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A physicist, an engineer and a programmer were in a car driving over a steep alpine pass when the brakes failed. The car was getting faster and faster, they were struggling to get round the corners and once or twice only the feeble crash barrier saved them from crashing down the side of the mountain. They were sure they were all going to die, when suddenly they spotted an escape lane. They pulled into the escape lane and came safely to a halt.

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The physicist said "We need to model the friction in the brake pads and the resultant temperature rise, see if we can work out why they failed".

The engineer said "I think I've got a few wrenches in the back. I'll take a look and see if I can work out what's wrong".

The programmer said "Why don't we try again and see if it's reproducible?"

# Section 8:

# Model-View-Controller

Slides adapted from Alex Mariakakis

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



# MVC

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- ✘ 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

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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

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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

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## ✘ Organization of code

- + Maintainable, easy to find what you need

## ✘ Ease of development

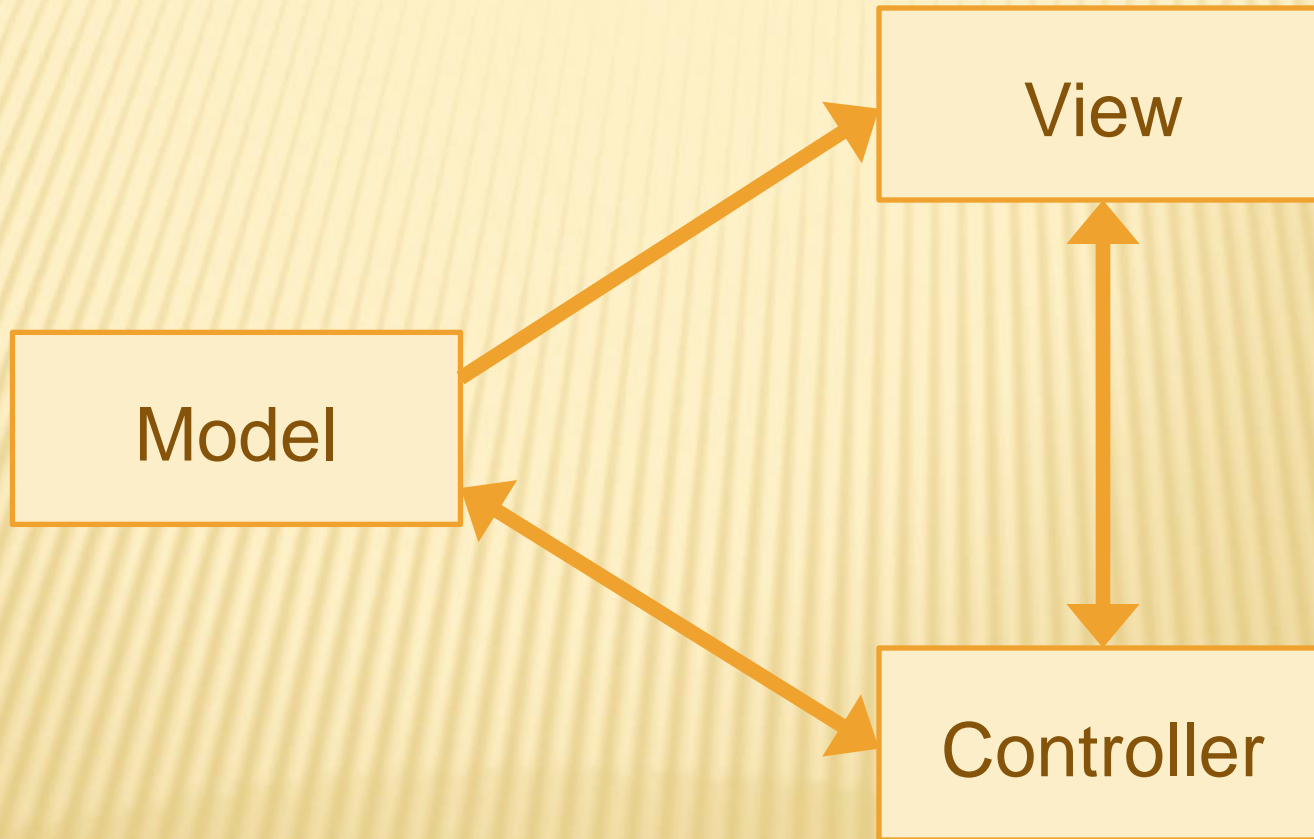
- + Build and test components independently

