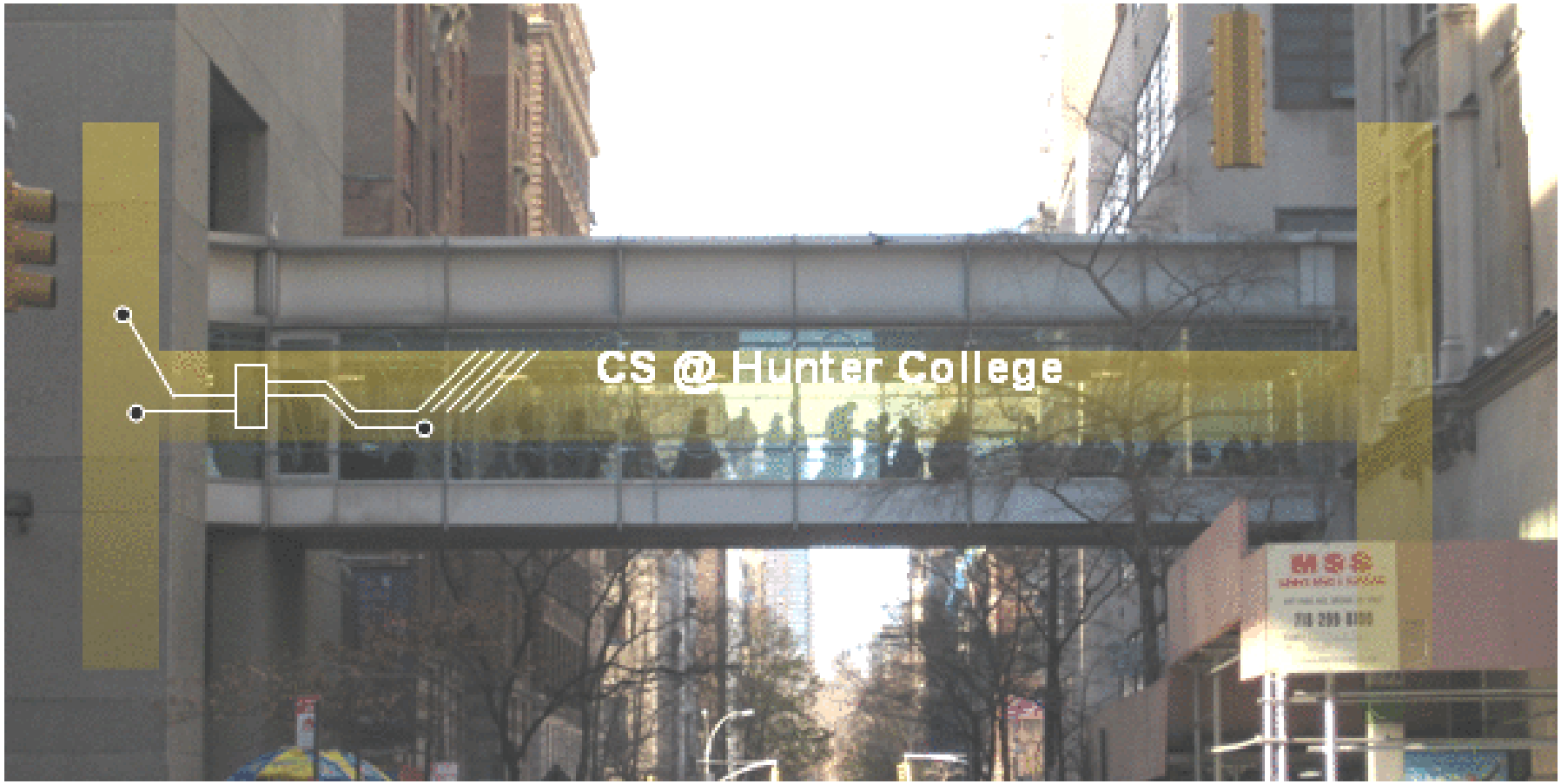
CSci 127: Introduction to Computer Science



hunter.cuny.edu/csci

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From email and tutoring.

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  - *More practice opportunities will be provided closer to the exam.*

