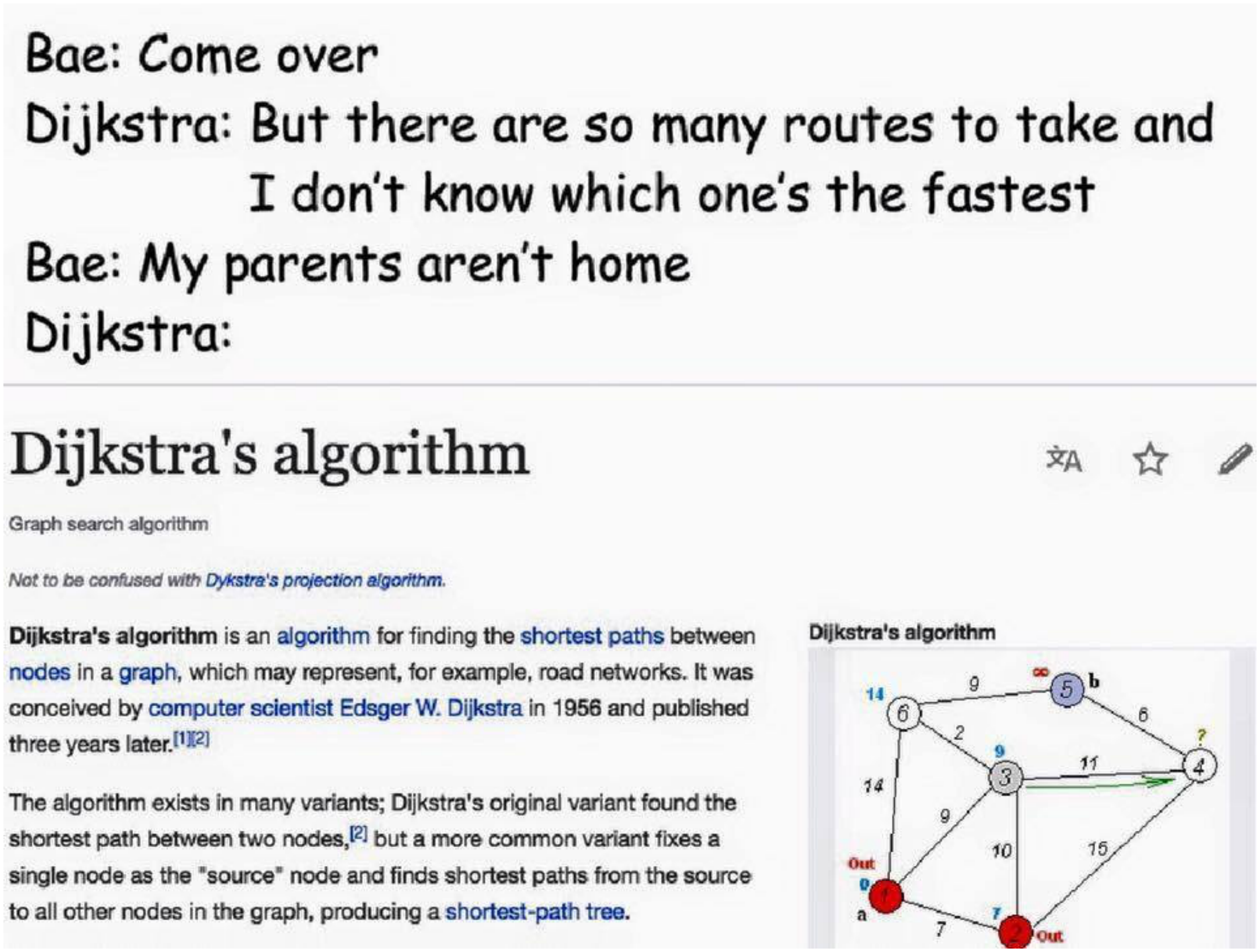


Bae: Come over

Dijkstra: But there are so many routes to take and I don't know which one's the fastest

Bae: My parents aren't home

Dijkstra:

# Dijkstra's algorithm

Graph search algorithm

*Not to be confused with Dykstra's projection algorithm.*

**Dijkstra's algorithm** is an algorithm for finding the shortest paths between nodes in a graph, which may represent, for example, road networks. It was conceived by computer scientist Edsger W. Dijkstra in 1956 and published three years later.[1][2]

The algorithm exists in many variants; Dijkstra's original variant found the shortest path between two nodes,[2] but a more common variant fixes a single node as the "source" node and finds shortest paths from the source to all other nodes in the graph, producing a shortest-path tree.

