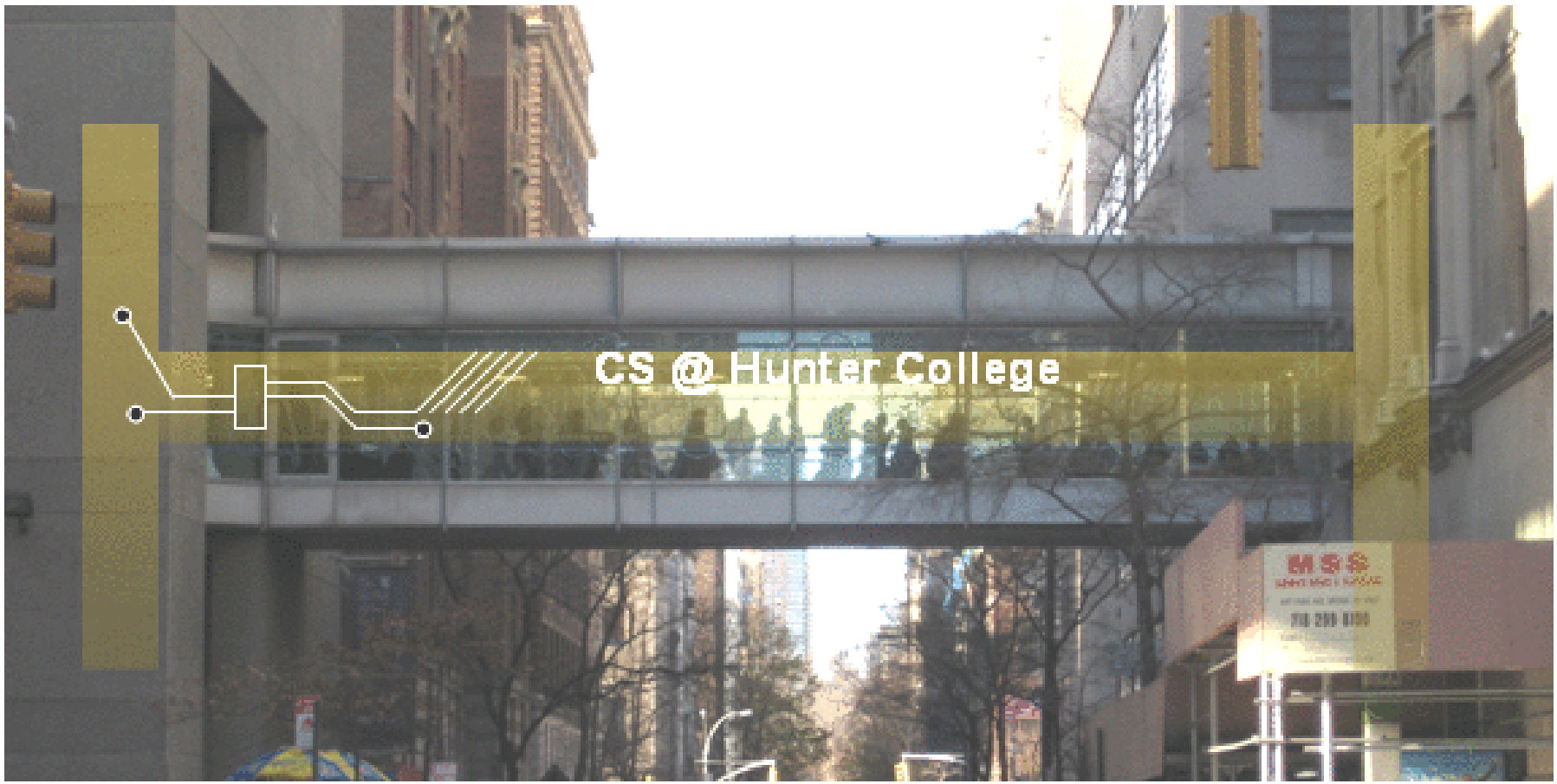
CSci 127: Introduction to Computer Science



hunter.cuny.edu/csci

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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
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Challenge:

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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)

