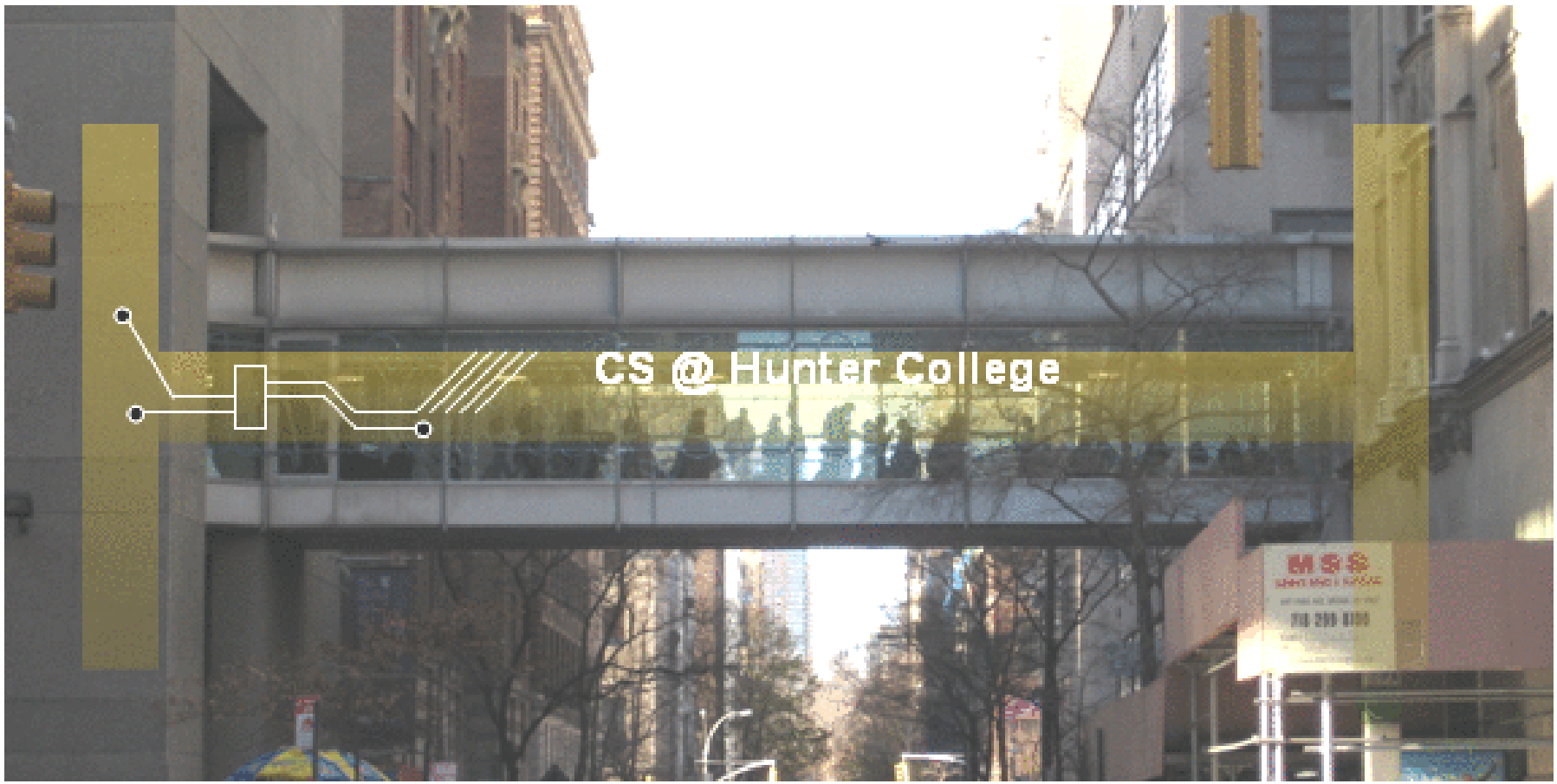
CSci 127: Introduction to Computer Science



hunter.cuny.edu/csci

Announcements

- Grades have been updated on Blackboard. Let us know if you see anything missing, so we can fix it (we found duplicate accounts and typos in EmpID's).
- Each lecture includes a survey of computing research and tech in NYC.

  Today: Prof. Anita Raja
  Distributed Artificial Intelligence

Today's Topics

- Recap: Functions & Top Down Design
- Mapping GIS Data
- Random Numbers
- Indefinite Loops
- CS Survey

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- **Recap: Functions & Top Down Design**
- Mapping GIS Data
- Random Numbers
- Indefinite Loops
- CS Survey

In Pairs or Triples:

```
def prob4(amy, beth):
    if amy > 4:
        print("Easy case")
        kate = -1
    else:
        print("Complex case")
        kate = helper(amy,beth)
    return(kate)
```

```
def helper(meg,jo):
    s = ""
    for j in range(meg):
        print(j, ": ", jo[j])
        if j % 2 == 0:
            s = s + jo[j]
            print("Building s:", s)
    return(s)
```

- What are the formal parameters for the functions?
- What is the output of:

```
r = prob4(4,"city")
print("Return:  ", r)
```

- What is the output of:

```
r = prob4(2,"university")
print("Return:  ", r)
```

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Python Tutor

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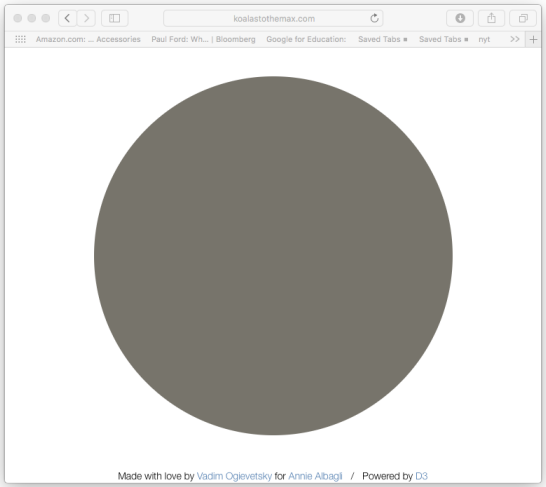
(Demo with pythonTutor)

From Last Time: koalas



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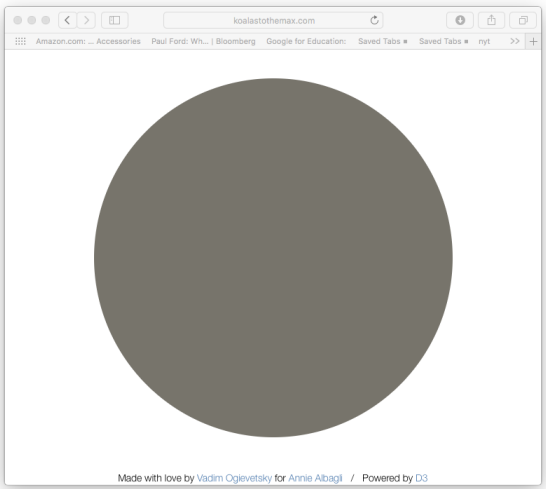

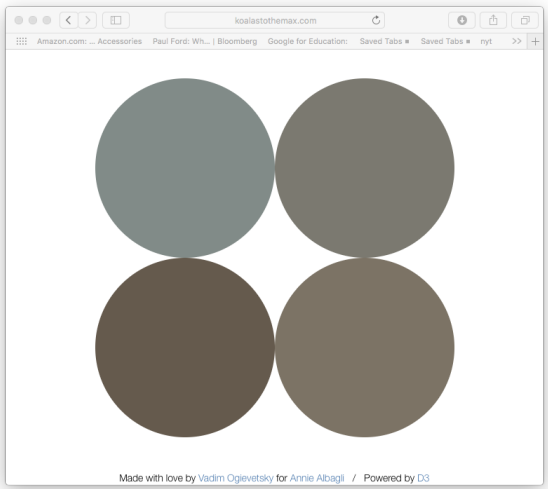

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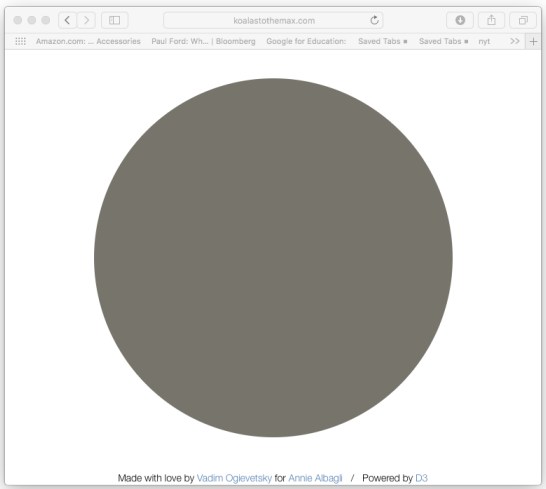