Today's Topics

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

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Challenge:

```
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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Formal Parameters

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Python Tutor

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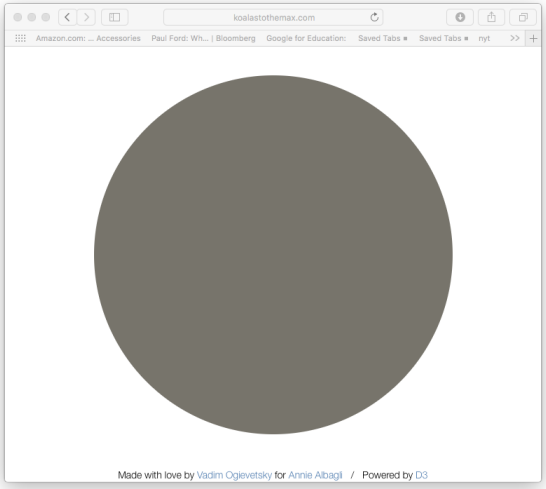
(Demo with pythonTutor)

From Last Time: koalas



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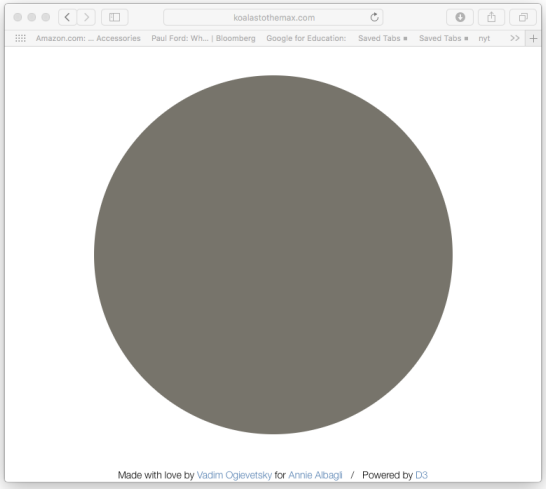

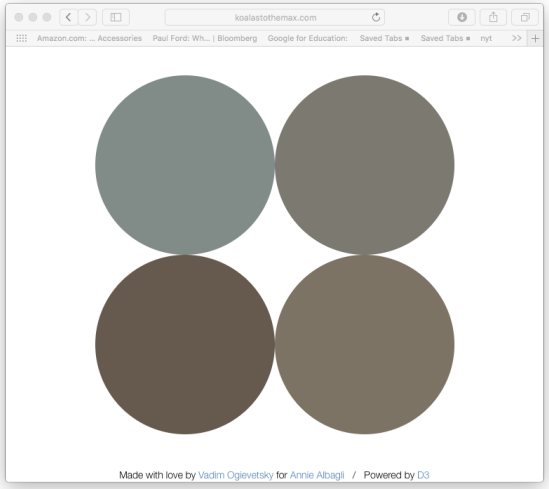

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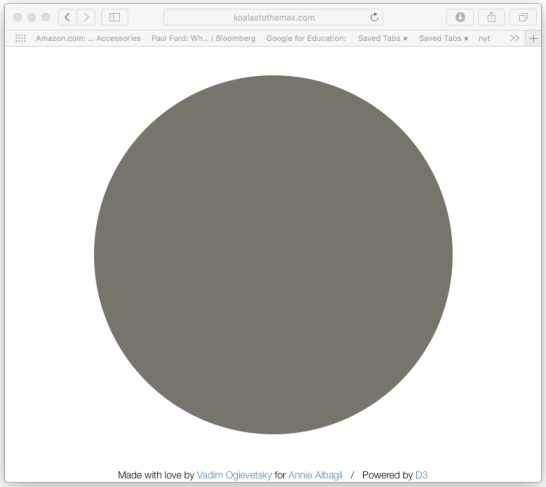

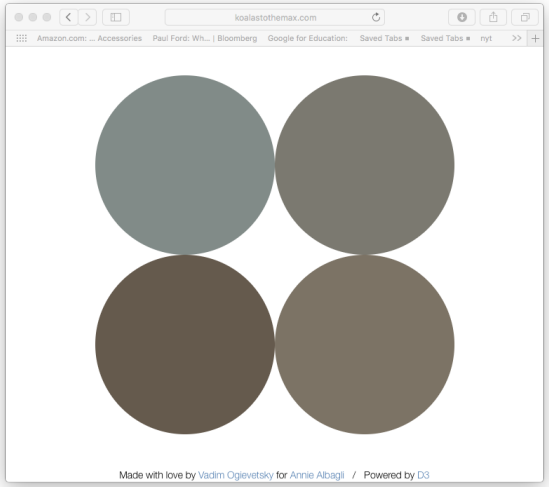

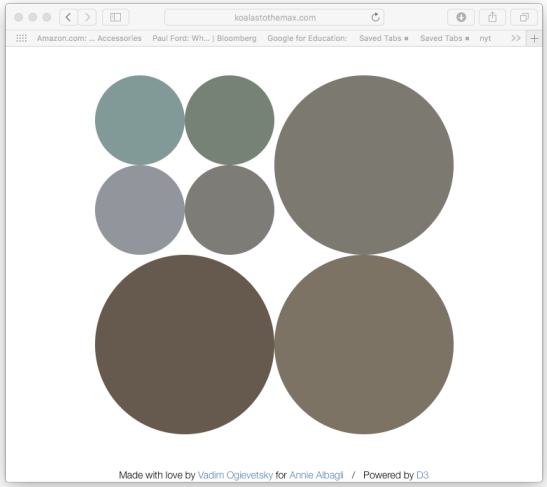

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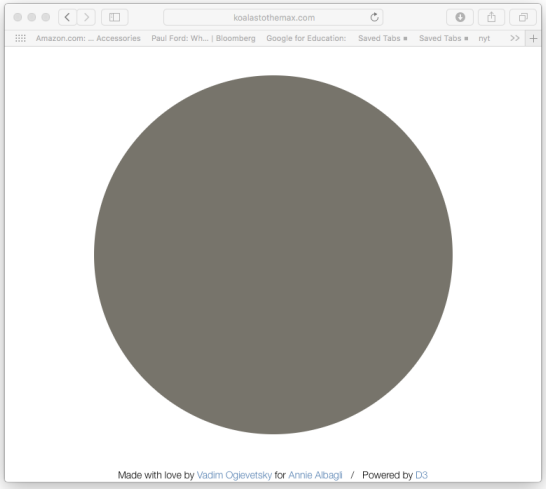

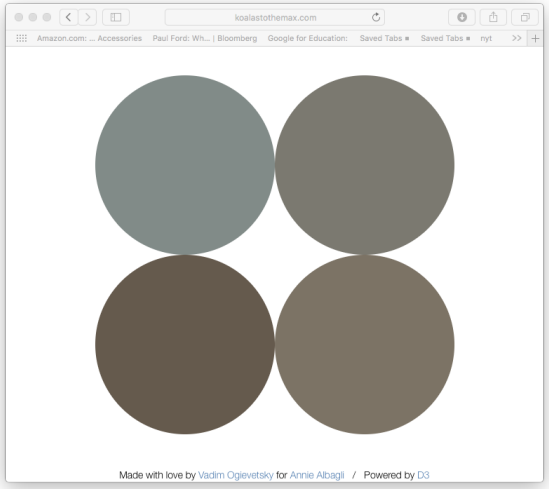

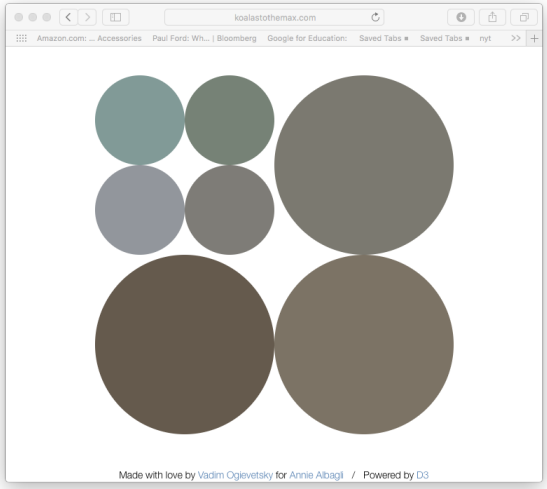

`http://koalastothemax.com`

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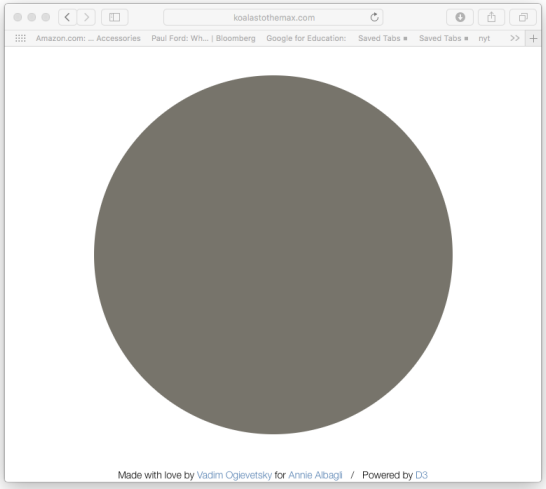