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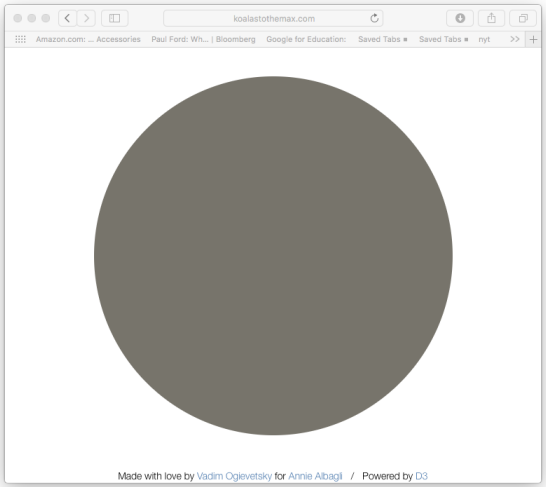

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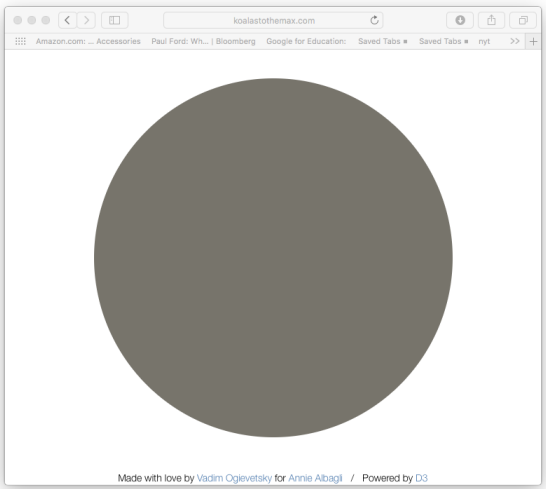

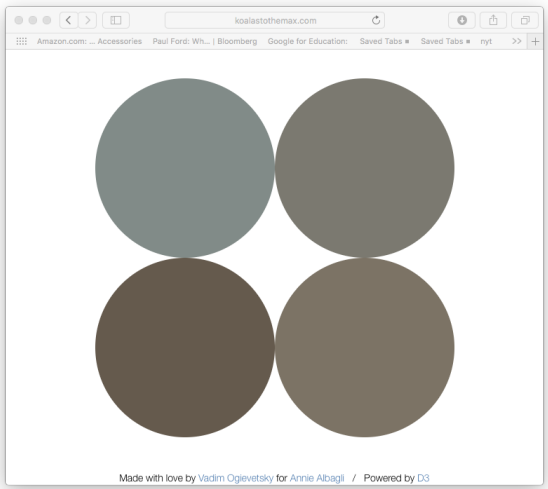

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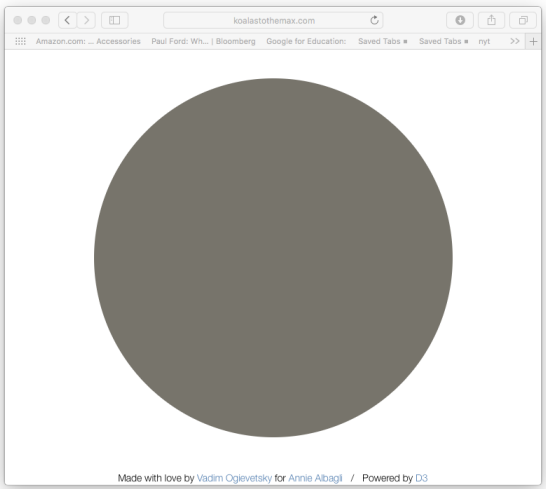