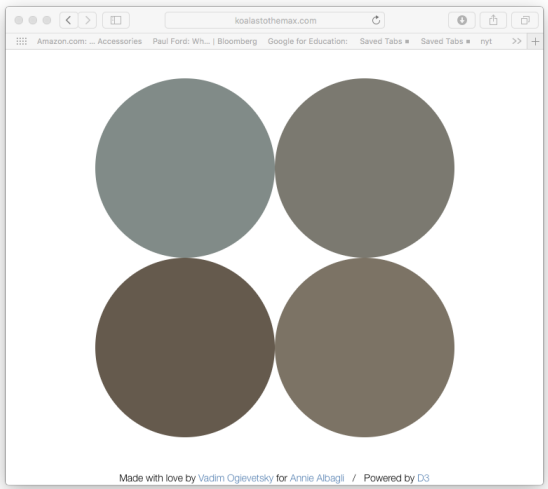

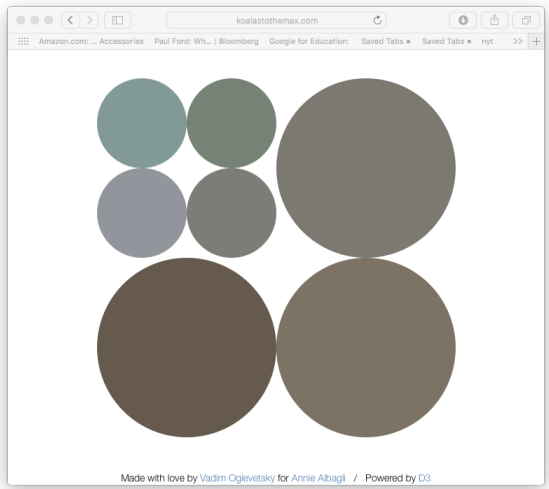

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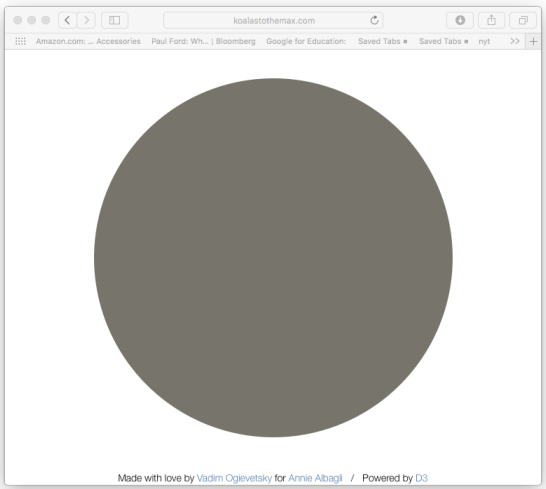

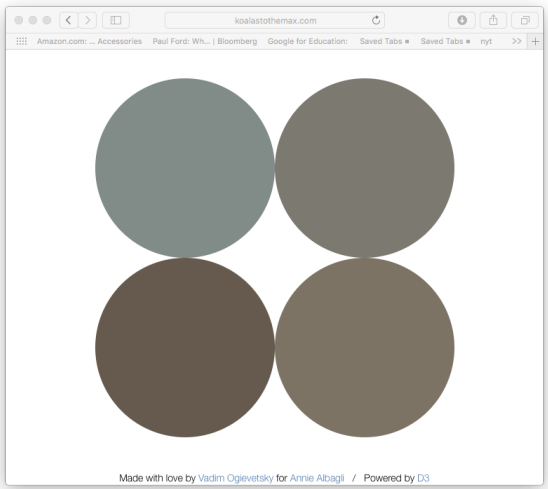

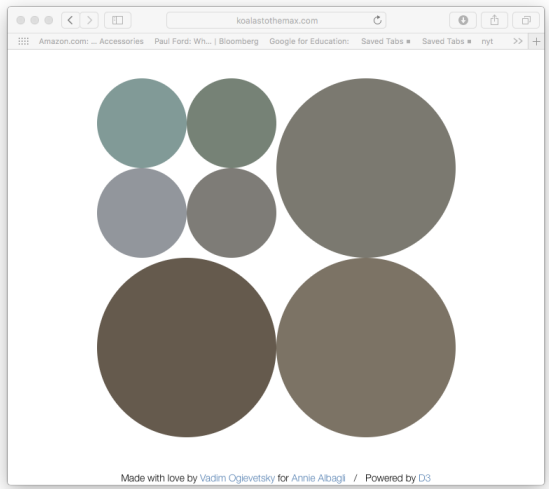

`http://koalastothemax.com`

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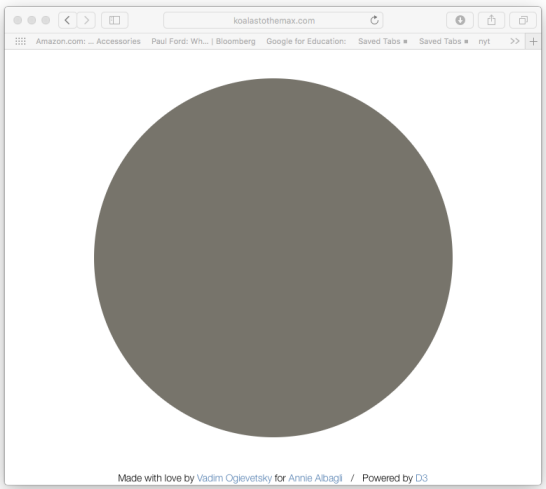

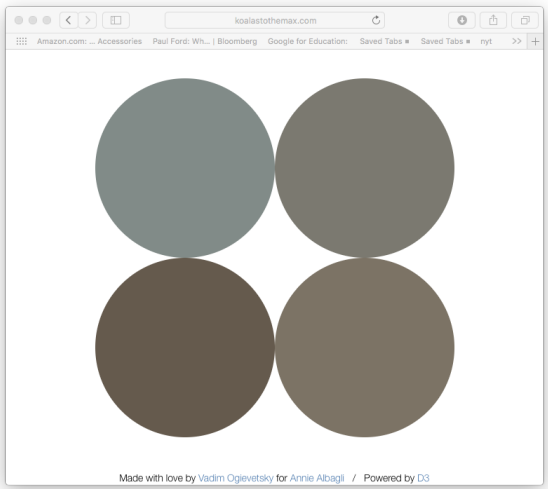

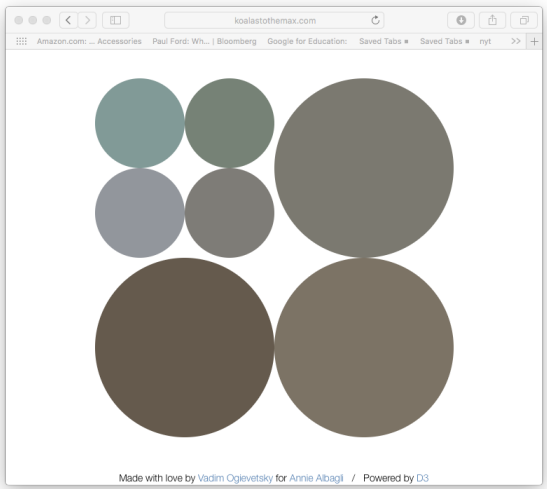

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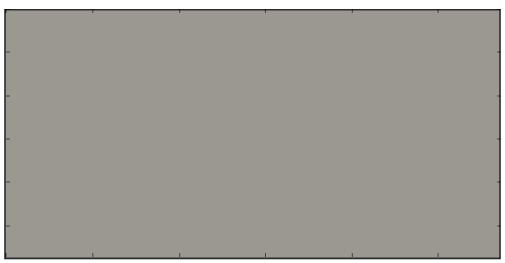

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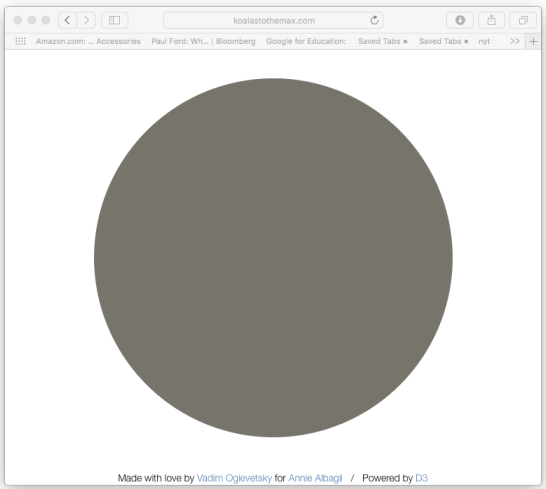

