Model-View-Controller

CSE 331 – Section 8

11/15/2012

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with material from Krysta Yousoufian, Jackson Roberts, Hal Perkins

Agenda

- hw4, hw6 being graded
- hw7 due tonight
- Midterms from Hal

- hw8 due Tuesday after Thanksgiving (11/27)
- Today: MVC, callbacks, hw8 demo

Comparator vs. Comparable

- You’re familiar with Comparable<E>, which makes sense when there’s a natural ordering on E – for example strings, ints

- But there’s a lot of times when you’ll have sorting needs for a type specific to one instance
  - Point – sort by x? y? dist from origin? angle?

Comparator<T>

- Interface requiring one method
  - public int compare(T o1, T o2)

- Examples:

```
class PointMagnitudeComparator
            implements Comparator<Point> {
public  int compare(Point p1, Point p2) {
   double p1Mag = Math.sqrt(p1.x*p1.x +
                                       p1.y*p1.y);
   double p2Mag = Math.sqrt(p2.x*p2.x +
                                       p2.y*p2.y);
   return (int) (p1Mag – p2Mag);
 }
}
```

```
class PointYCoordComparator
            implements Comparator<Point> {
 public int compare(Point p1, Point p2) {
            return p1.Y - p2.Y;
 }
}
```

Using Comparator<T>

- Comparators can be used anywhere a Comparable class is taken

- Examples:

```
Comparator<Point>  cp = new PointMagnitudeComparator();

Set<Point> sortedSet = new TreeSet<Point>(cp);

List<Point> pointList = new ArrayList<Point>();
Collections.sort(pointList, cp);
```

MVC

- THE classic design pattern
- Used for data-driven user applications
- Such apps juggle several tasks:
  - **Loading** and **storing** the **data** – getting it in/out of storage on request
  - **Constructing** the **user interface** – what the user sees
  - **Interpreting user actions** – deciding whether to modify the UI or data
- These tasks are largely independent of each other
- Model, View, and Controller each get one task

Model

talks to data source to retrieve and store data

Which database tables is the requested data stored in?

What SQL query will get me the data I need?

View

asks model for data and presents it in a user-friendly format

Would this text look better blue or red? In the bottom corner
or front and center?

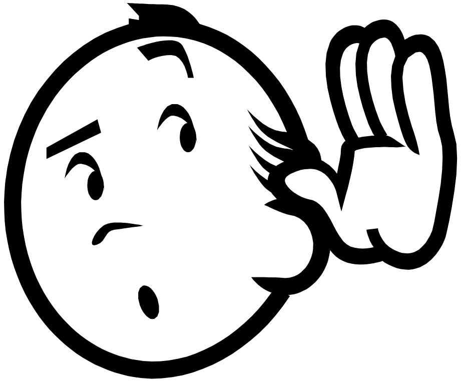
Should these items go in a dropdown list or radio buttons?

Controller

listens for the user to change data or state in the UI, notifying the model or view accordingly

The user just clicked the “hide details” button. I better tell the view.

The user just changed the event details. I better let the model know to update the data.



MVC: Summary

Model

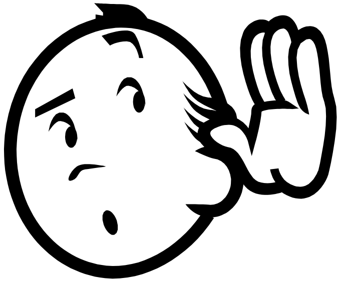
talks to data source to retrieve and store data