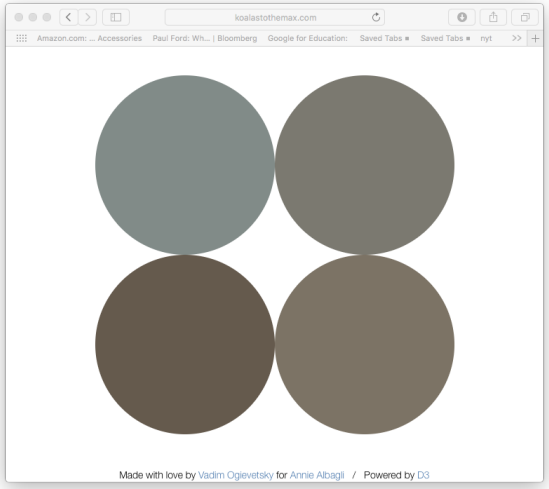

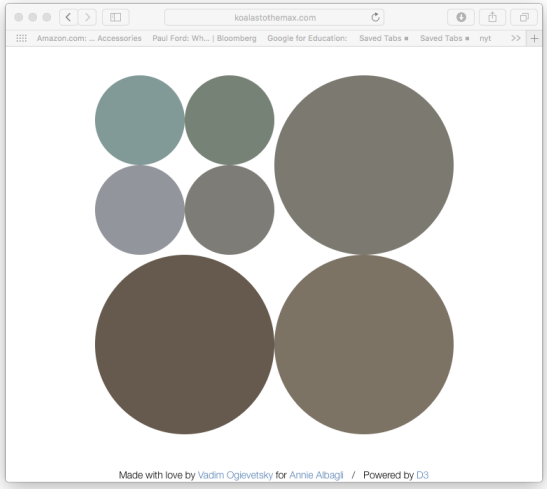

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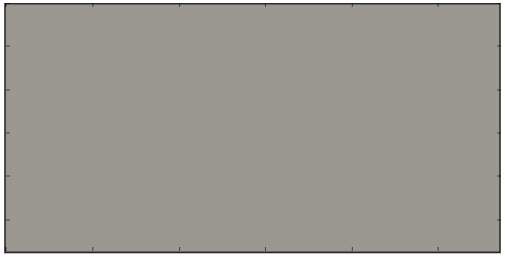

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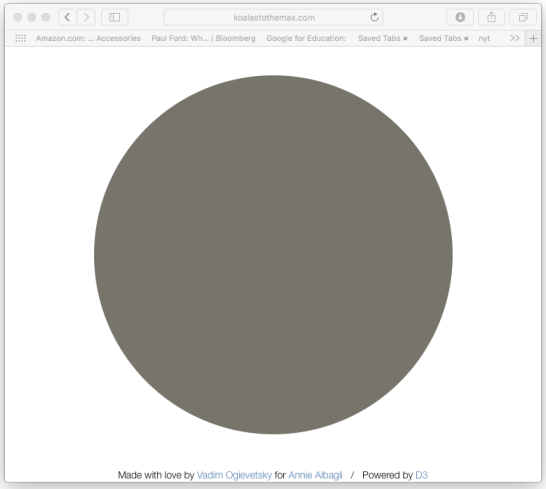

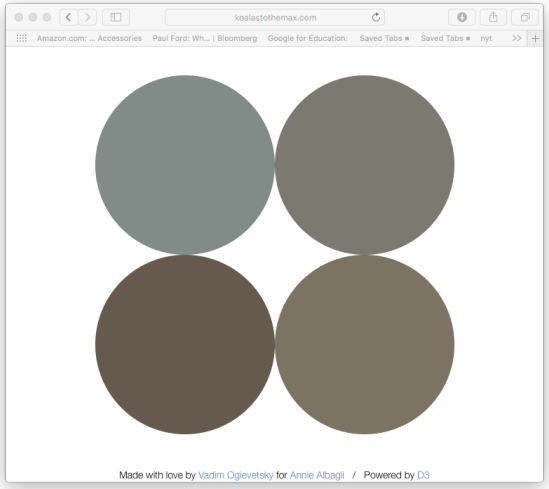

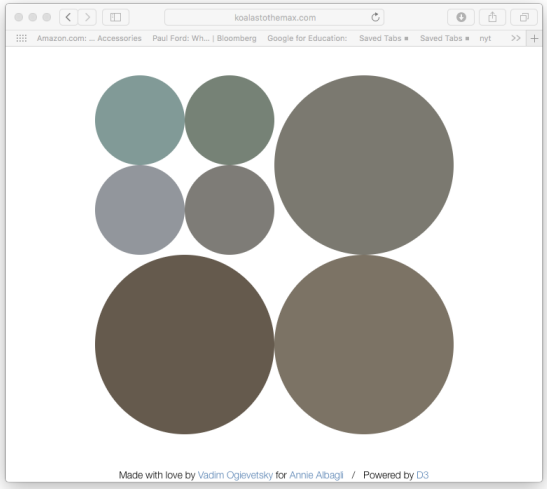

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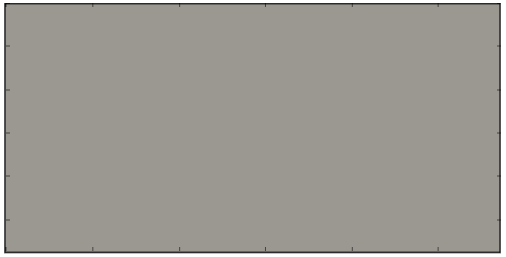

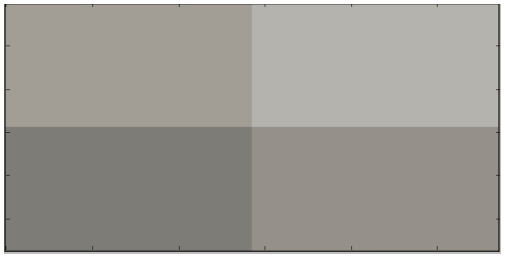

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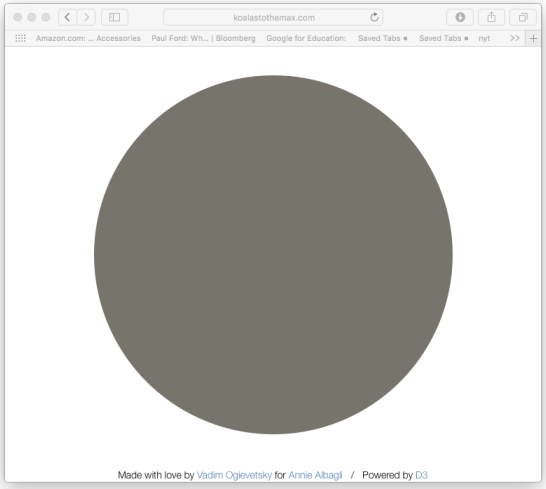

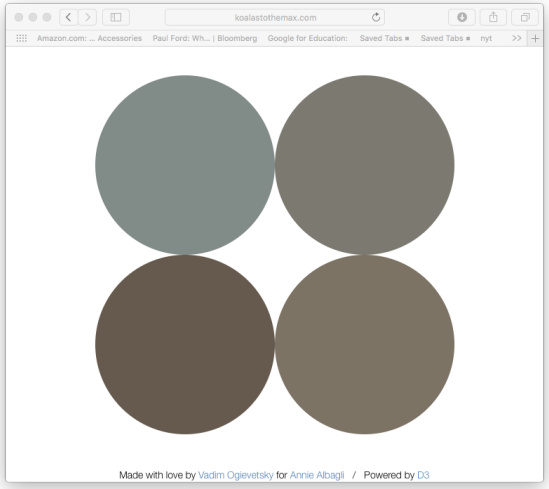

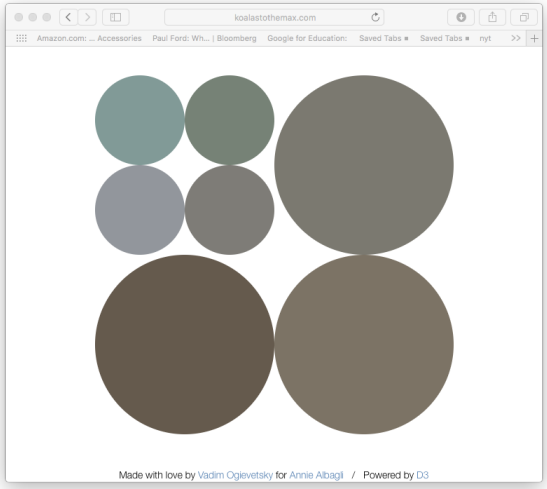

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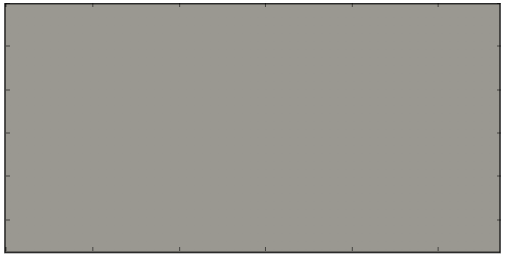

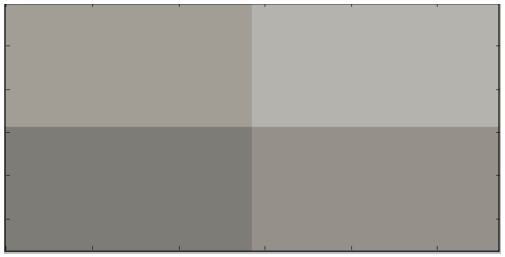

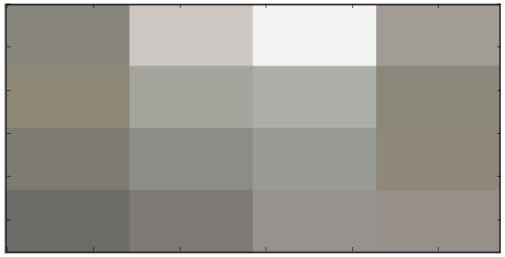

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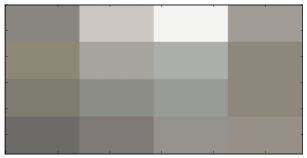
Process:



Get template from `github` → Fill in missing functions → Test locally idle3/python3 → Submit to Gradescope