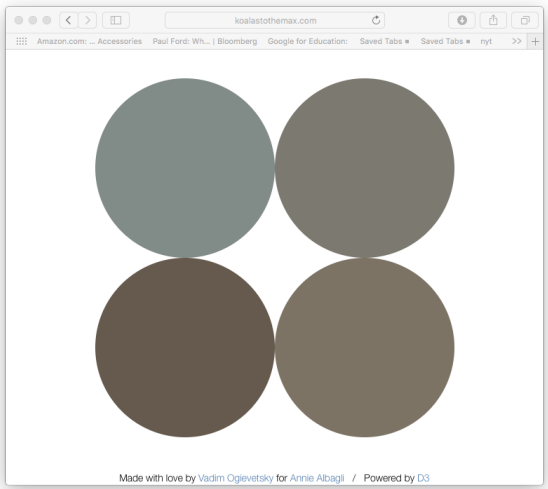

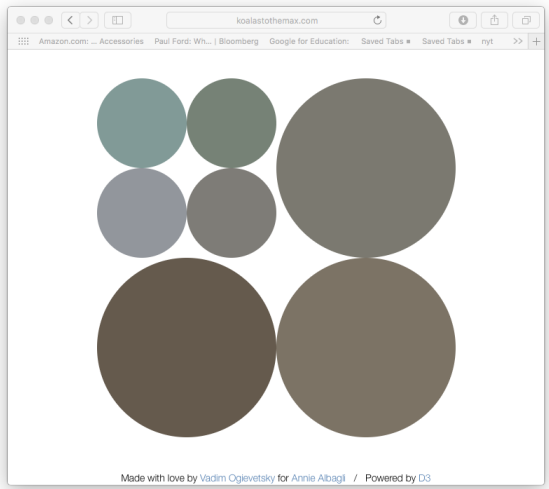

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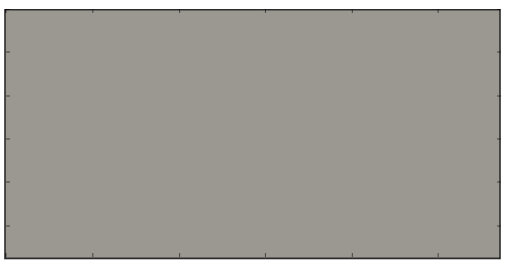

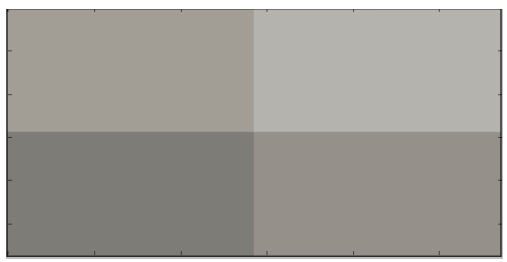

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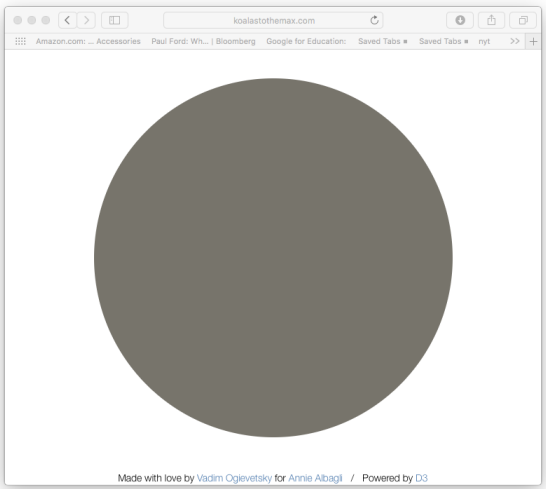

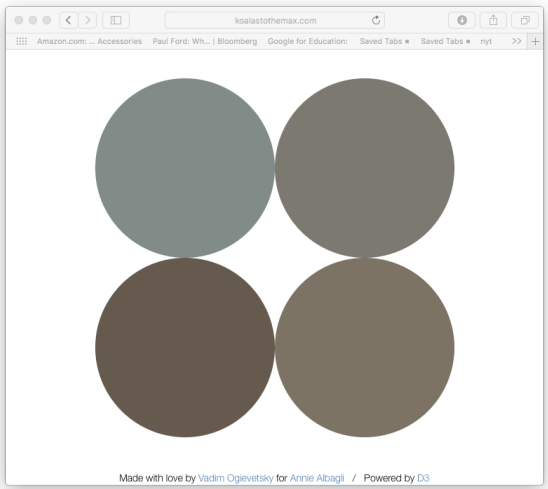

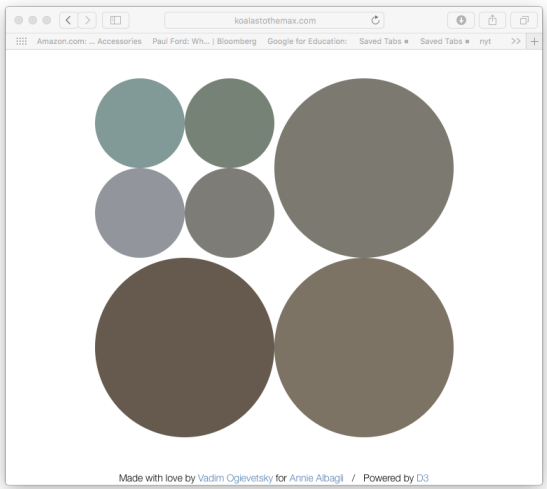

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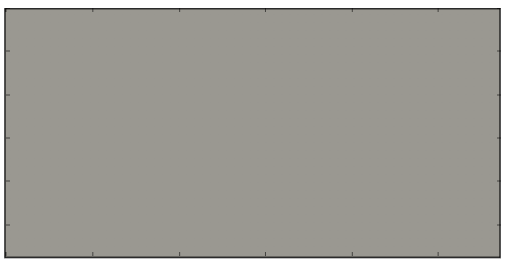

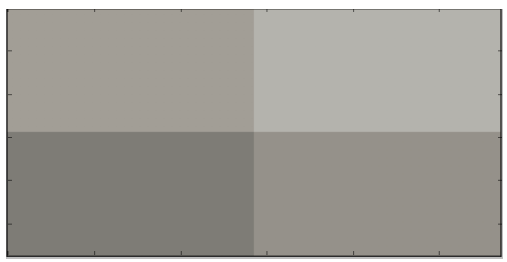

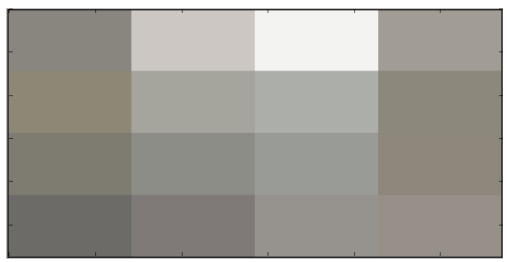

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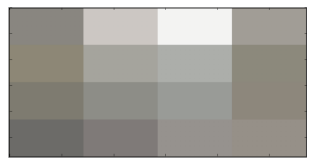
Process:

Get template from `github`

$\rightarrow$ Fill in missing functions



$\rightarrow$ Test locally idle3/python3

$\rightarrow$ Submit to Gradescope

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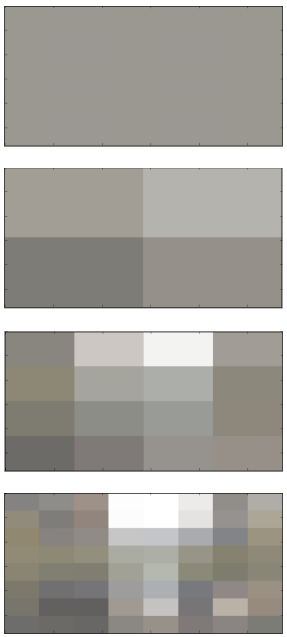

```
69  def main():
70      inFile = input('Enter image file name: ')
71      img = plt.imread(inFile)
72
73      #Divides the image in 1/2, 1/4, 1/8, ... 1/2^8, and displays each:
74      for i in range(8):
75          img2 = img.copy()   #Make a copy to average
76          quarter(img2,i)     #Split in half i times, and average regions
77
78          plt.imshow(img2)    #Load our new image into pyplot
79          plt.show()          #Show the image (waits until closed to continue)
80
81      #Shows the original image:
82      plt.imshow(img)         #Load image into pyplot
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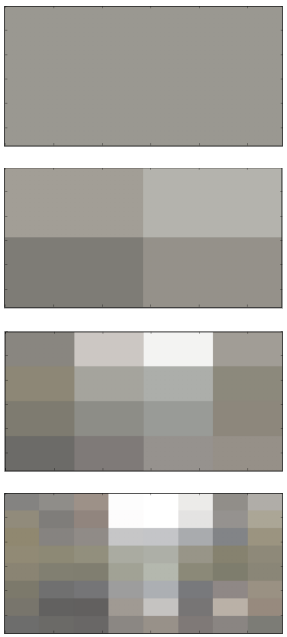

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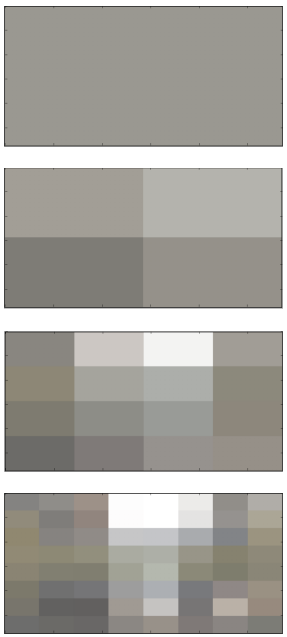

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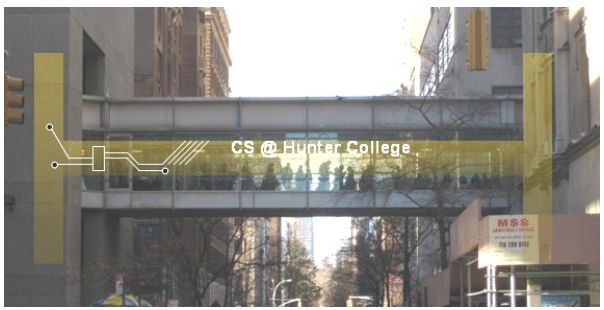
- The `main()` is written for you.
- Only fill in two functions: `average()` and `setRegion()`.

Top-Down Design

- The last example demonstrates **top-down design**: breaking into subproblems, and implementing each part separately.

Top-Down Design



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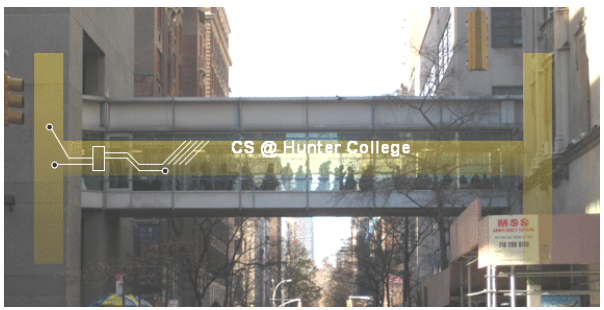

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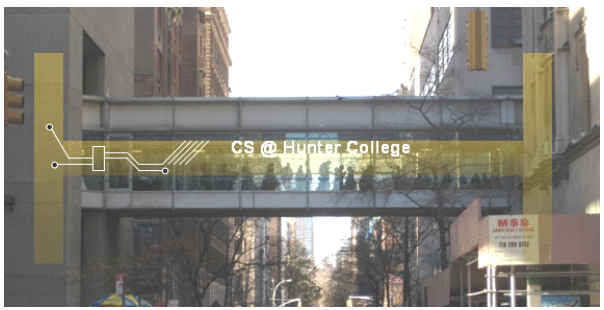

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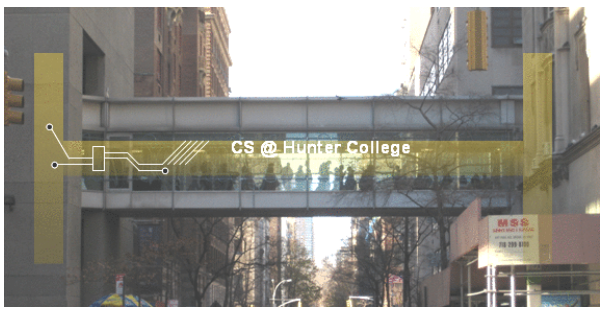

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- Excellent approach since you can then test each part separately before adding it to a large program.

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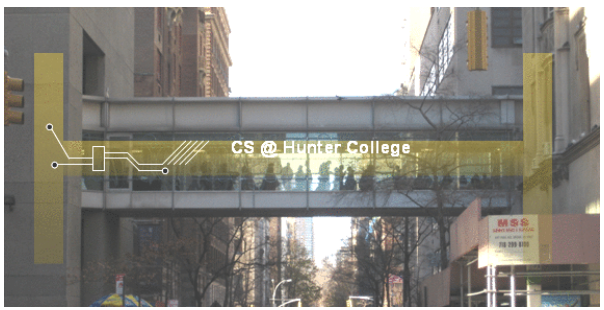

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  - Break the problem into tasks for a "To Do" list.
  - Translate list into function names & inputs/returns.
  - Implement the functions, one-by-one.
- Excellent approach since you can then test each part separately before adding it to a large program.
- Very common when working with a team: each has their own functions to implement and maintain.

In Pairs or Triples:

- Write the missing functions for the program:

```
def main():
    tess = setUp()     #Returns a purple turtle with pen up.
    for i in range(5):
        x,y = getInput()       #Asks user for two numbers.
        markLocation(tess,x,y) #Move tess to (x,y) and stamp.
```

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Group Work: Fill in Missing Pieces

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Group Work: Fill in Missing Pieces

1. Write import statements.

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import turtle
```

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```

Third Part: Fill in Missing Pieces

1. Write import statements.
2. Write down new function names and inputs.

```
import turtle
def setUp():
    #FILL IN
def getInput():
    #FILL IN
def markLocation(t,x,y):
    #FILL IN
```

```
def main():
    tess = setUp()    #Returns a purple turtle with pen up.
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```

Third Part: Fill in Missing Pieces

1. Write import statements.
2. Write down new function names and inputs.
3. Fill in return values.

```
import turtle
def setUp():
    #FILL IN
    return(newTurtle)
def getInput():
    #FILL IN
    return(x,y)
def markLocation(t,x,y):
    #FILL IN



def main():
    tess = setUp()    #Returns a purple turtle with pen up.
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        x,y = getInput()       #Asks user for two numbers.
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```