**Dijkstra's algorithm**

# Section 8:
Model-View-Controller
and HW 8

Slides adapted from Alex Mariakakis

with material from Krysta Yousoufian, Kellen Donohue, and James Fogarty

## Agenda

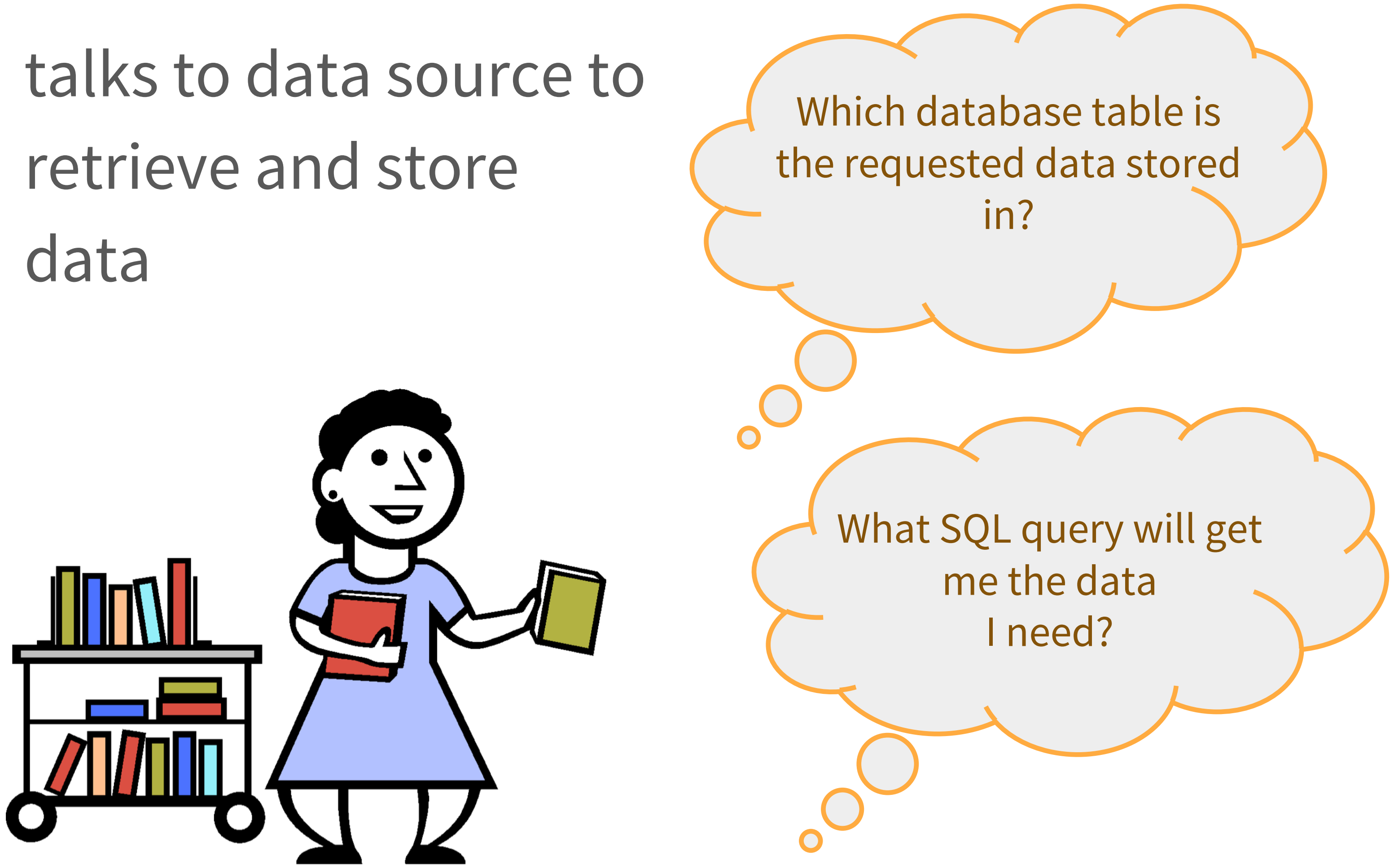
- Homeworks
    - Homework 7 due last night (5/16)
    - Homework 8 due next Wednesday (5/23)
- Model-View-Controller
- Homework 8

## 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 table is the requested data stored in?
What SQL query will get me the data I need?

## VIEW

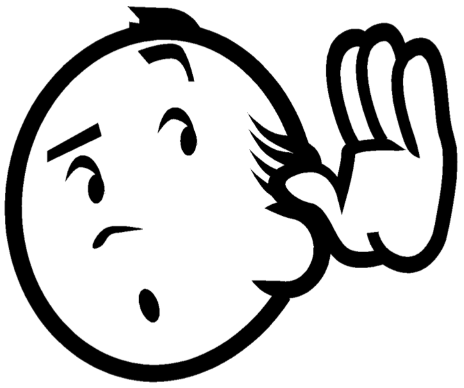
asks model for data and presents it in a user-friendly format