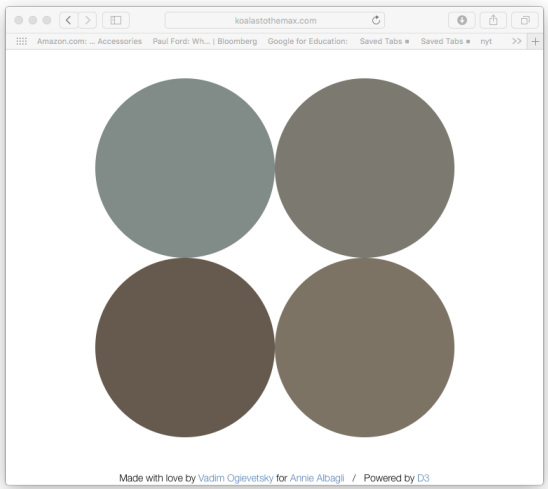

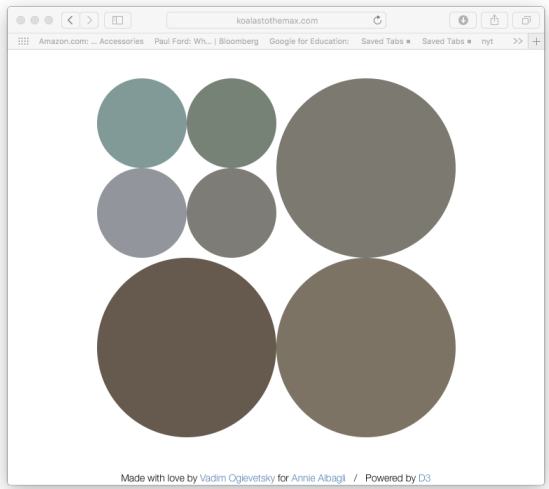

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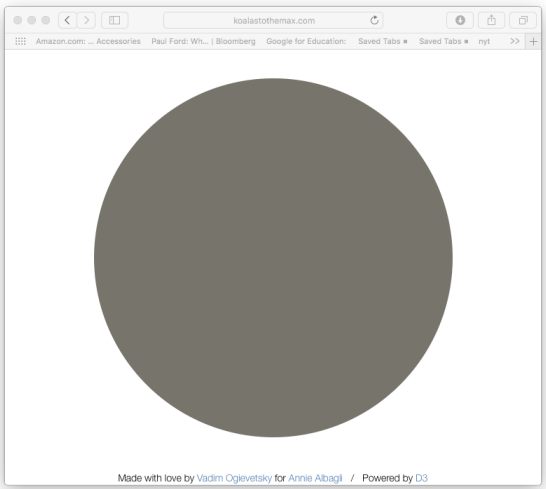