Third Part: Fill in Missing Pieces

1. Write import statements.
2. Write down new function names and inputs.
3. Fill in return values.
4. Fill in body of functions.

```
import turtle
def setUp():
    newTurtle = turtle.Turtle()
    newTurtle.penup()
    return(newTurtle)
def getInput():
    x = int(input('Enter x: '))
    y = int(input('Enter y: '))
    return(x,y)
def markLocation(t,x,y):
    t.goto(x,y)
    t.stamp()
def main():
    tess = setUp()    #Returns a purple turtle with pen up.
    for i in range(5):
        x,y = getInput()       #Asks user for two numbers.
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  - `num2string(0)` returns: `zero`
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  - `num2string(2)` returns: `two`

In Pairs or Triples:

- Write a function that takes a number as an input and prints its corresponding name.
- For example,
  - `num2string(0)` returns: `zero`
  - `num2string(1)` returns: `one`
  - `num2string(2)` returns: `two`
- You may assume that only single digits, 0,1,...,9, are given as input.

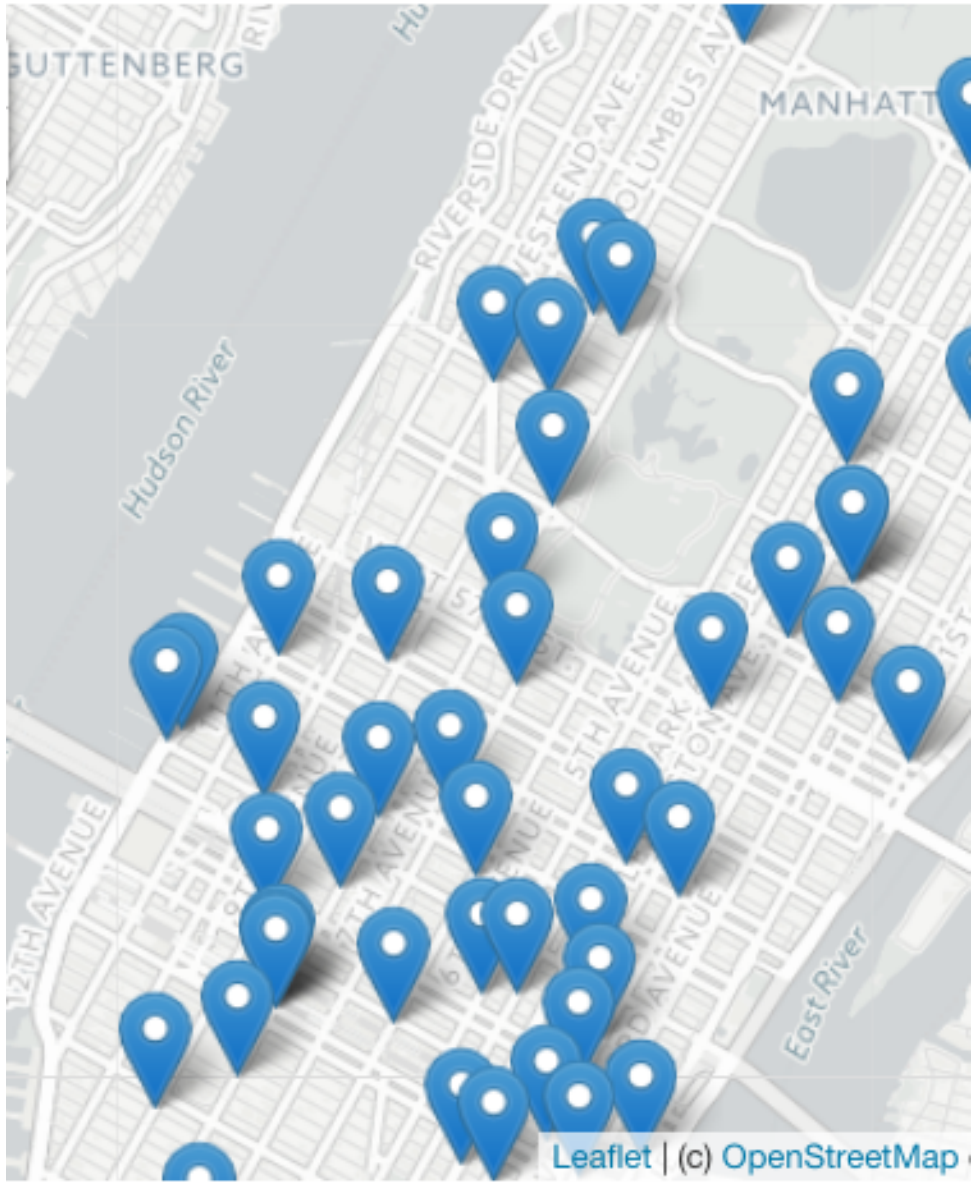
Python Tutor

(On github)

Today's Topics

- Recap: Functions & Top Down Design
- **Mapping GIS Data**
- Random Numbers
- Indefinite Loops
- CS Survey

Folium


Hudson River
East River
RIVERSIDE DRIVE
5TH AVENUE
Leaflet | (c) OpenStreetMap

Folium

- A module for making HTML maps.

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- An extra step:

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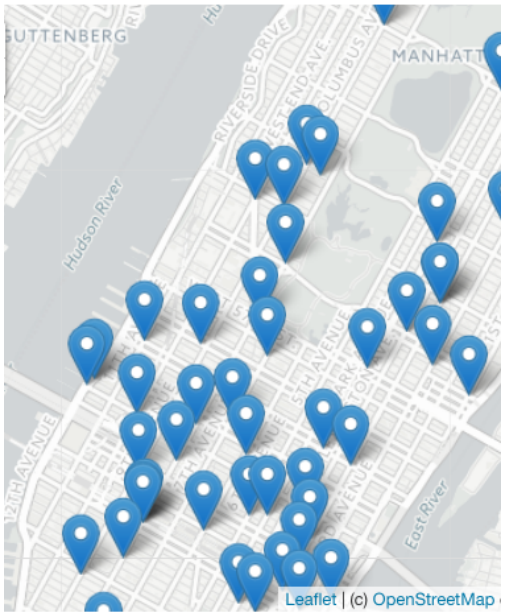
- Outputs `.html` files which you can open in a browser.
- An extra step:

Write code. → *Run program.* → *Open .html in browser.*

Demo



(Map created by Folium.)

Folium

- To use:

  ```
  import folium
  ```

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  newMark = folium.Marker([lat,lon],popup=name)
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  newMark.add_to(myMap)
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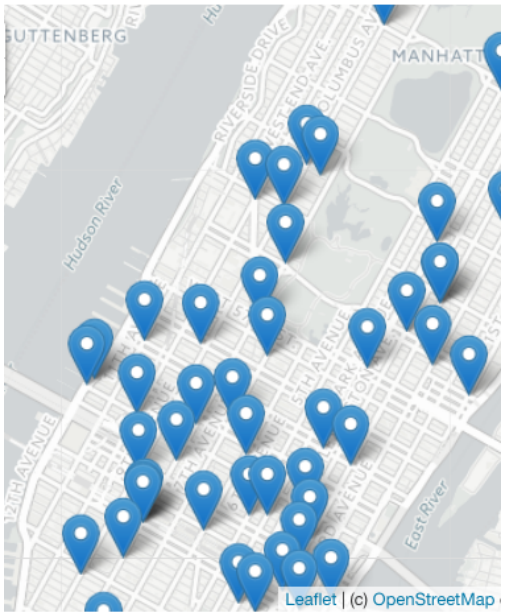
- Many options to customize background map ("tiles") and markers.

Demo



(Python program using Folium.)

In Pairs of Triples

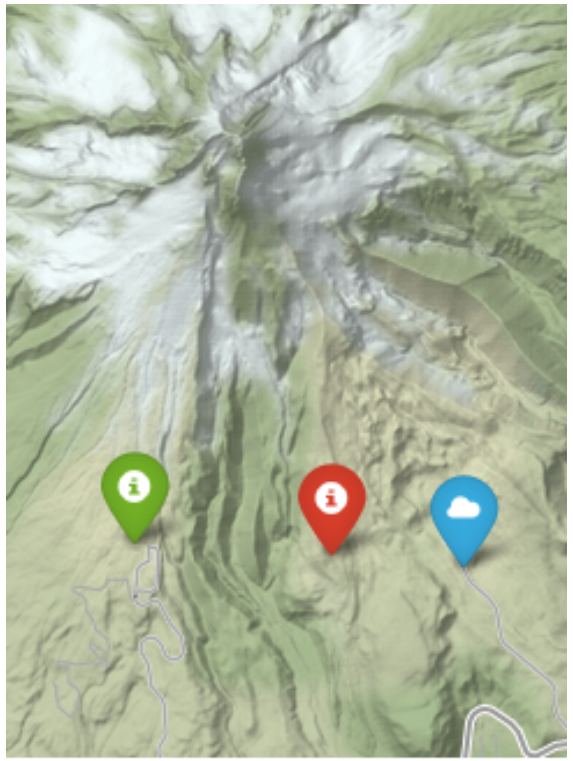
- Predict which each line of code does:

```
m = folium.Map(
    location=[45.372, -121.6972],
    zoom_start=12,
    tiles='Stamen Terrain'
)

folium.Marker(
    location=[45.3288, -121.6625],
    popup='Mt. Hood Meadows',
    icon=folium.Icon(icon='cloud')
).add_to(m)

folium.Marker(
    location=[45.3311, -121.7113],
    popup='Timberline Lodge',
    icon=folium.Icon(color='green')
).add_to(m)

folium.Marker(
    location=[45.3300, -121.6823],
    popup='Some Other Location',
    icon=folium.Icon(color='red', icon='info-sign')
).add_to(m)
```



(example from Folium documentation)

Today's Topics

- Recap: Functions & Top Down Design
- Mapping GIS Data
- **Random Numbers**
- Indefinite Loops
- CS Survey

Python's random package

- Python has a built-in package for generating pseudo-random numbers.

```
import turtle
import random

trey = turtle.Turtle()
trey.speed(10)

for i in range(100):
  trey.forward(10)
  a = random.randrange(0,360,90)
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- Useful command to generate whole numbers:

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  which gives a number chosen randomly from the specified range.

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  which gives a number chosen (uniformly) at random from [0.0,1.0).
- Very useful for simulations, games, and testing.