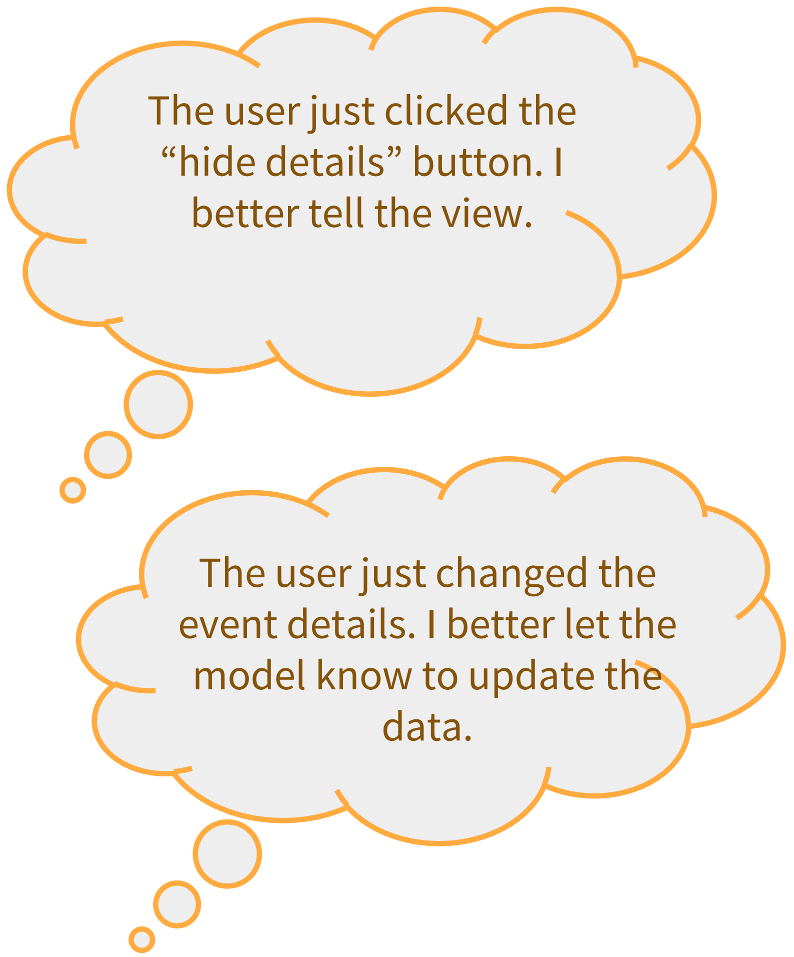
Would this text look better blue or red? In the bottom corner
or front and center?

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

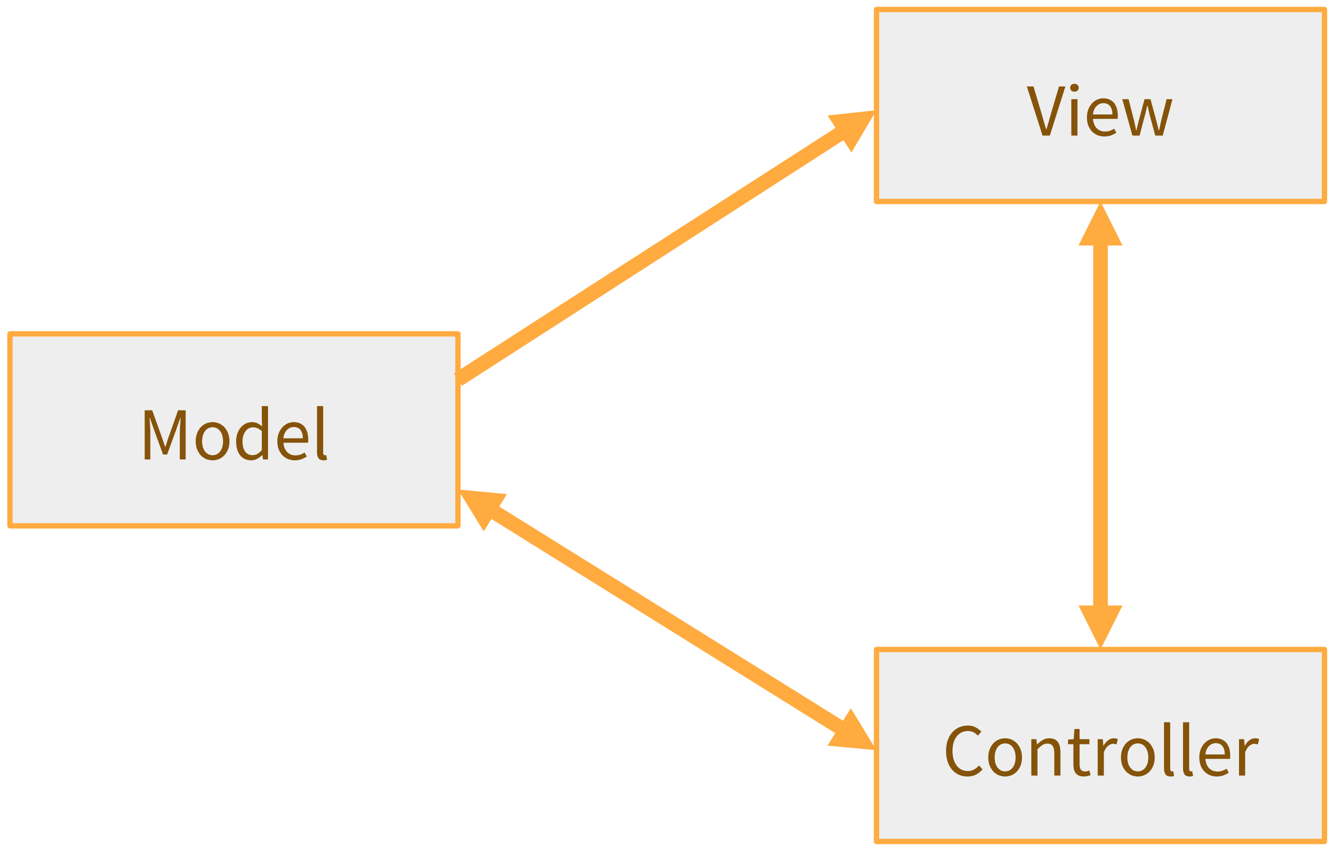



The user just clicked the "hide details" button. I better tell the view.
The user just changed the event details. I better let the model know to update the data.