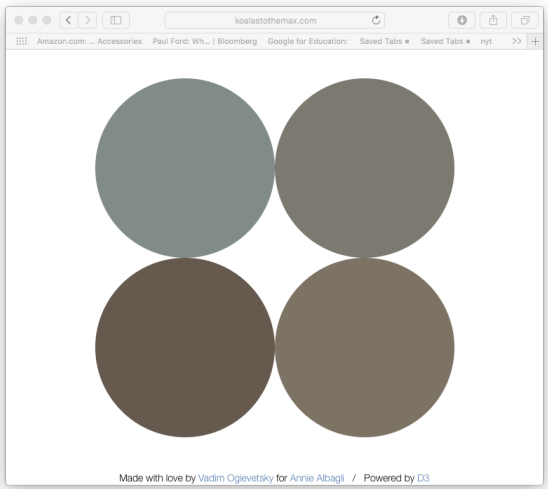

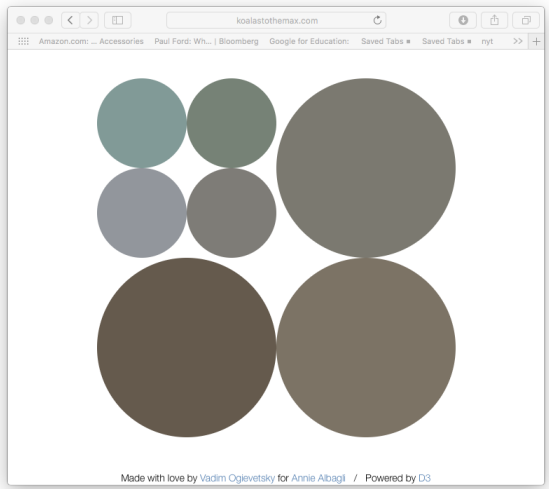

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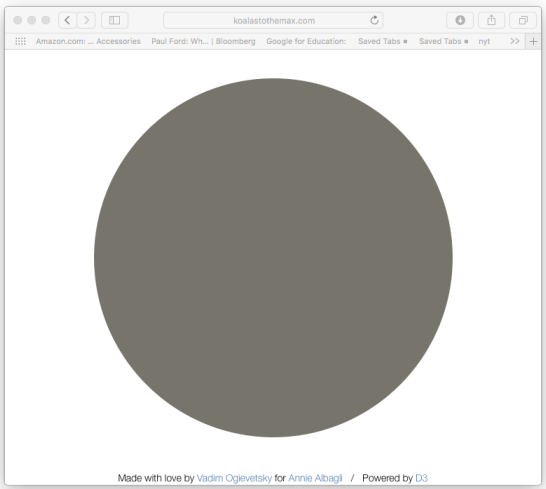

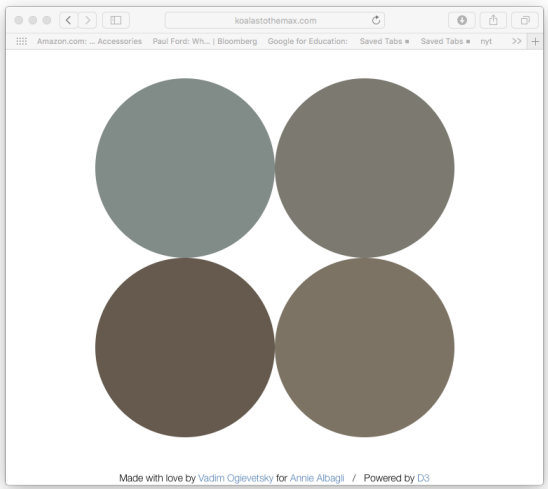

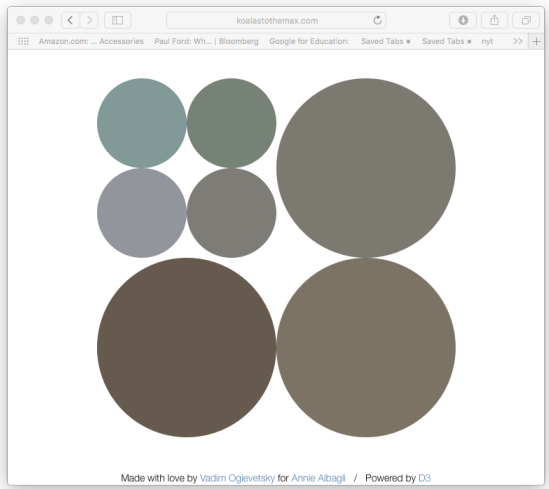

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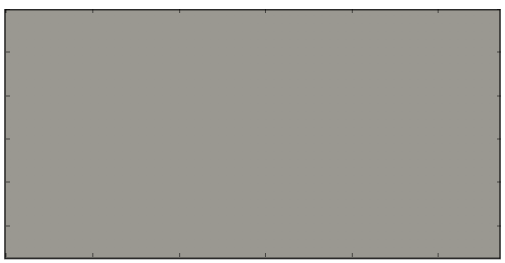

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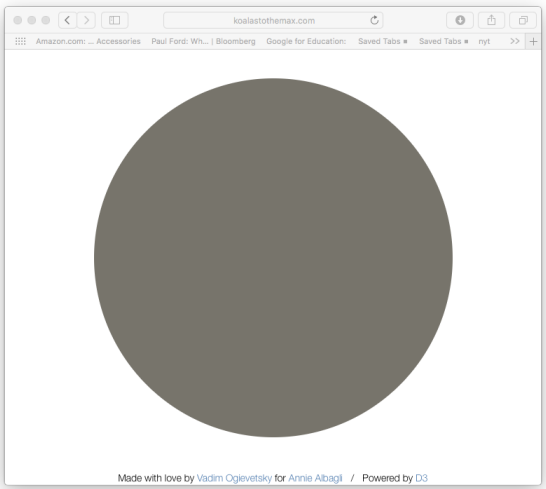