Trinket

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(Demo turtle random walk)

Today's Topics

- Recap: Functions & Top Down Design
- Mapping GIS Data
- Random Numbers
- **Indefinite Loops**
- CS Survey

In Pairs or Triples:

Predict what the code will do:

```
dist = int(input('Enter distance: '))
while dist < 0:
    print('Distances cannot be negative.')
    dist = int(input('Enter distance: '))

print('The distance entered is', dist)
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Python Tutor

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(Demo with pythonTutor)

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```
#Spring 2012 Final Exam, #8

nums = [1,4,0,6,5,2,9,8,12]
print(nums)
i=0
while i < len(nums)-1:
    if nums[i] < nums[i+1]:
        nums[i], nums[i+1] = nums[i+1], nums[i]
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- Indefinite loops repeat as long as the condition is true.

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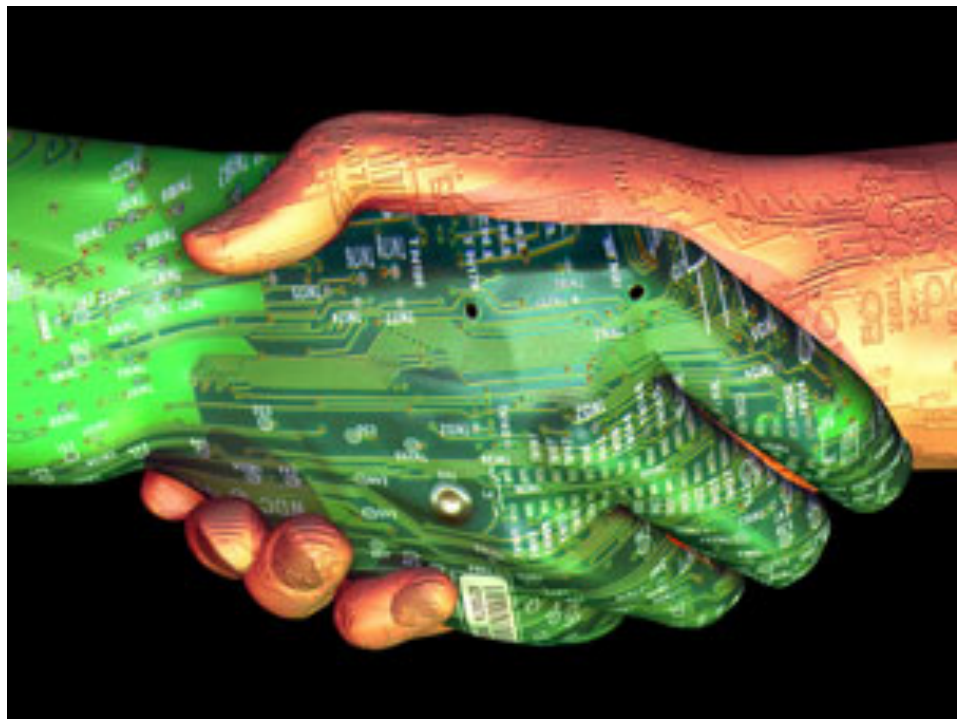
- The condition determines how many times.
- Very useful for checking input, simulations, and games.
- More details next lecture...

Today's Topics

- Recap: Functions & Top Down Design
- Mapping GIS Data
- Random Numbers
- Indefinite Loops
- **CS Survey**

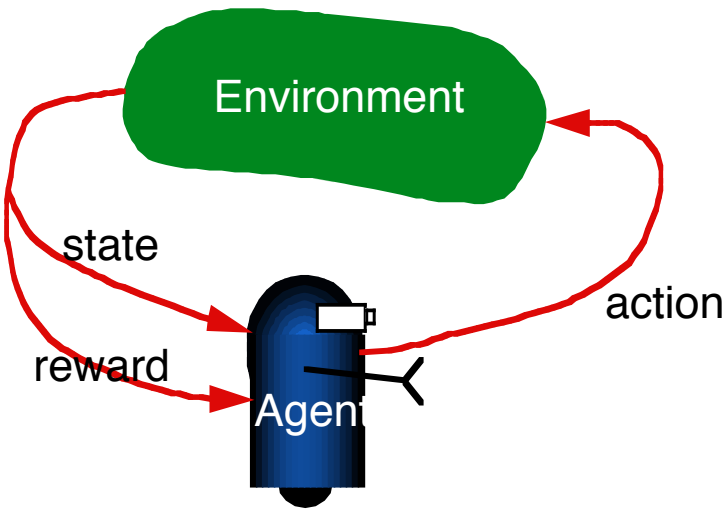
CS Survey: Prof. Raja, Distributed Artificial Intelligence

A Model for Computation in the 21st Century

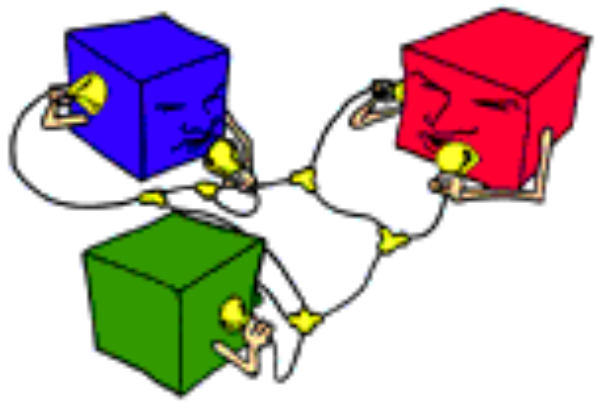


CS Survey: Prof. Raja, Distributed Artificial Intelligence

Computational Agent?

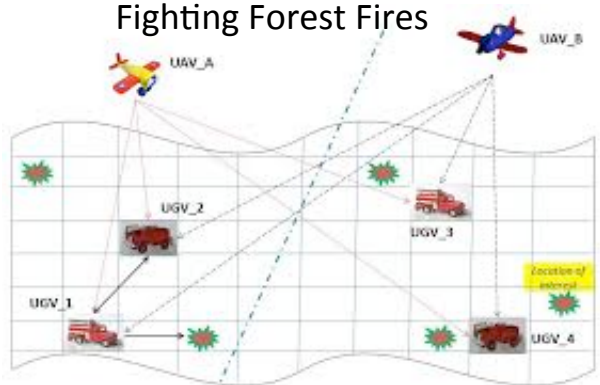


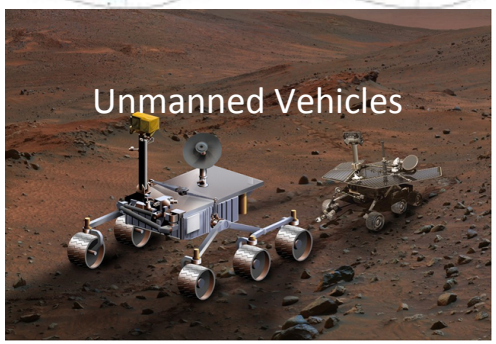
Multi-Agent System/ Distributed AI

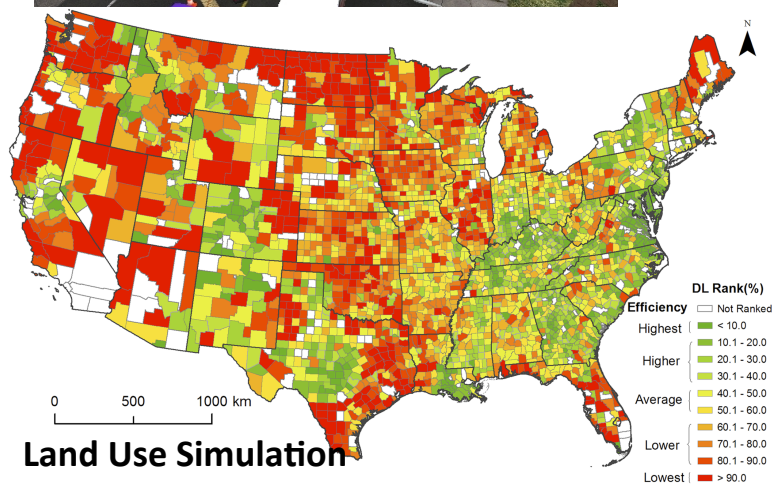


Multi agent Applications

Fighting Forest Fires