## BENEFITS OF MVC

- Organization of code
  - Maintainable, easy to find what you need
- Ease of development
  - Build and test components independently
- 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

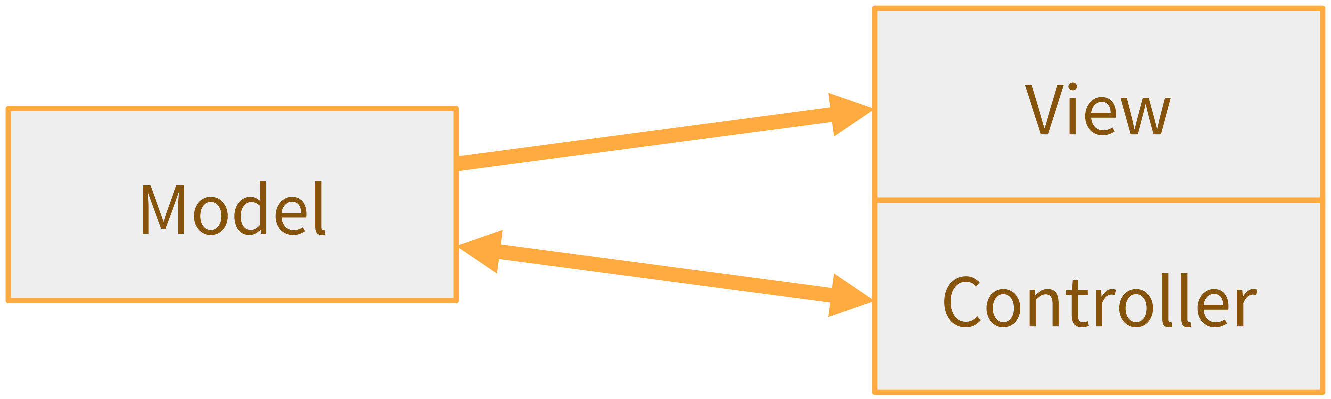
## MVC FLOW IN THEORY



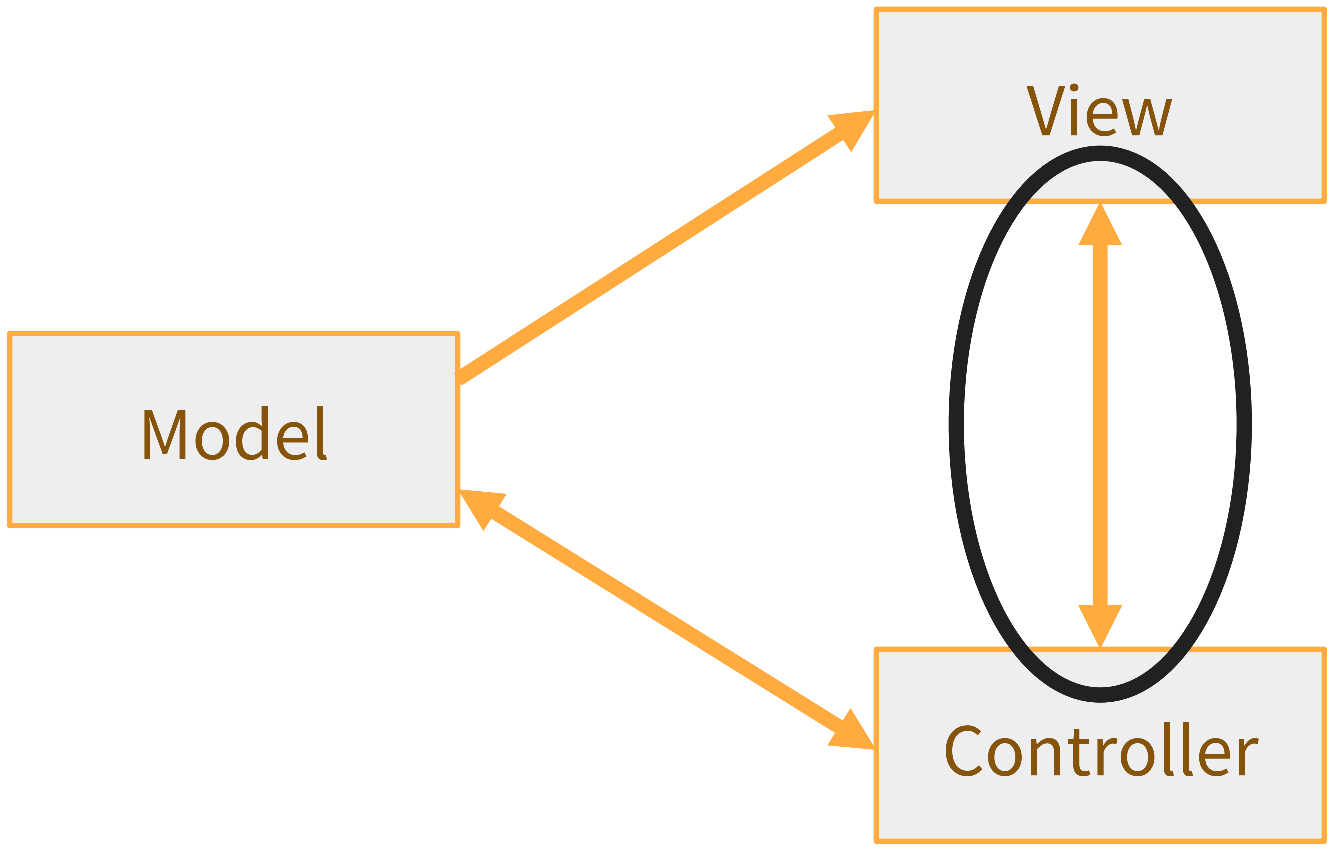
## MVC FLOW

- In theory…
  - Pattern of behavior in response to inputs (controller) are independent of visual geometry (view)
  - Controller contacts view to interpret what input events should mean in the context of the view
- In practice…
  - View and controller are so intertwined that they almost always occur in matched pairs (ex: command line interface)
  - Many architectures combine the two

## MVC FLOW IN PRACTICE



## PUSH VS. PULL



## PUSH VS. PULL ARCHITECTURE

- Push architecture
  - As soon as the model changes, it notifies all of the views
- Pull architecture
  - When a view needs to be updated, it asks the model for new data

## PUSH VS. PULL ARCHITECTURE

- Advantages for push
  - Guaranteed to have latest data in case something goes wrong later on
- Advantages for pull
  - Avoid unnecessary updates, not nearly as intensive on the view

## MVC EXAMPLE – TRAFFIC SIGNAL

# TRAFFIC SIGNAL – MVC

| Component | Model | View | Controller |
|---|---|---|---|
| Detect cars waiting to enter intersection | | | X |
| Traffic lights to direct car traffic | | X | |
| Decide to change the light's status | X | | |
| Manual override for particular lights | | | X |
| Detect pedestrians waiting to cross | | | X |
| Pedestrian signals to direct pedestrians | | X | |
| External timer which triggers changes at set interval | | | X |