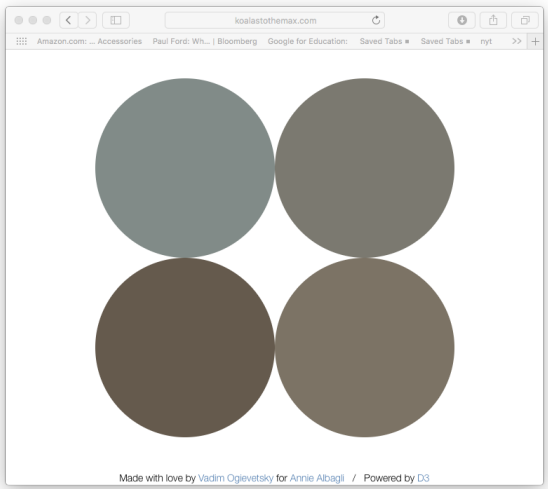

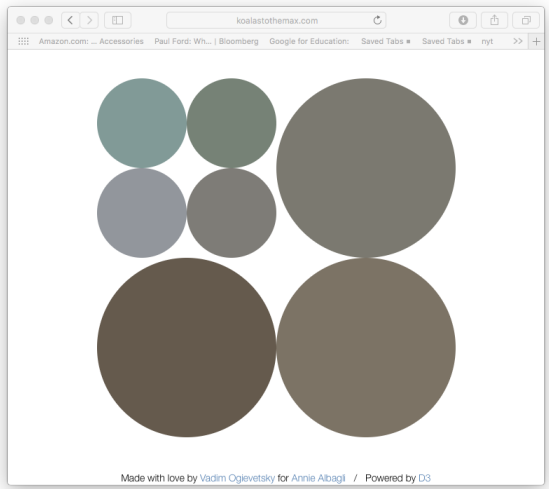

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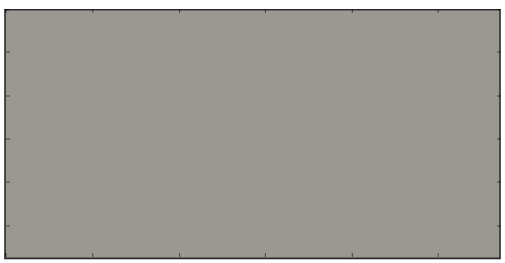

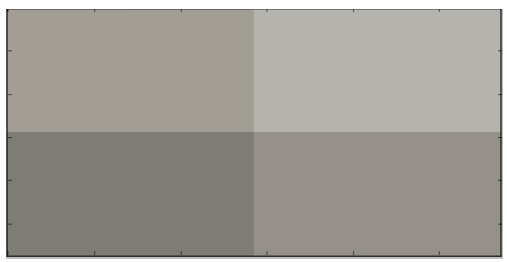

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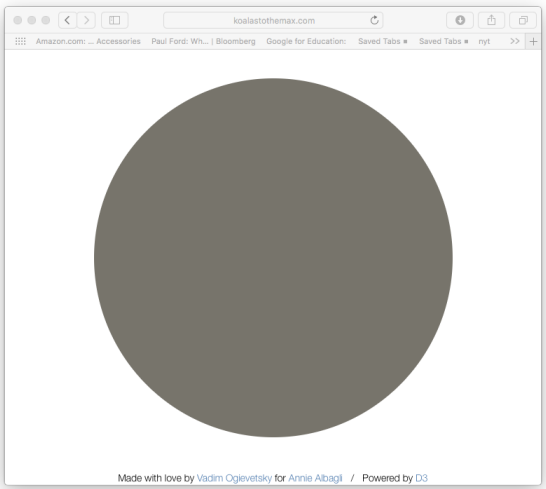