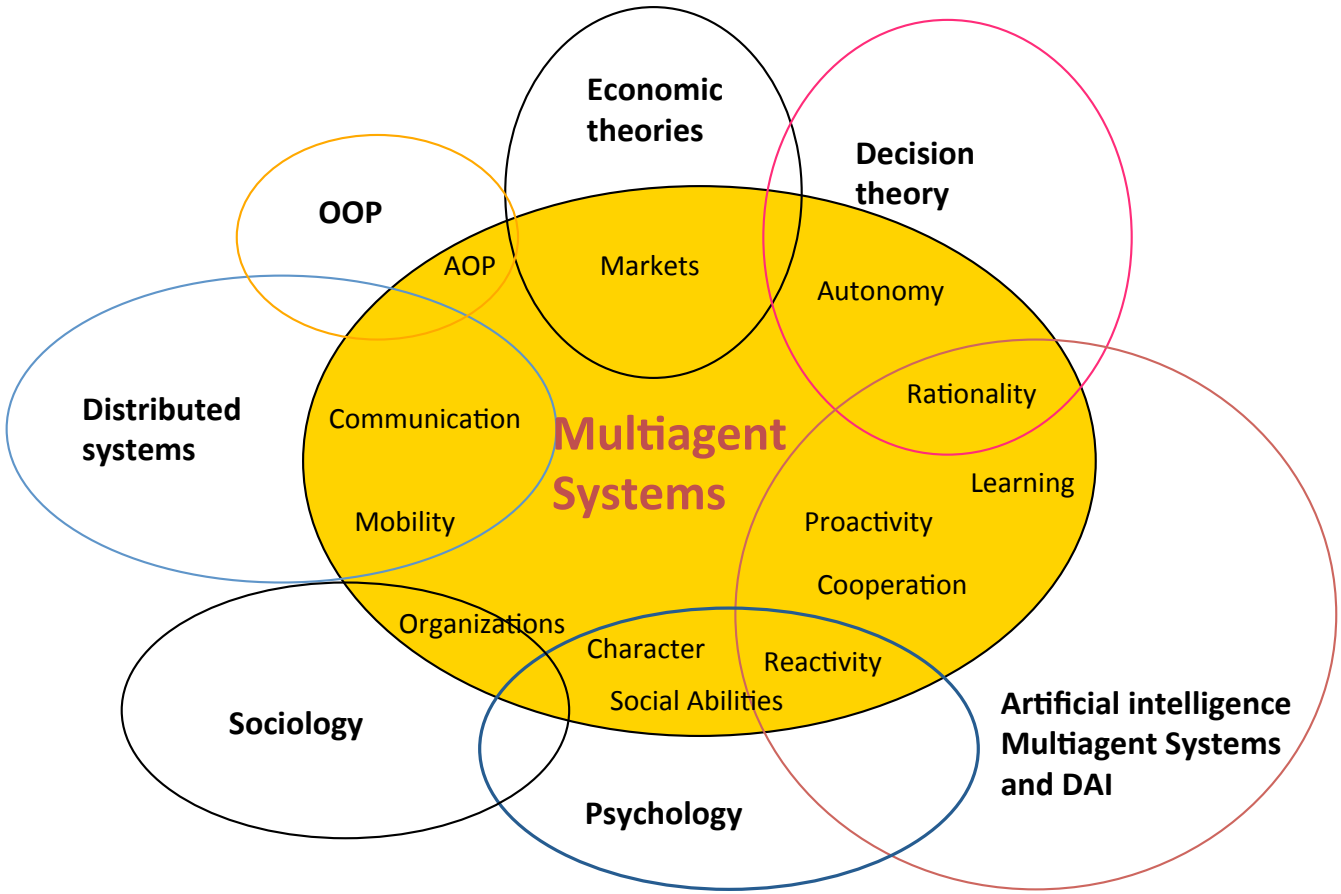






Land Use Simulation

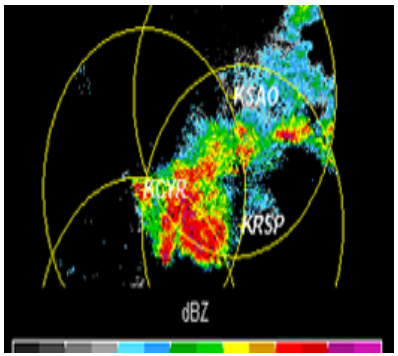
CS Survey: Prof. Raja, Distributed Artificial Intelligence



5

CS Survey: Prof. Raja, Distributed Artificial Intelligence

My Research

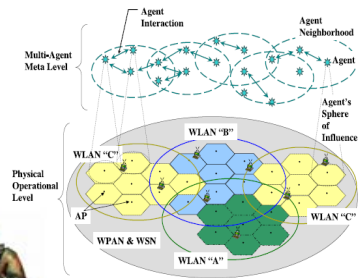


Tracking Meteorological Phenomenon

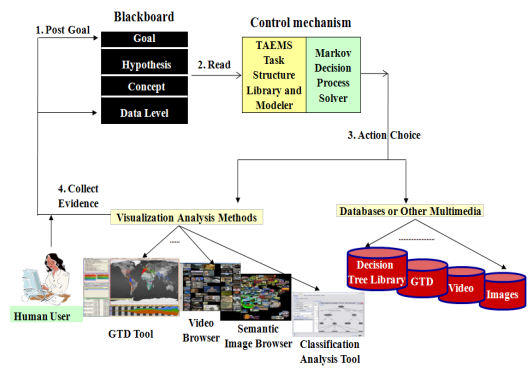
Prediction and Prevention of Preterm Birth

Smart Home Technology

Network Load Balancing



Predictive Analytics

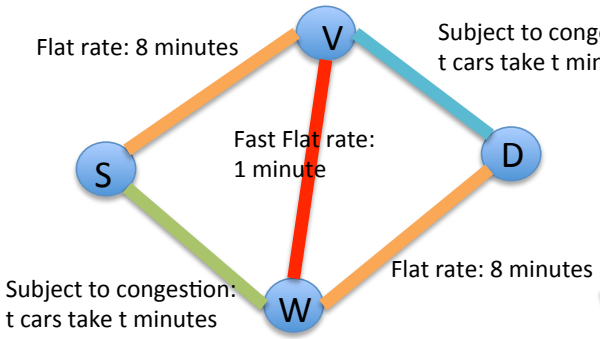


Traffic Networks

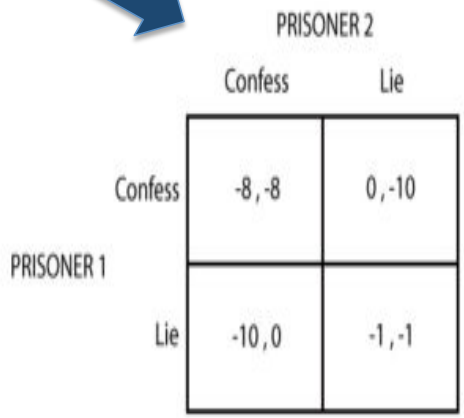
- Average commute time in US: 26 minutes
  - 20% longer than 1988
- Selfish routing
- Prevalence of traffic-based social networks (Waze, google maps)

- Goal : Reduce congestion

CS Survey: Prof. Raja, Distributed Artificial Intelligence

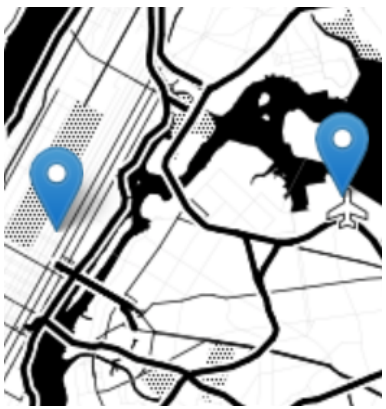


Braess Paradox



Prisoner's Dilemma

Design Challenge: Routing Traffic



Driving times to LGA with x cars already en route:

- $T_{RFK}(x) = 14 + \frac{x}{10{,}000}$ for the RFK bridge.
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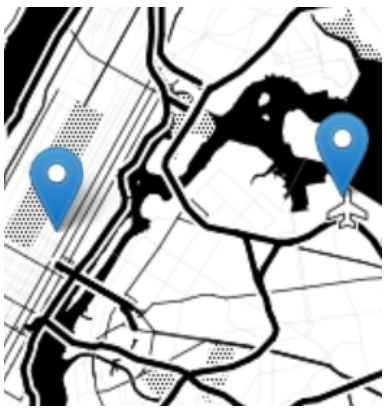

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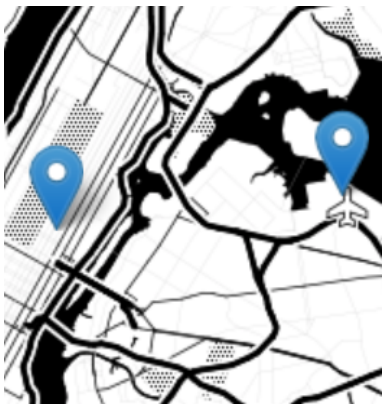
1. Assuming no traffic (i.e. $x = 0$), which is fastest?
2. How many cars would slow that route to make another route faster?
3. Should you always route all cars to the current fastest route? Why or why not?
4. How would you divide $50,000$ cars between the routes? Assume all start empty.

Recap

- On lecture slip, write down a topic you wish we had spent more time (and why).



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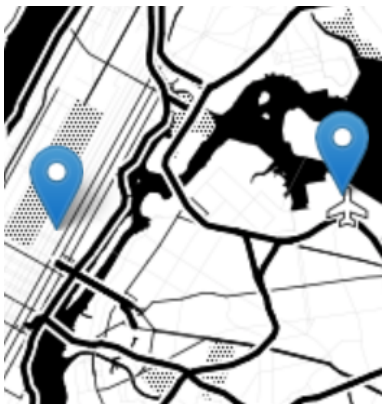
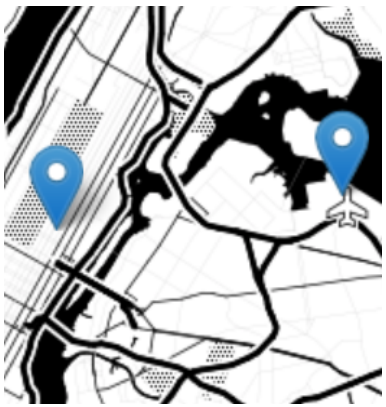


Recap