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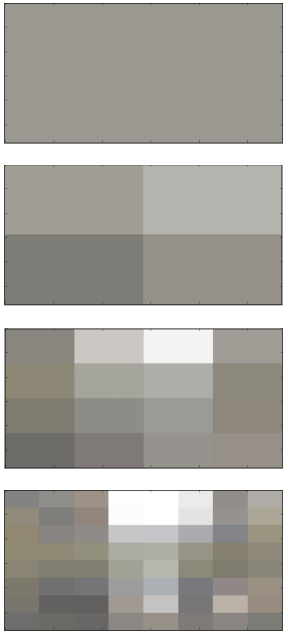

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def main():
    inFile = input('Enter image file name: ')
    img = plt.imread(inFile)

    #Divides the image in 1/2, 1/4, 1/8, ... 1/2^8, and displays each:
    for i in range(8):
        img2 = img.copy()   #Make a copy to average
        quarter(img2,i)     #Split in half i times, and average regions

        plt.imshow(img2)    #Load our new image into pyplot
        plt.show()          #Show the image (waits until closed to continue)

    #Shows the original image:
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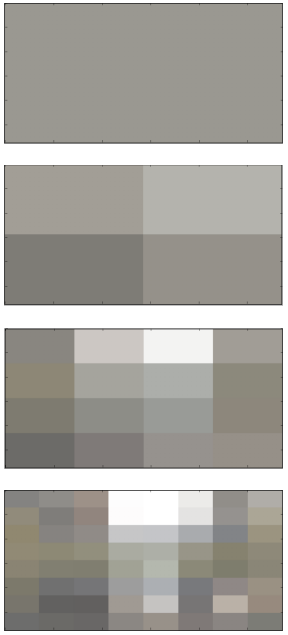

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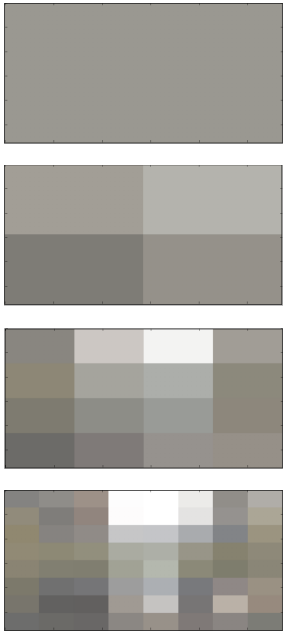

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- The `main()` is written for you.
- Only fill in two functions: `average()` and `setRegion()`.

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  - 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.

Challenge:

Write the missing functions for the program:

```
def main():
    turtle.setworldcoordinates(-100, -100, 100, 100)
    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.
    turtle.done() #need a user to click close window button to exit.
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Group Work: Fill in Missing Pieces

1. Write import statements.

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Third Part: Fill in Missing Pieces

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

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

def main():
    #code omitted
```

Third Part: Fill in Missing Pieces

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

```
def setUp():
    #FILL IN
    return newTurtle
def getInput():
    #FILL IN
    return x,y
def markLocation(t,x,y):
    #FILL IN
def main():
    #code omitted
```

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.

```
def setUp():
    newTurtle = turtle.Turtle()
    newTurtle.penup()
    newTurtle.color("purple")
    return newTurtle
```

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.

```
def getInput():
    x = int(input("Enter x: ")) #input("Enter x: ") take input after prompt "Enter x: " and returns a string, int(input("Enter x: ")) converts that string to an int
    y = int(input("Enter y: "))
    return x, y #we can return two items in python
```

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.

```
def markLocation(tess, x, y):
    tess.goto(x, y)
    tess.stamp()
```

Complete Code

```
import turtle

def setUp():
    newTurtle = turtle.Turtle()
    newTurtle.penup()
    newTurtle.color("purple")
    return newTurtle
```

Complete Code: II

```
def getInput():
    x = int(input("Enter x: ")) #input("Enter x: ") take input after prompt "Enter x: " and returns a string, int(input("Enter x: ")) converts that string to an int
    y = int(input("Enter y: "))
    return x, y #we can return two items in python
```

Complete Code: III

```
def markLocation(tess, x, y):
    tess.goto(x, y)
    tess.stamp()
```

Complete Code: IV

```
def main():
    turtle.setworldcoordinates(-100, -100, 100, 100)
    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.

    turtle.done() #add so that the screen does not exit without a user click
```

Complete Code: IV