## ✘ 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

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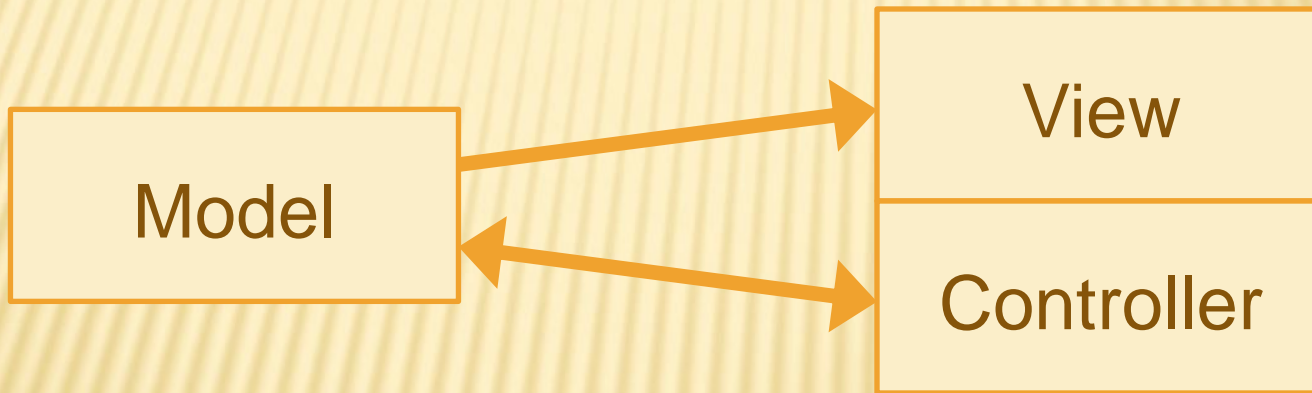
## ✘ In theory...

- + 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...

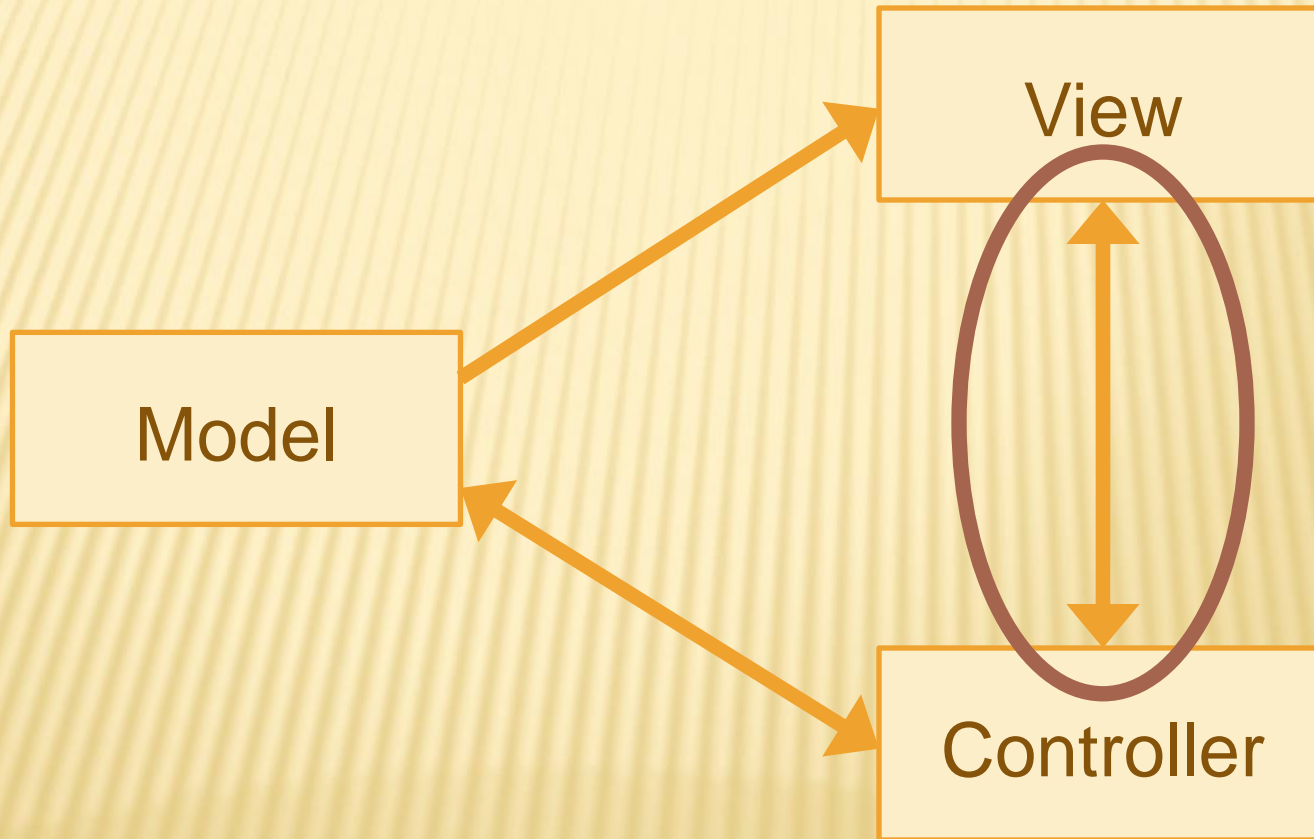
- + View and controller are so intertwined that they almost always occur in matched pairs (ex: command line interface)
- + Many architectures combine the two

# 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    |            |
| Regulate valid traffic movements                      | 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

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## × 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

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- × **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

# HW8 OVERVIEW

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- ✘ 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

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- ✘ **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