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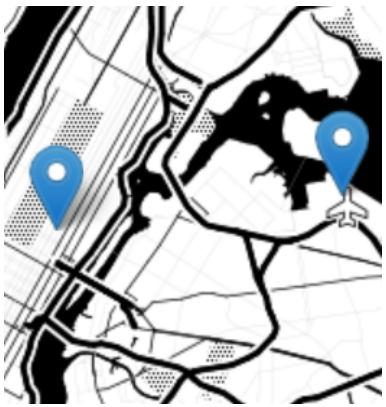

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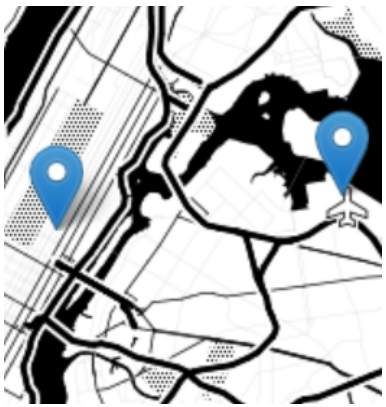

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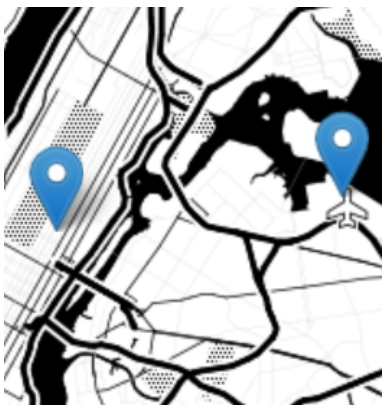

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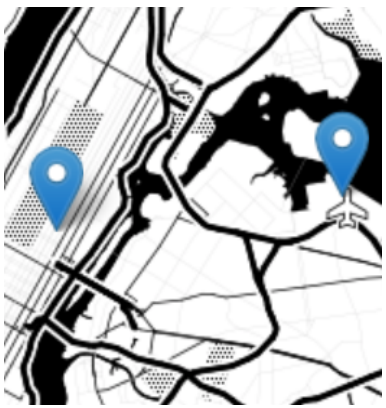

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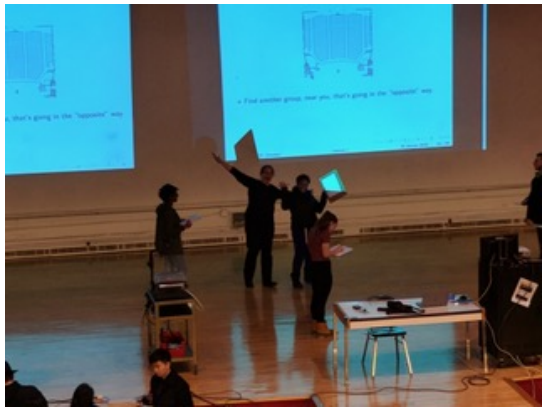
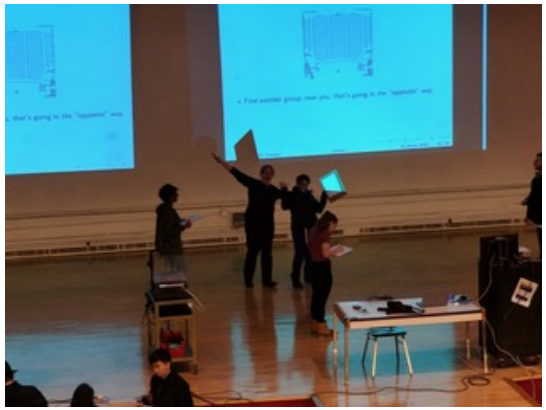
- Introduced a Python library, `Folium` for creating interactive HTML maps.
- Introduced `while` loops for repeating commands for an indefinite number of times.
- Pass your lecture slips to the aisles for the UTAs to collect.

Practice Quiz & Final Questions



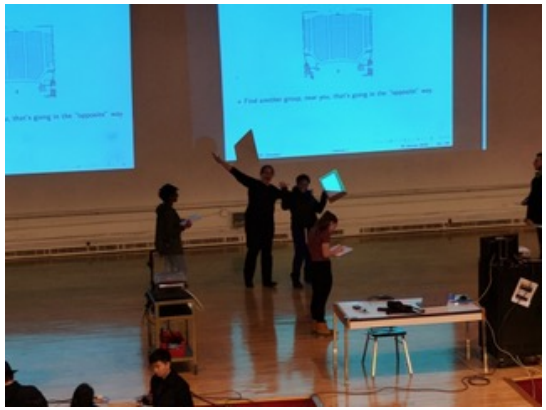
- Lightning rounds:

Practice Quiz & Final Questions



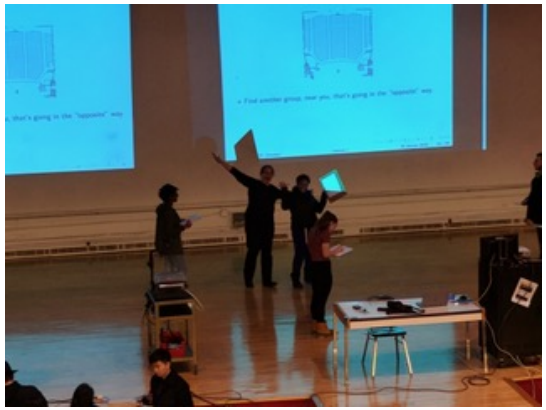
- Lightning rounds:
  - write as much you can for 60 seconds;

Practice Quiz & Final Questions



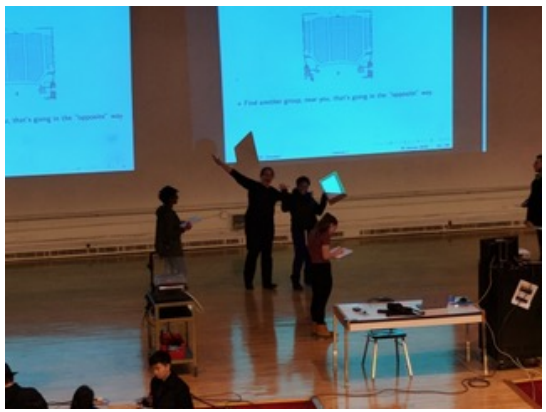
- Lightning rounds:
  - write as much you can for 60 seconds;
  - followed by answer; and

Practice Quiz & Final Questions



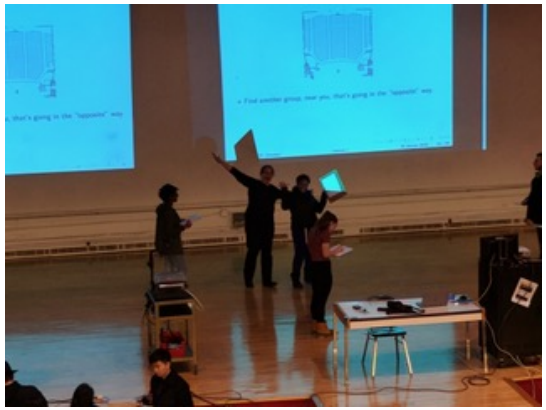
- Lightning rounds:
  - write as much you can for 60 seconds;
  - followed by answer; and
  - repeat.

Practice Quiz & Final Questions



- Lightning rounds:
  - write as much you can for 60 seconds;
  - followed by answer; and
  - repeat.
- Past exams are on the webpage (under Final Exam Information).

Practice Quiz & Final Questions



- Lightning rounds:
  - write as much you can for 60 seconds;
  - followed by answer; and
  - repeat.
- Past exams are on the webpage (under Final Exam Information).
- Theme: Functions & Top-Down Design (Summer 18, #7 & #5).