```
25 if __name__ == '__main__':
26     main()
```

Challenge:

- Write a function that takes a number as an input and prints its corresponding name.

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- For example,
  - `num2string(0)` returns: `zero`
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  - `num2string(2)` returns: `two`
- You may assume that only single digits, 0,1,...,9, are given as input.

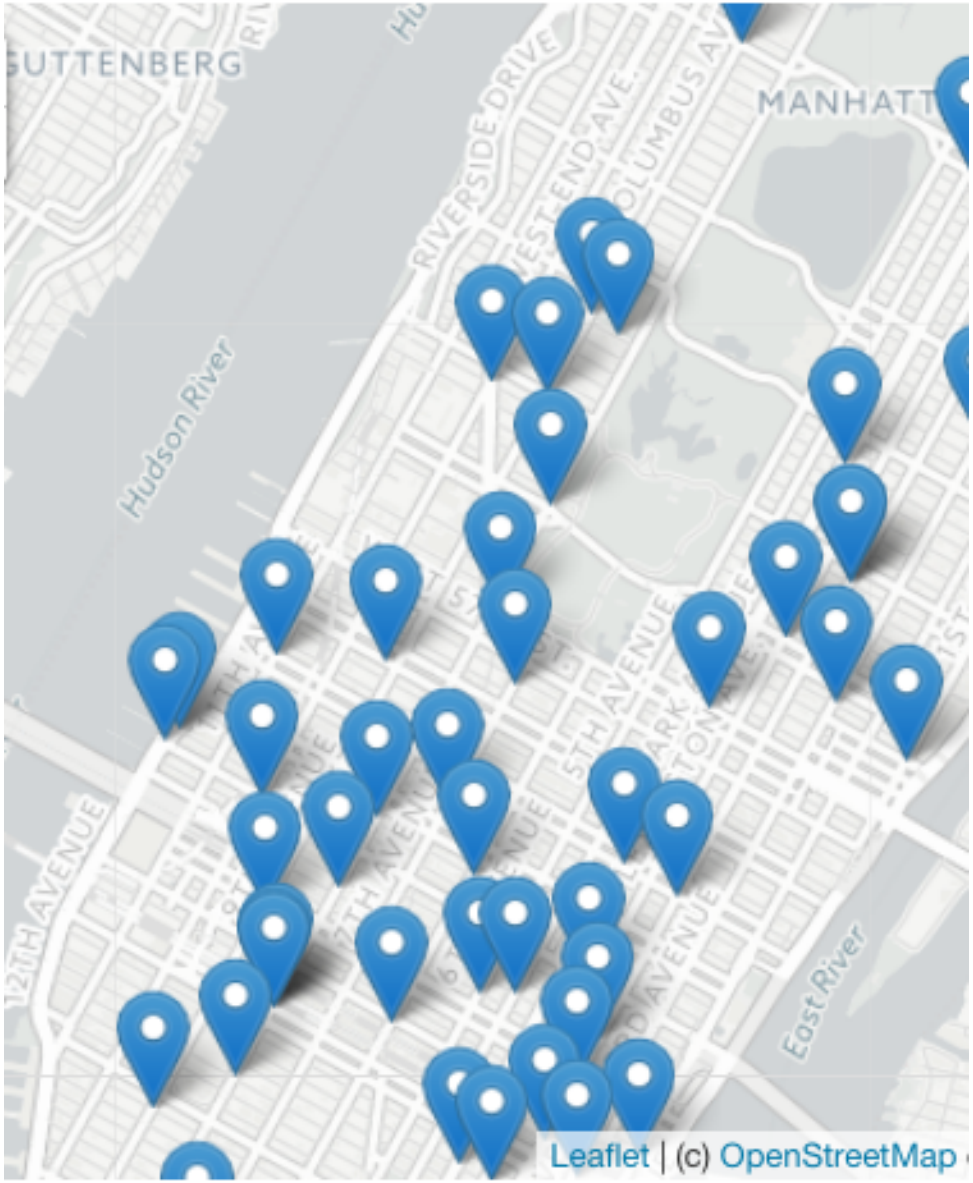
Python Tutor

(numsConvert.py on On github)

Today's Topics

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

Folium


SUTTENBERG
MANHATT
RIVERSIDE DRIVE
WEST END AVE
COLUMBUS AV
Hudson River
5TH AVENUE
12TH AVENUE
East River
Leaflet | (c) OpenStreetMap

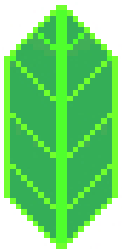
Folium

- A module for making HTML maps.

Folium

Folium

Folium



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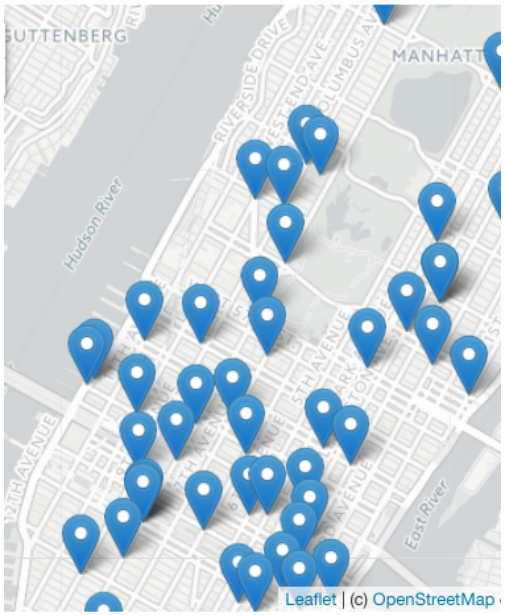
Folium

- A module for making HTML maps.
- It's a Python interface to the popular `leaflet.js`.
- Outputs `.html` files which you can open in a browser.
- An extra step:

Write code.	$\rightarrow$	*Run program.*	$\rightarrow$	*Open .html in browser.*

Demo



(Map created by Folium.)

Folium

- To use:

  ```
  import folium
  ```

Folium

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  newMark.add_to(myMap)
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- Add to the map:

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  newMark.add_to(myMap)
  ```
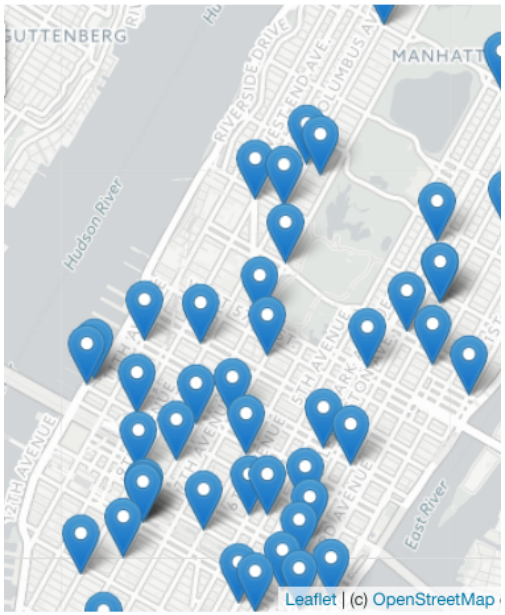

- Many options to customize background map ("tiles") and markers.

Demo



(Python program using Folium.)