View

asks model for data and presents it in a user-friendly format

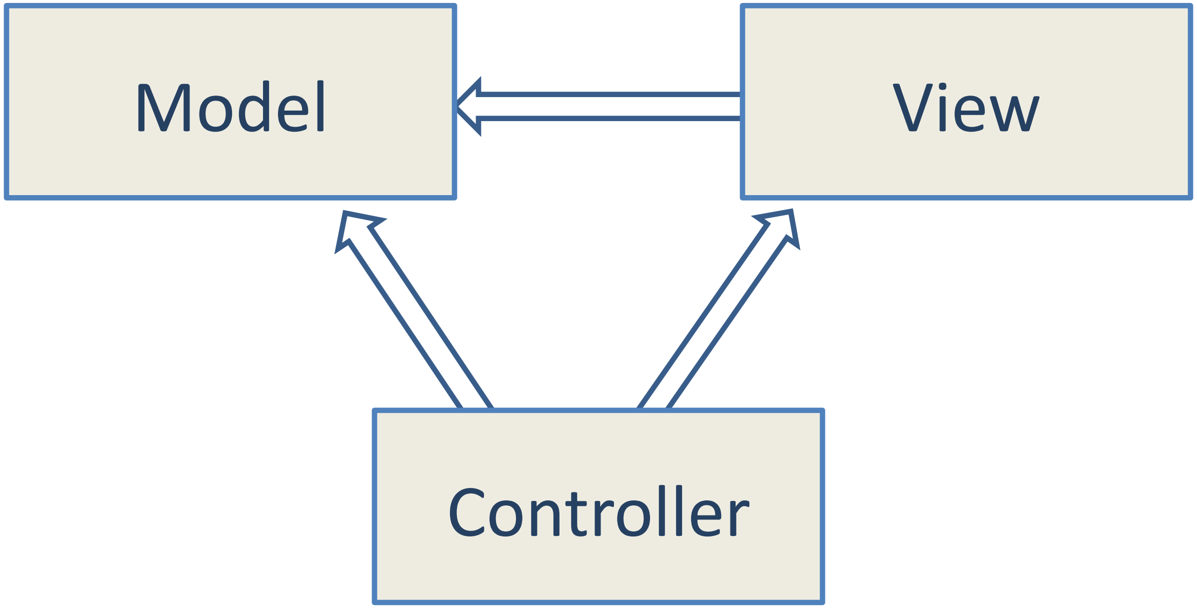
Controller

listens for the user to change data or state in the UI, notifying the model or view accordingly



Communication Flow

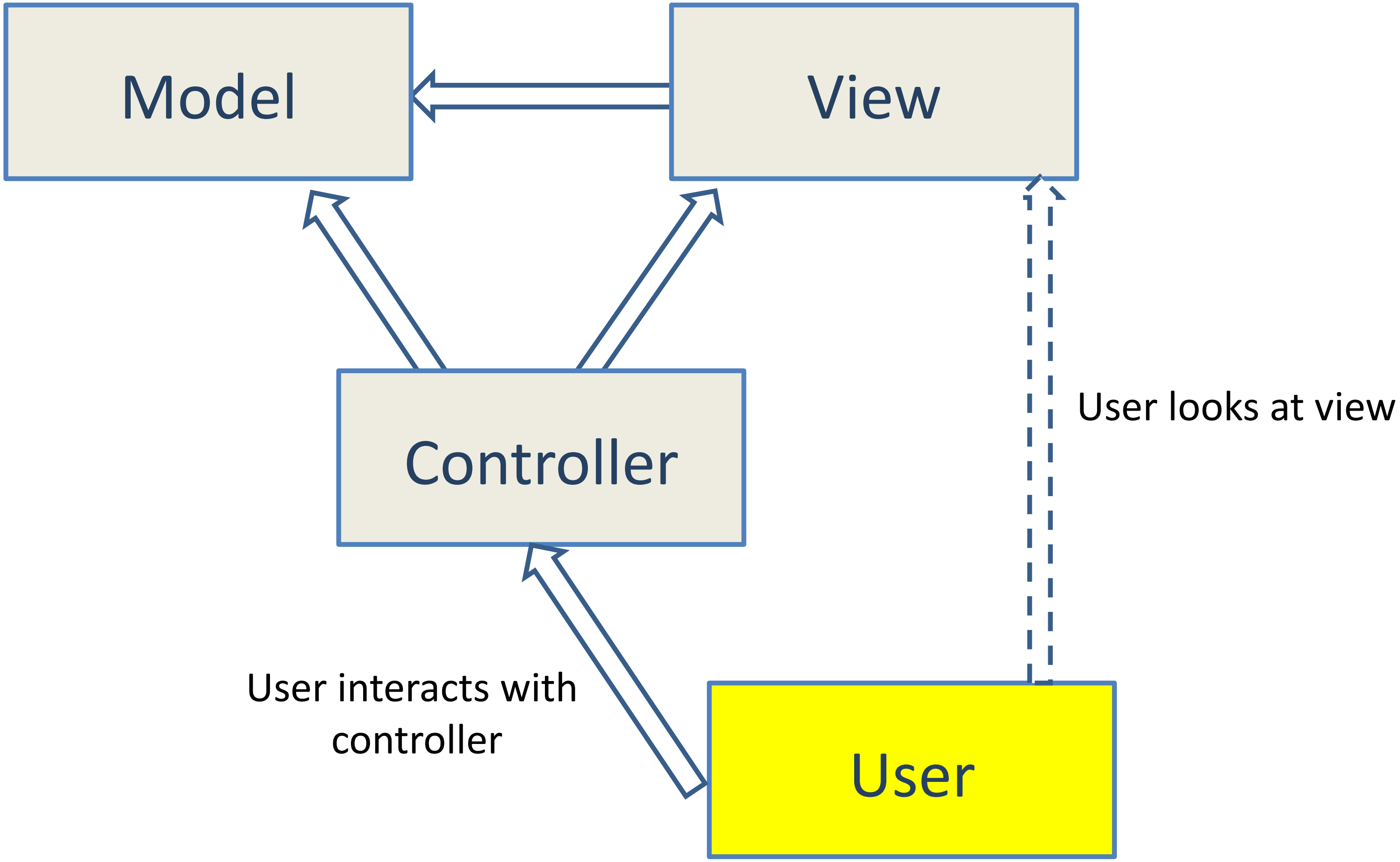
Taken from http://msdn.microsoft.com/en-us/library/ff649643.aspx