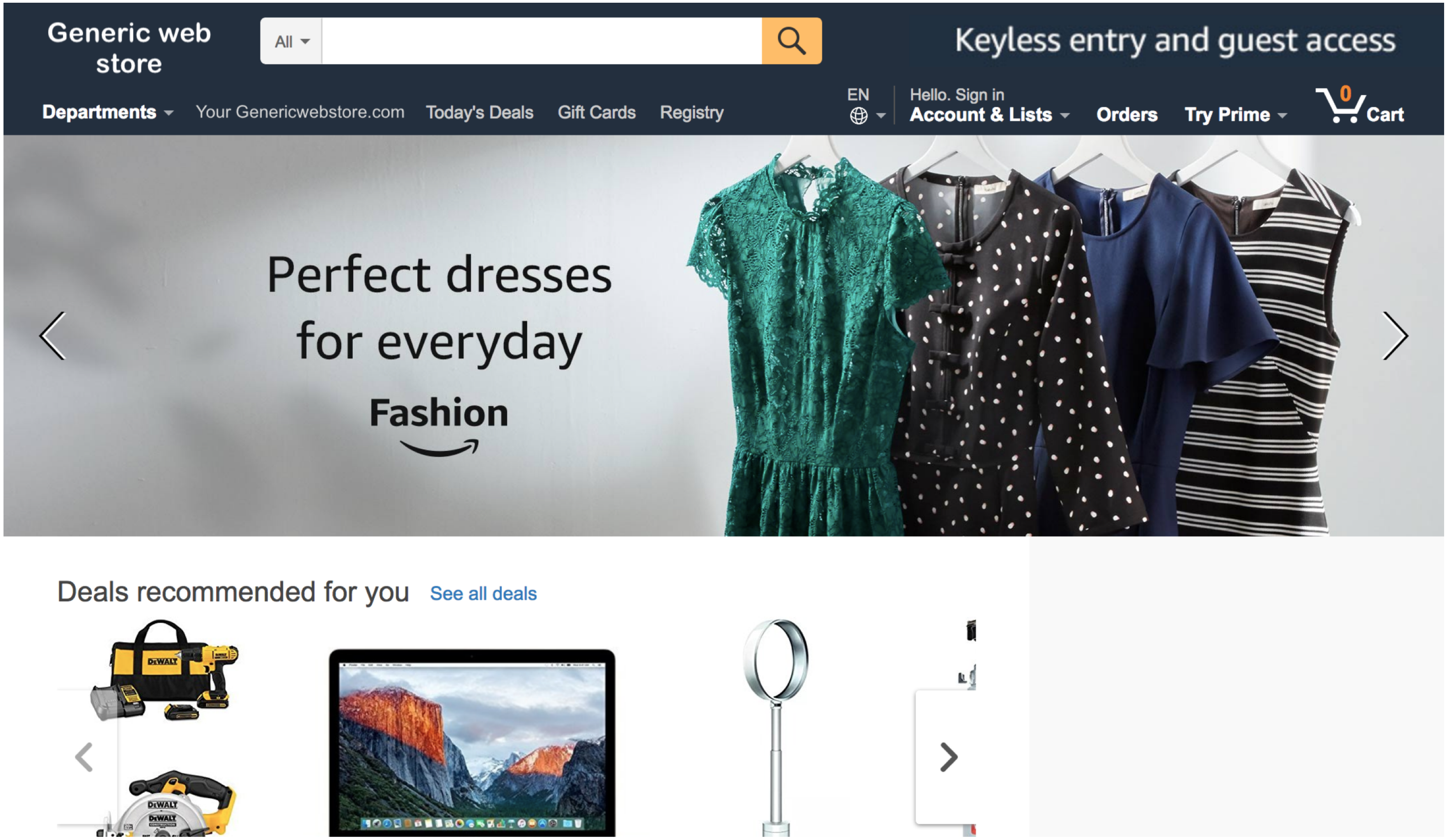
# TRAFFIC SIGNAL

- **Model**
  - Stores current state of traffic flow
    - Knows current direction of traffic
    - Capable of skipping a light cycle
  - Stores whether there are cars and/or pedestrians waiting
- **View**
  - Conveys information to cars and pedestrians in a specific direction
- **Controller**
  - Aware of model's current direction
  - Triggers methods to notify model that state should change

## TRAFFIC SIGNAL CODE

- **Model**
  - TrafficModel – keeps track of which lights should be on and off
- **View**
  - CarLight – shows relevant state of TrafficModel to cars
  - PedestrianLight – shows relevant state of TrafficModel to pedestrians
- **Controller**