In Pairs of Triples

```
import folium
import webbrowser
import os #use to find directory

m = folium.Map(location = [45.372,
   -121.6972],
               zoom_start = 12,
               tiles = 'Stamen Terrain')
#stamen Terrain highlights hill shading and
#natural vegetation colors
```

In Pairs of Triples

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

In Pairs of Triples

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

In Pairs of Triples

```
folium.Marker(
        location = [45.3300, -121.6823],
        popup = 'some other location',
        icon = folium.Icon(color = 'red',
        icon = 'info_sign')
).add_to(m)
```

In Pairs of Triples

```
#google "display html page python"
#https://stackoverflow.com/questions/40905703/how-to-open-an-html-file-in-the-browser-from-python
filename = 'three_marks.html'
m.save(outfile = filename)
webbrowser.open('file://' + os.path.realpath(filename))
```

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')
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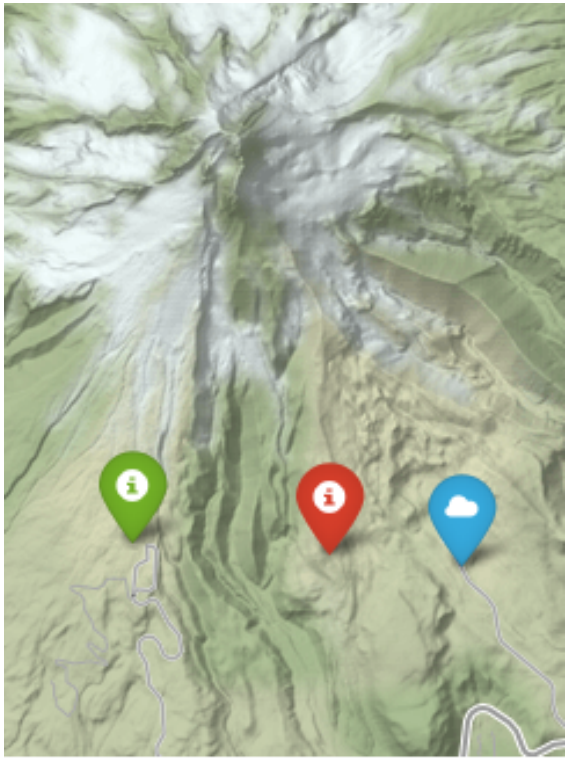

(example from Folium documentation)

Today's Topics

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

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)
  trey.right(a)
```

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  which gives a number chosen randomly from the specified range.

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- Useful command to generate real numbers:

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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

```
import turtle
import random

trey = turtle.Turtle()
trey.speed(10)
for i in range(100):
    trey.forward(10)
    a = random.randrange(0, 360, 90) # generate a random int in [0, 90, 180, 270]
    trey.right(a)
turtle.done() #wait user to click x (window close button) in the top left of window.
```

Today's Topics

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

Challenge:

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)
```

Challenge:

Predict what the code will do:

```
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]
    i = i+1
print(nums)
```