Benefits of MVC

- Organization of code
  - Maintainable, easy to find what you need
- Ease of development
  - Build and test components independently
  - Different people work on different parts at the same time, designers can work on the view even if they don’t understand code
- Flexibility
  - Swap out views for different presentations of the same data (ex: calendar daily, weekly, or monthly view)
  - Swap out models to change data storage without affecting user

Communication Flow & User Interaction

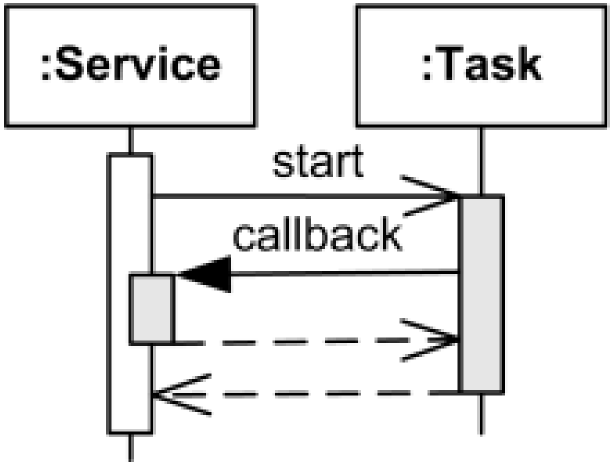


Communication Flow & User Interaction

- If the user only interacts with controller, then how to update view, model?
  - Callbacks
- Remember callbacks are different than calls
  - Think synchronous and asynchronous
  - Not blocking & non-blocking