  - PedestrianButton – notifies TrafficModel that there is a pedestrian waiting
  - CarDetector – notifies TrafficModel that there is a car waiting
  - LightSwitch – enables or disables the light
  - Timer – regulates time in some way, possibly to skip cycles

# MVC EXAMPLE – WEB STORE



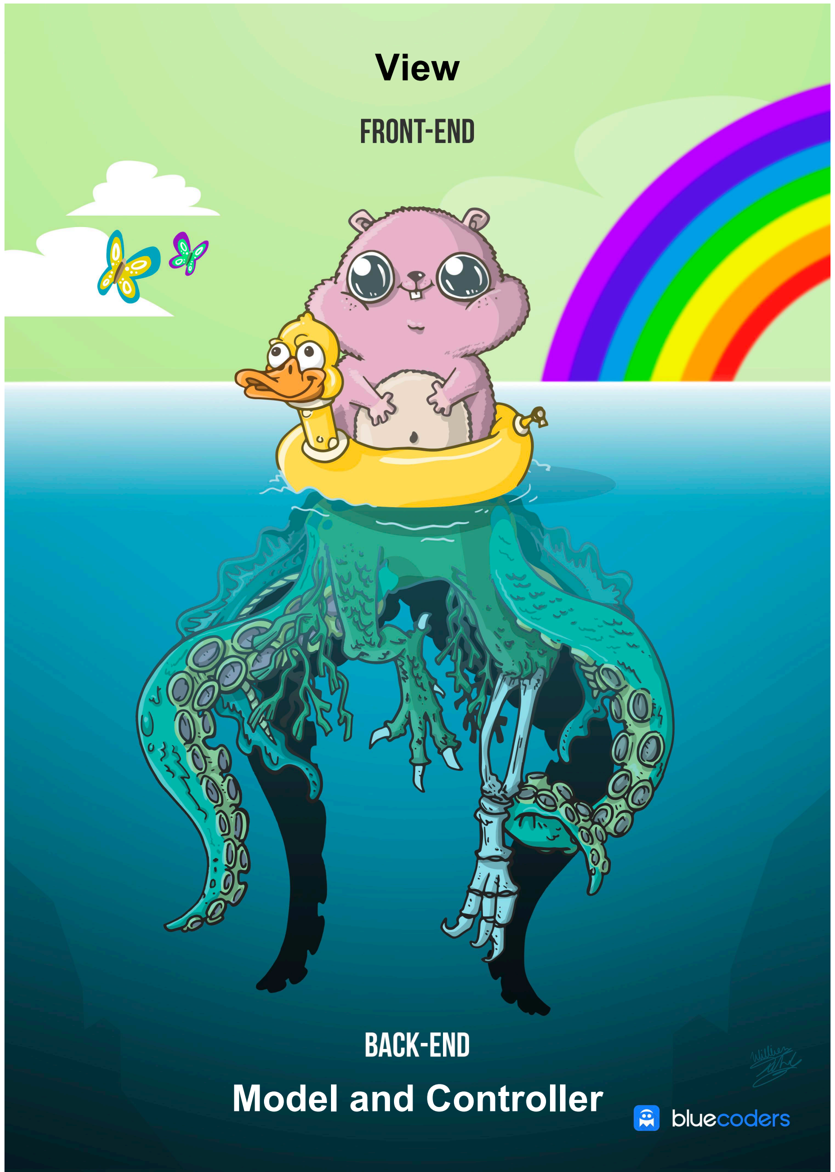
# WEB STORE – MVC

| Component | Model | View | Controller |
|---|---|---|---|
| Update user’s shopping cart | | | |
| Display price/details of a product | | | |
| Storage of product/inventory details | | | |
| Purchase items in shopping cart | | | |
| Record of customer transactions | | | |
| User sign-in | | | |
| Authenticate user sign-in attempt | | | |
| Check user credentials | | | |