Indefinite Loops

```
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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```
#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]:
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```

- Indefinite loops repeat as long as the condition is true.

Indefinite Loops

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dist = int(input('Enter distance: '))
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- Indefinite loops repeat as long as the condition is true.
- Could execute the body of the loop zero times, 10 times, infinite number of times.

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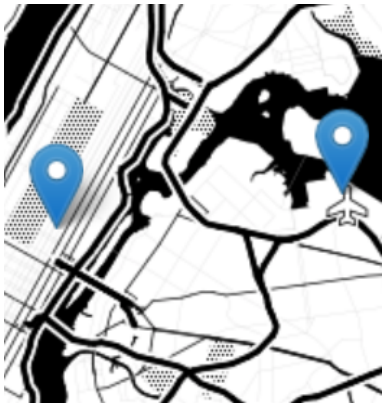
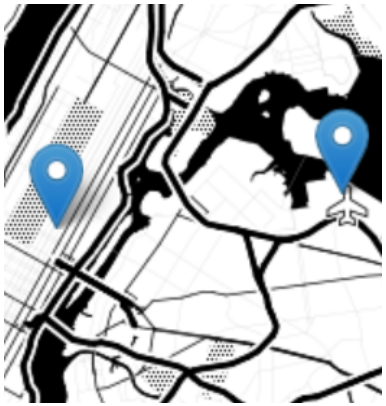
- Indefinite loops repeat as long as the condition is true.
- Could execute the body of the loop zero times, 10 times, infinite number of times.
- The condition determines how many times.
- Very useful for checking input, simulations, and games.
- More details next lecture...

Recap



- Top-down design: breaking into subproblems, and implementing each part separately.

Recap



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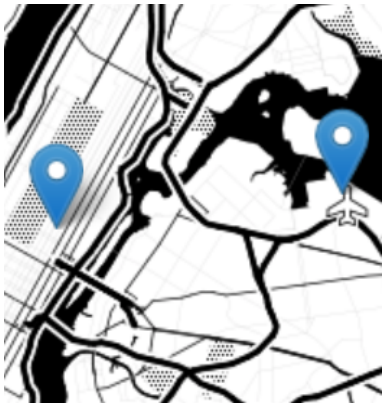
- Excellent approach: can then test each part separately before adding it to a large program.

Recap



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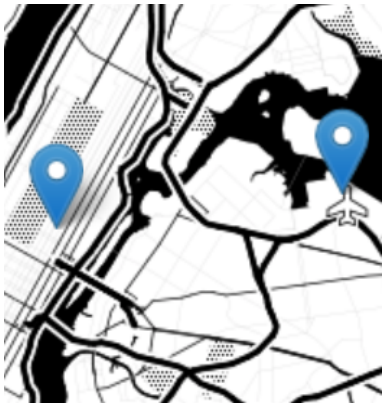
- When possible, design so that your code is flexible to be reused ("code reuse").

Recap



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- Introduced a Python library, `Folium` for creating interactive HTML maps.

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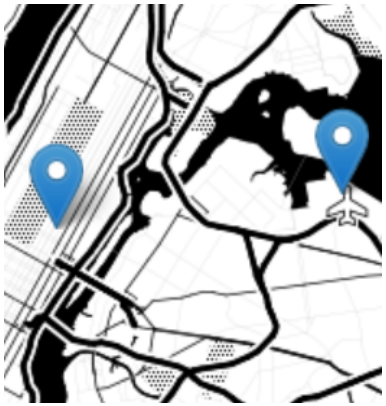

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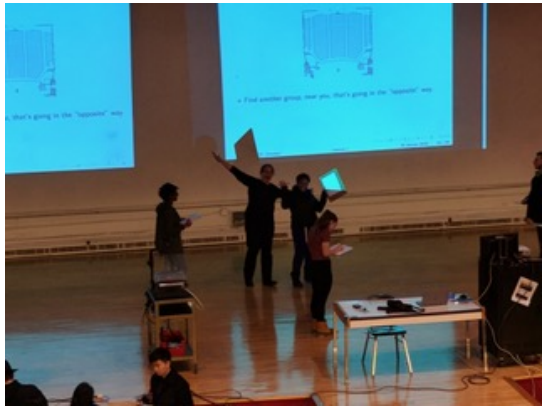
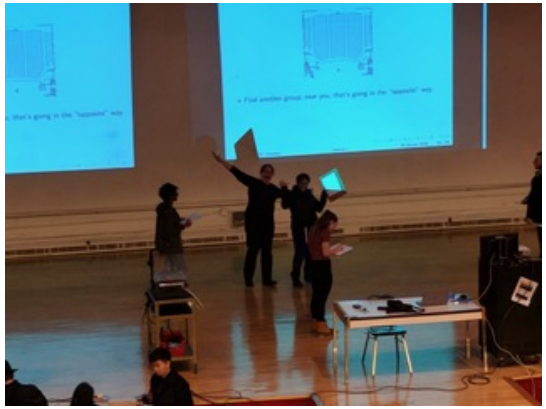
- When possible, design so that your code is flexible to be reused ("code reuse").
- Introduced a Python library, `Folium` for creating interactive HTML maps.
- Introduced `while` loops for repeating commands for an indefinite number of times.

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:
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- Past exams are on the webpage (under Final Exam Information).
- Theme: Functions & Top-Down Design (Summer 18, #7).

Weekly Reminders!

Before next lecture, don't forget to:

- Work on this week's Online Lab

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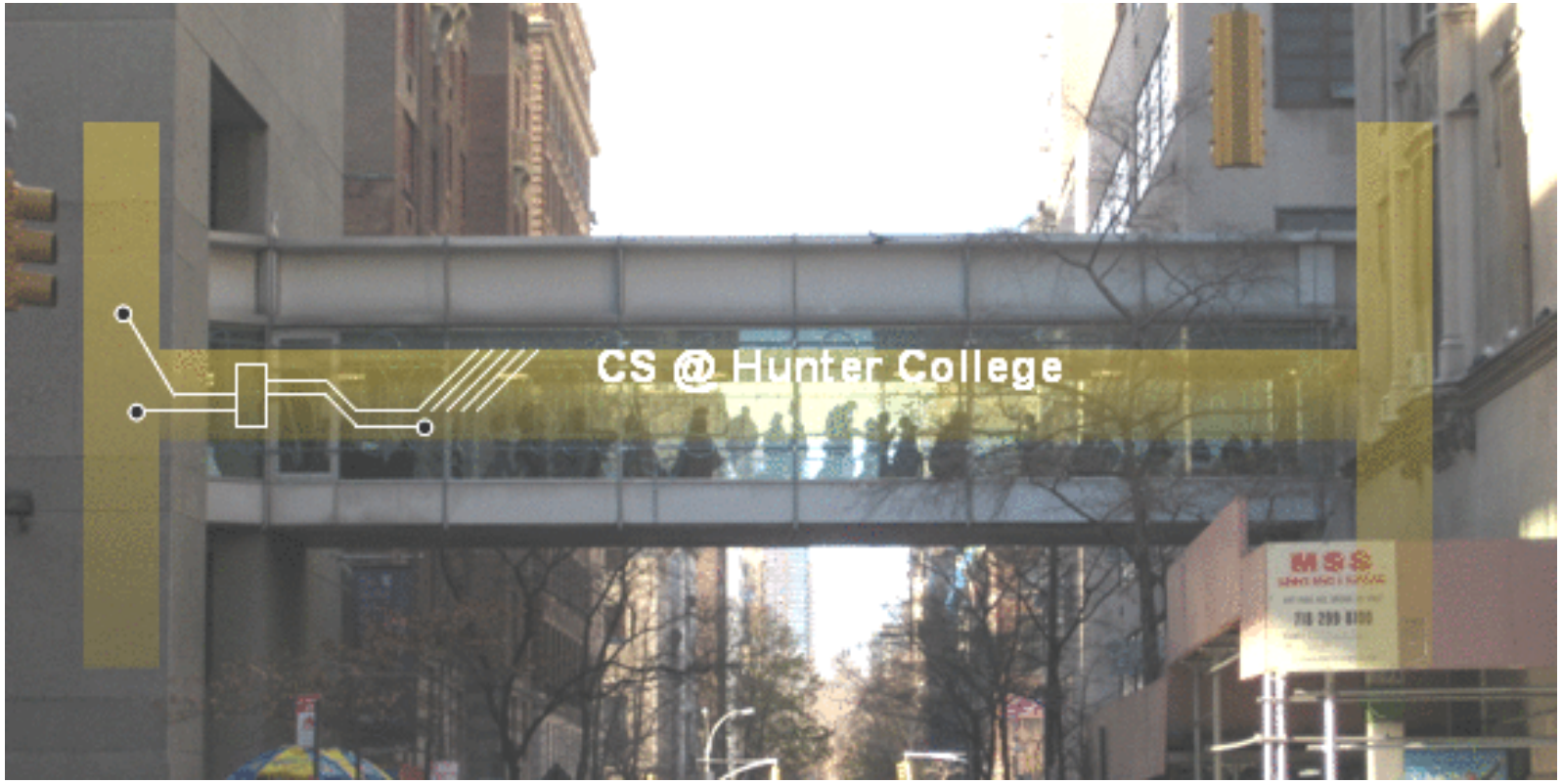
- Submit this week's 5 programming assignments **(programs 41-45)**
- If you need help, schedule an appointment for Tutoring in lab 1001G 11:30am-5pm
- Take the Lecture Preview on Blackboard on Monday (or no later than 10:15am on Tuesday)

Lecture Slips & Writing Boards



- Hand your lecture slip to a UTA.
- Return writing boards as you leave.