Callbacks

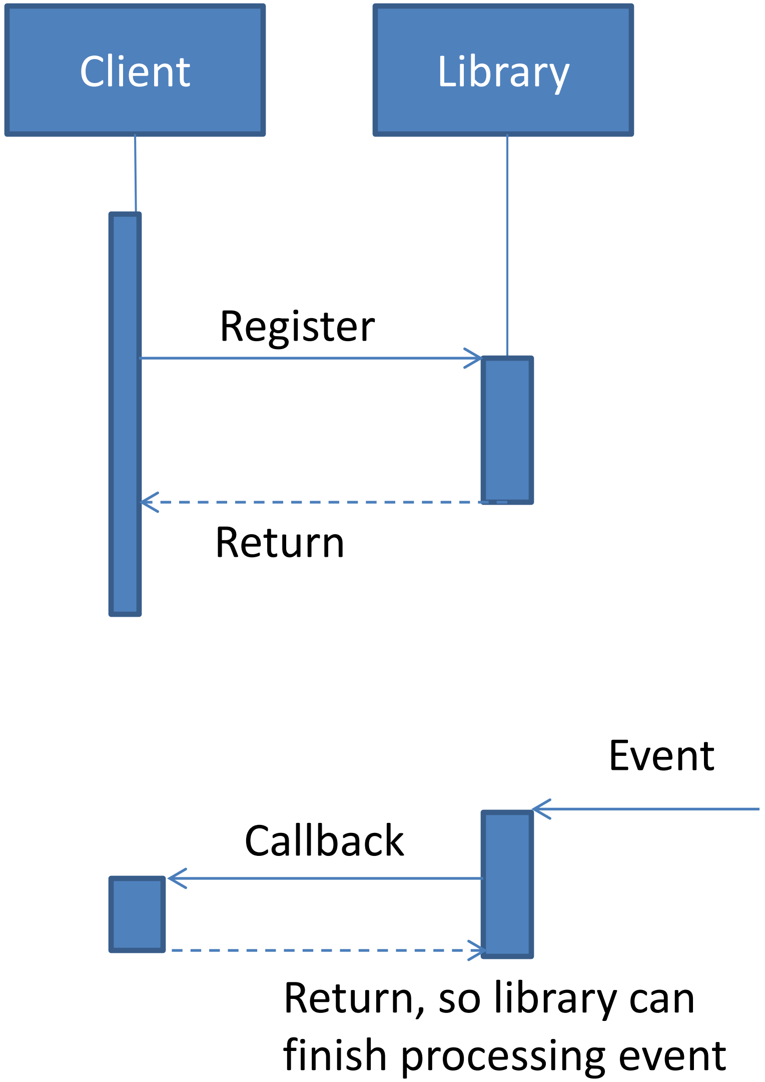
- Synchronous callbacks:
  - Examples: HashMap calls its client's hashCode, equals
  - Useful when the callback result is needed immediately by the library
- Asynchronous callbacks:
  - Examples: GUI listeners
  - *Register* to indicate interest and where to call back
  - Useful when the callback should be performed later, when some interesting event occurs



A synchronous callback.
Time increases downward.
Solid lines: calls
Dotted lines: returns

Asynchronous callbacks

- Asynchronous callbacks:
  - Examples: GUI listeners
  - *Register* to indicate interest
    and where to call back
  - Useful when the callback should be performed later, when some interesting event occurs



