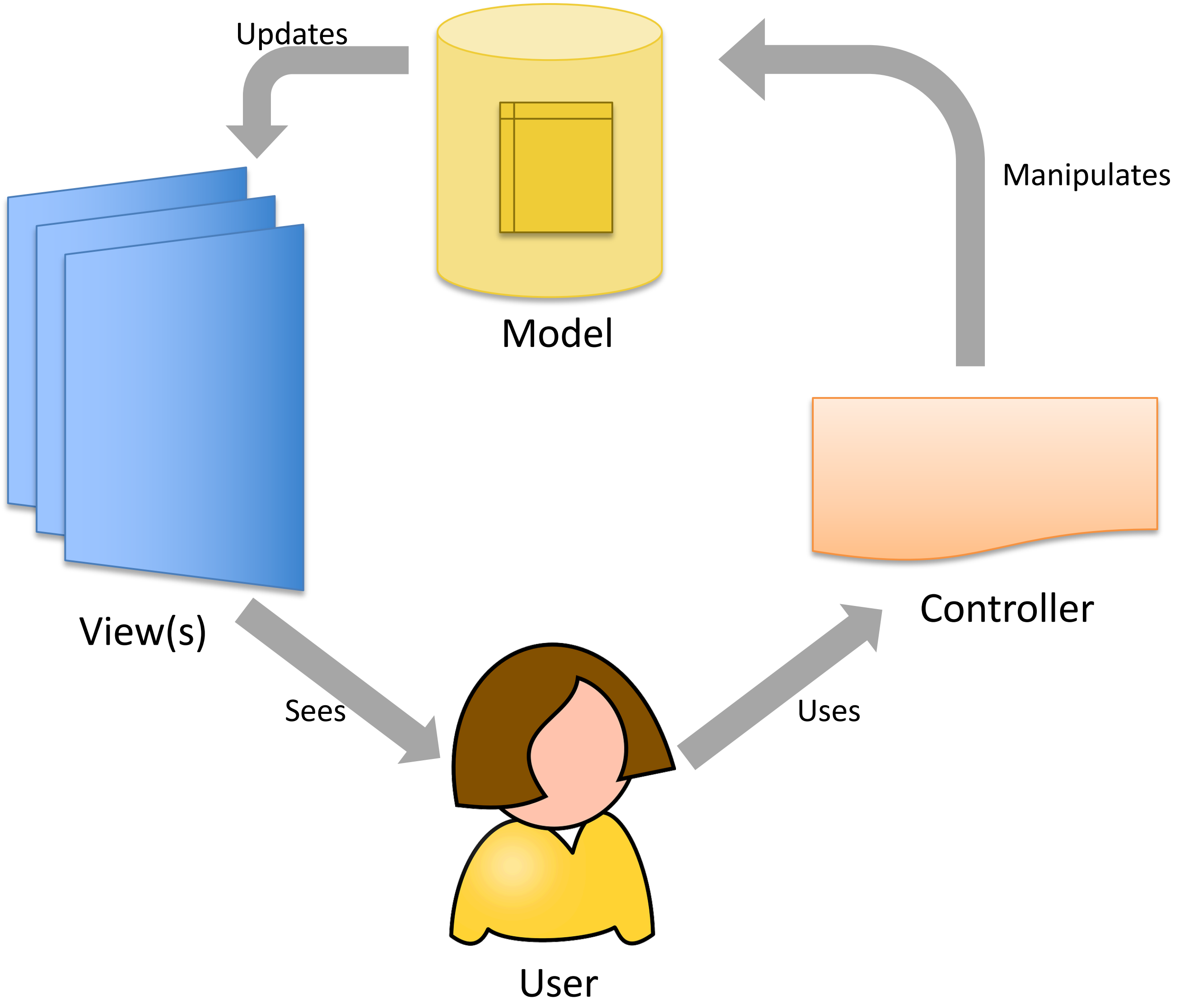
Model

JavaScript API

`document.addEventListener()`

Controllers

MVC Pattern


Updates
Model
Manipulates
View(s)
Controller
Sees
Uses
User

MVC Benefits?

- Decouples important "model state" from how that state is presented and manipulated
  - Suggests where to insert interfaces in the design
  - Makes the model testable independent of the GUI

- Multiple views
  - e.g. from two different angles, or for multiple different users

- Multiple controllers
  - e.g. mouse vs. keyboard interaction

MVC Variations

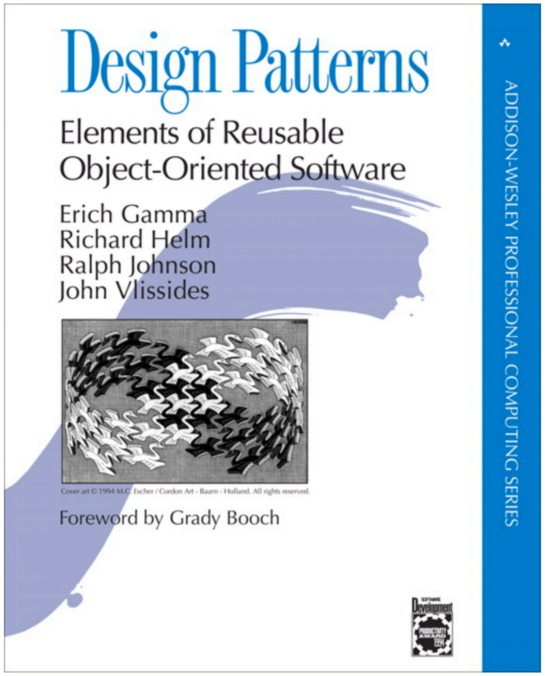
- Many variations on MVC pattern

- Hierarchical / Nested
  - As in the Swing libraries, in which JComponents often have a "model" and a "controller" part

- Coupling between Model / View or View / Controller
  - e.g. in MOD the Model and the View are coupled because the model carries most of the information about the view

Design Patterns

- Design Patterns
  - Influential OO design book published in 1994 (so a bit dated)
  - Identifies many common situations and "patterns" for implementing them in OO languages


Design Patterns
Elements of Reusable Object-Oriented Software
Erich Gamma
Richard Helm
Ralph Johnson
John Vlissides
Cover art © 1994 M.C. Escher / Cordon Art - Baarn - Holland. All rights reserved.
Foreword by Grady Booch
ADDISON-WESLEY PROFESSIONAL COMPUTING SERIES

- Some we have seen explicitly:
  - e.g. *Iterator* pattern
- Some we've used but not explicitly described:
  - e.g. The Broadcast class from the Chat HW uses the *Factory* pattern
- Some are workarounds for OO's lack of some features:
  - e.g. The *Visitor* pattern is like OCaml's fold + pattern matching