## WEB STORE – MVC

| Component | Model | View | Controller |
|---|---|---|---|
| Update user’s shopping cart | | | X |
| Display price/details of a product | | X | |
| Storage of product/inventory details | X | | |
| Purchase items in shopping cart | | | X |
| Record of customer transactions | X | | |
| User sign-in | | X | |
| Authenticate user sign-in attempt | | | X |
| Check user credentials | X | | |

## To summarize – Don’t do this



## HW8 OVERVIEW

- Apply 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

## HW8 DATA FORMAT

- List of buildings (abbreviation, name, loc in pixels)

```
BAG Bagley Hall (East Entrance) 1914.5103,1708.8816
BGR By George 1671.5499,1258.4333
```

- List of paths (endpoint 1, endpoint 2, 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
```

- (0,0) is in the upper left

## 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** will change in HW9, but **Model** will stay the same

## Homework 8 in Detail

- Data files
  - `campus_buildings.dat`: Possible src/dst for path finding
  - `campus_paths.dat`: Info for all nodes, edges in your Graph/Model
  - You do the parsing

## Homework 8 in Detail Cont.

- Runnable program with following commands:
  - ***b*** lists all buildings in form `abbreviated name: long name`
  - ***r*** prompts user for abbrev. names of two buildings then finds a path between them
  - ***q*** quits the program (don't use `System.exit`)
  - ***m*** prints the menu of commands
- Route directions format
  - Path from `Building_A` to `Building_B`:

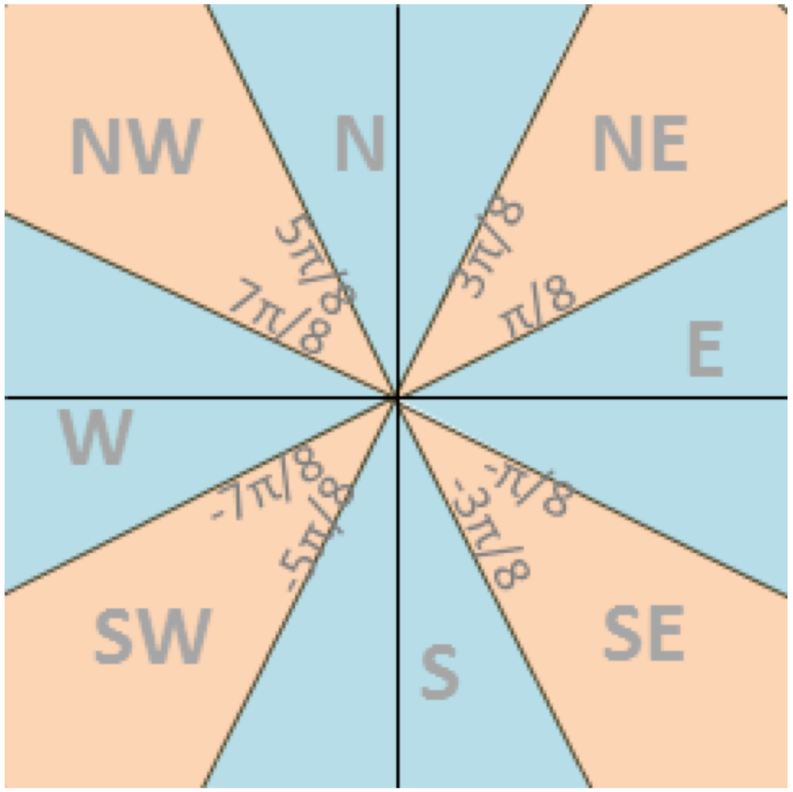
    Walk `dist` feet `direction` to ($x_1$, $y_1$)

    Walk `dist` feet `direction` to ($x_2$, $y_2$)

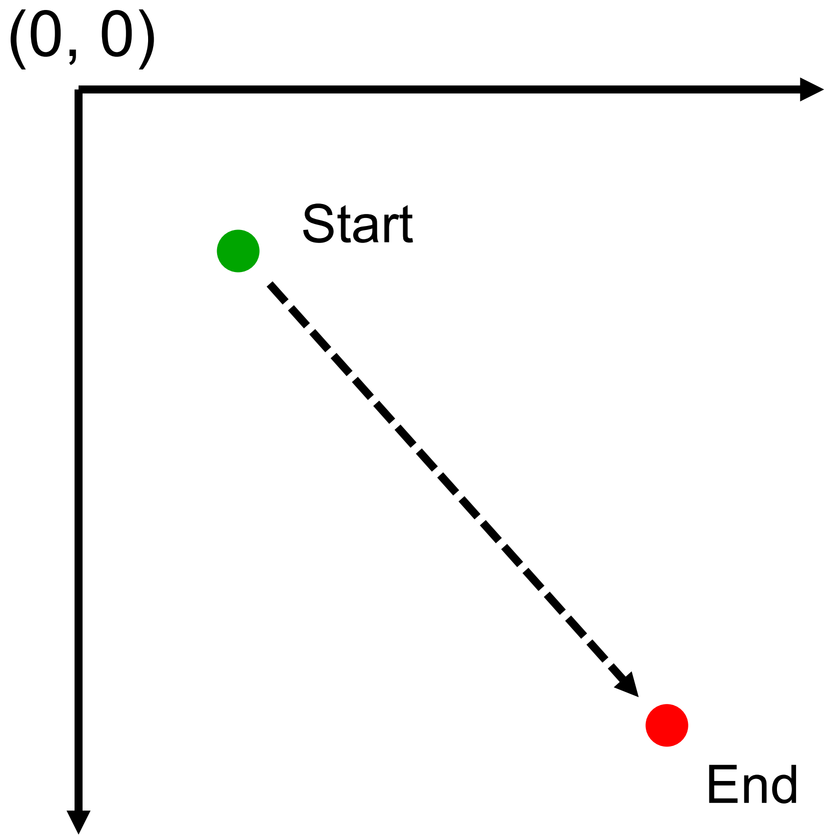
    …
  - Total distance: `x` feet

# Homework 8 in Detail Cont.

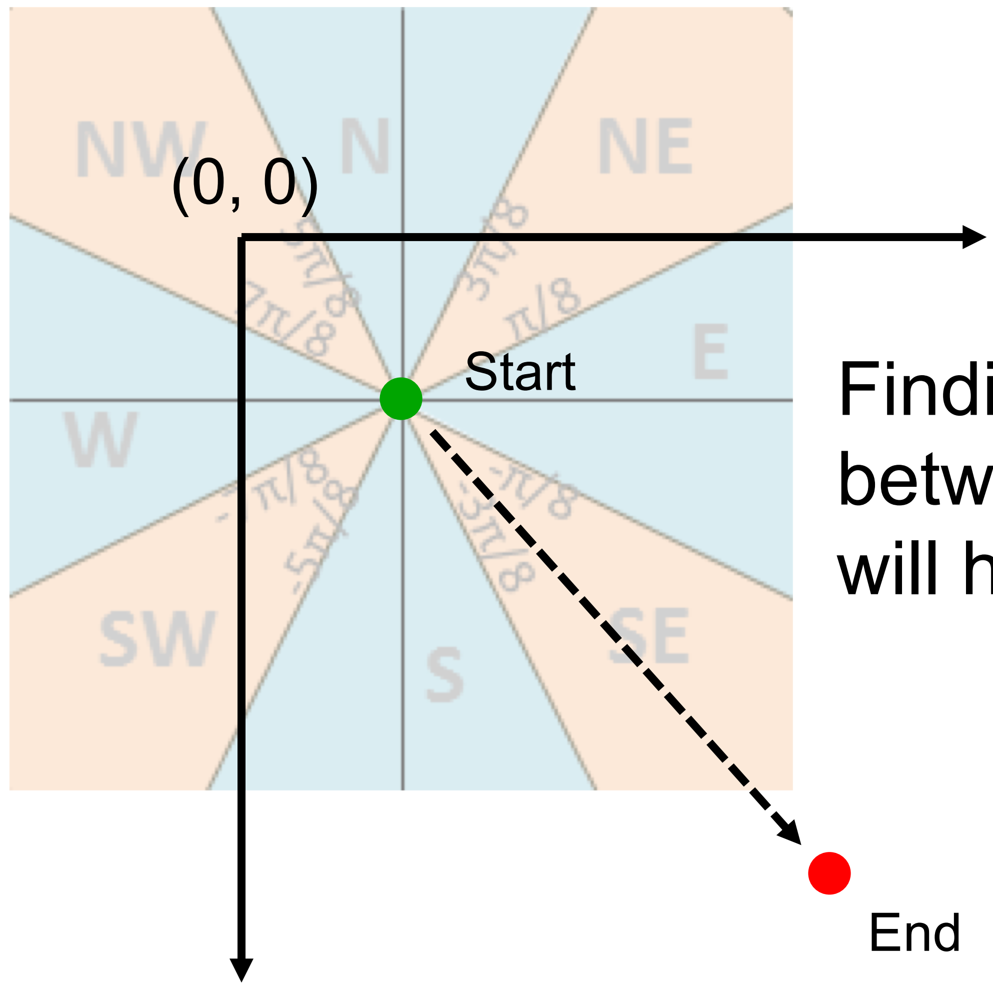
- Solving for the direction
  - Compare coordinates for start, end of edge
  - Pixel (0, 0) is the top-left corner (this is the tricky part)
  - Helper functions can be very useful
    - Math.atan2(double y, double x)
    - Math.toDegrees(double angleRadian)
  - Points that are **exactly** on the boundary should default to the single-letter direction (N, S, E, W)
  - **More info on the homework spec**



## Homework 8 in Detail Cont.



## Homework 8 in Detail Cont.



Finding slope between start/end will help