Asynchronous callbacks

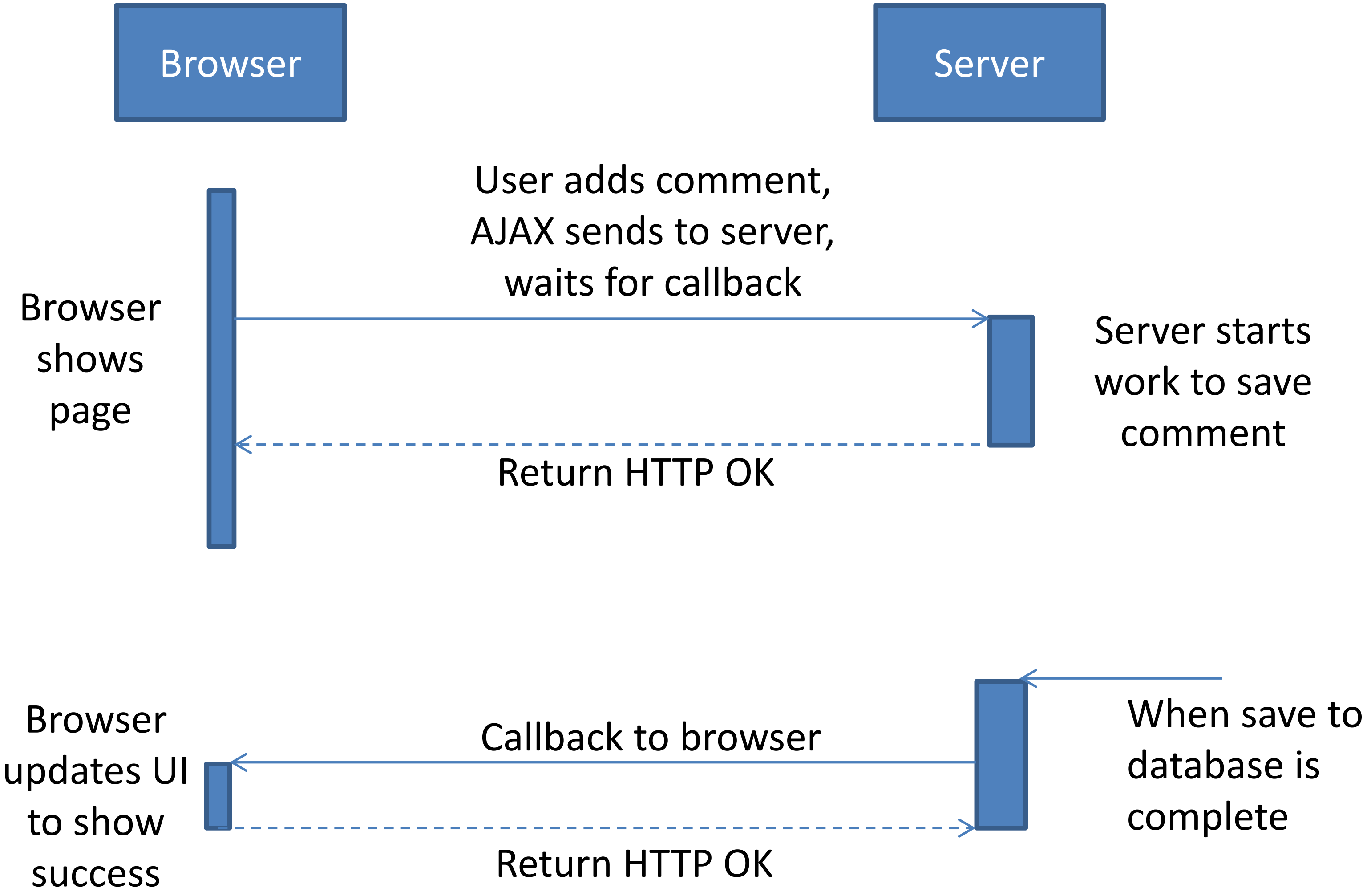
- Calendar asynchronous callback demo
  - Form’s calendar registers to receive click events by adding the ineraction method to calendar’s list of methods to call when it’s clicked.

```
this.calendar1.DateChanged +=
   new Forms.DateRangeEventHandler(
     this.calendar1_DateChanged
);
```

  - When calendar is clicked it alerts everyone who signed up to be notified of the click.
  - The callback is executed

```
private void monthCalendar1_DateChanged(
  object sender,
  DateRangeEventArgs e) {
     MessageBox.Show("Calendar clicked: " + e.Start);
}
```

AJAX



Browser

Server

User adds comment, AJAX sends to server, waits for callback

Browser shows page

Server starts work to save comment

Return HTTP OK

When save to database is complete

Callback to browser

Browser updates UI to show success

Return HTTP OK

Callbacks & MVC

- Controller utilizes callbacks to respond to user events, update the model

- View uses callbacks to update when the model changes

- Callbacks are used very commonly outside MVC as well, especially in distributed systems

MVC in industry

- Image stitcher demo

  http://research.microsoft.com/en-us/um/redmond/groups/ivm/ice/

- Ruby on Rails / Django enforce programmatically
  - models, views, and controllers folders

  http://code.google.com/p/lab-specimen-transport-system/

Homework 8

- Applying your generic graph & Dijkstra's to campus map data

- Given a list of buildings, and walking paths

- Produce routes from one building to another on the walking paths

- Command-line interface now, GUI in HW9

Homework 8 Data Format

- List of buildings (abbrev, long name, loc in pixels):

```
BAG      Bagley Hall (East Entrance)       1914.51031709.8816
BAG (NE) Bagley Hall (Northeast Entrance)   1878.37861661.4083
BGR      By George          1671.54991258.4333
```

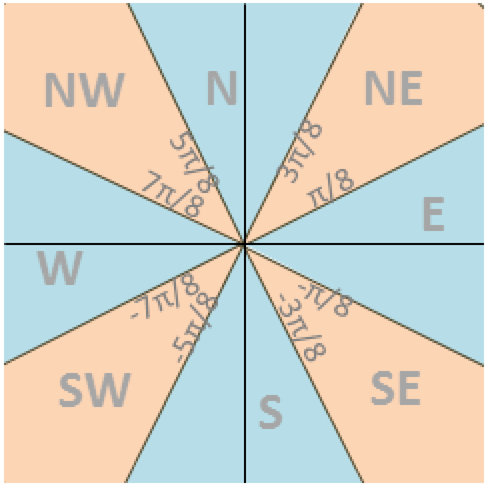
- List of paths (betweeen two pixels, dist in feet):

```
1903.7201,1952.4322
         1906.1864,1939.0633: 26.583482327919597
         1897.9472,1960.0194: 20.597253035175832
         1915.7143,1956.5: 26.68364745009741
2337.0143,806.8278
         2346.3446,817.55768: 29.685363221542797
         2321.6193,788.16714: 49.5110360968527
         2316.4876,813.59229: 44.65826043418031
```

- Remember (0,0) is in the upper left (not lower)

Homework 8 Output

- List of walking directions between two given points
  - Distance in feet
  - Directions:



- Demo

MVC in HW8

- Model stores graph, performs Dijkstra’s

- View shows results to users in text format

- Controller takes user commands and uses view to show results

- View and Controller changed in HW9, but Model stays the same

MVC Example – Traffic Signal

- Regulate valid traffic movements (i.e don't run cars into each other)
- Detect cars waiting to enter intersection
- Detect pedestrians waiting to cross street.
- Traffic lights to direct car traffic
- Pedestrian signals to direct peds to cross
- Manual override for particular lights (i.e. disable traffic signals for a parade)
- External timer which triggers changes in light at set interval

MVC Example – Traffic Signal

- Model:
  - stores current state of traffic flow
  - stores whether cars and pedestrians who are waiting
  - "Java" interface:
    ```
    getCurrentTrafficDirection()
    carWaiting(direction)
    pedWaiting(direction)
    timeStep()  // May skip a light cycle
    ```
  - Implements Observable

MVC Example – Traffic Signal

- Views:
  - CarLight
    - Each instance knows what direction it is associated with.
    - Observes TrafficModel
  - PedLight
    - same as CarLight, but for pedestrians

MVC Example – Traffic Signal

- Controllers:
  - PedButton
    - Is aware of what TrafficModel it controls, and its direction
    - When triggered, calls pedWaiting(direction) on that TrafficModel
  - CarDetector
    - is aware of TrafficModel and direction
    - When triggered, calls carWaiting(direction)

MVC Example – Traffic Signal

- Controllers (cont'd):
  - LightSwitch:
    - aware of what light it controls
    - when triggered, enables or disables the light
  - Timer:
    - Somehow regulates time (how is not important)
    - aware of a TrafficModel
    - calls timeStep() at a regular interval

MVC Example – Registration

- Registration system with web interface
- Advisors create classes, set space, time, restrictions
- Professors can see who’s signed up for their class
- Students can sign up for classes, see available classes, see what they’ve signed up for
- Administrators can place holds on student registration
- Professors can be notified when a student drops
- Students can be notified when a spot is available in a class they want

MVC Example – Wrapup

- Did you imagine a push or a pull model (or both)?

- What would change for interaction with an API, or mobile app?

- Now advisors can see what students are registered for, change their registration, what changes?