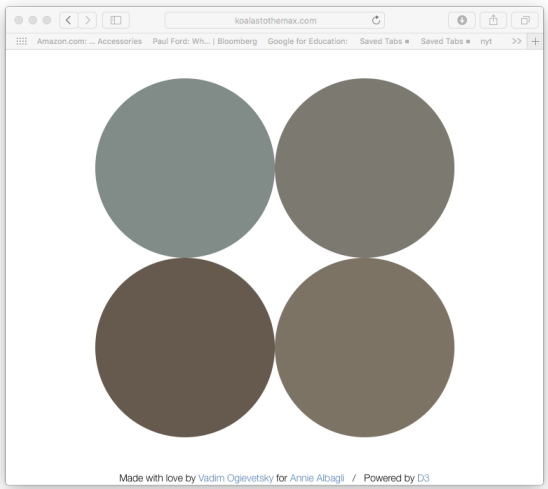

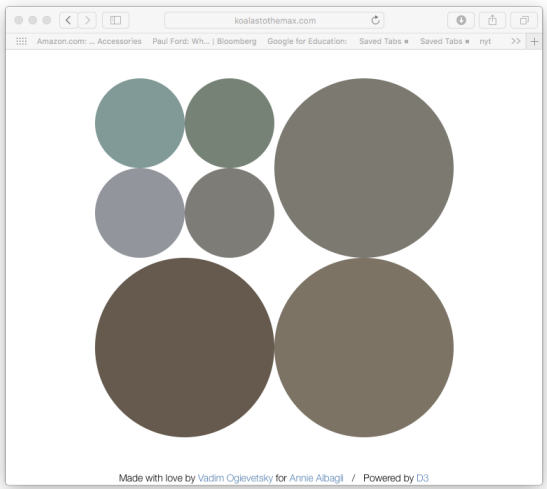

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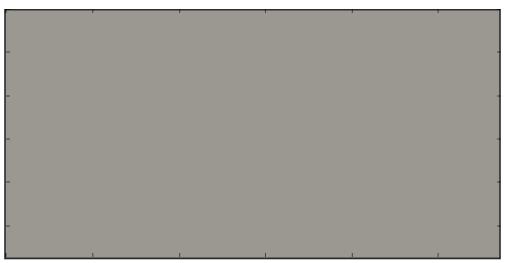

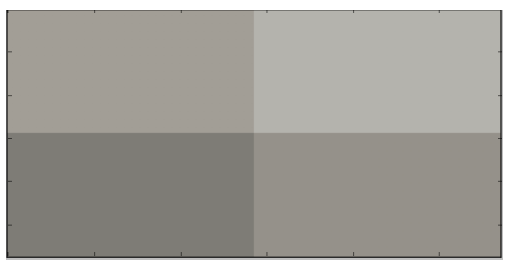

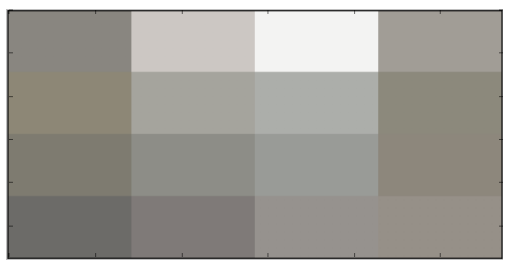

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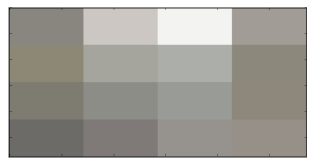
Process:






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

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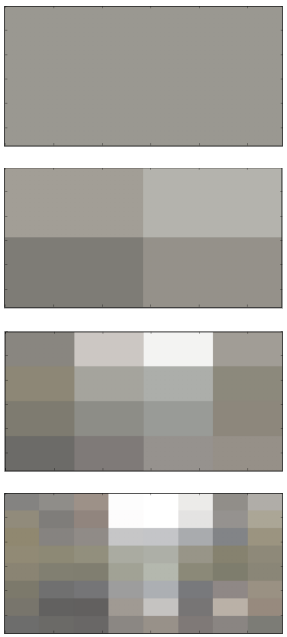

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70      inFile = input('Enter image file name: ')
71      img = plt.imread(inFile)
72
73      #Divides the image in 1/2, 1/4, 1/8, ... 1/2^8, and displays each:
74      for i in range(8):
75          img2 = img.copy()   #Make a copy to average
76          quarter(img2,i)     #Split in half i times, and average regions
77
78          plt.imshow(img2)    #Load our new image into pyplot
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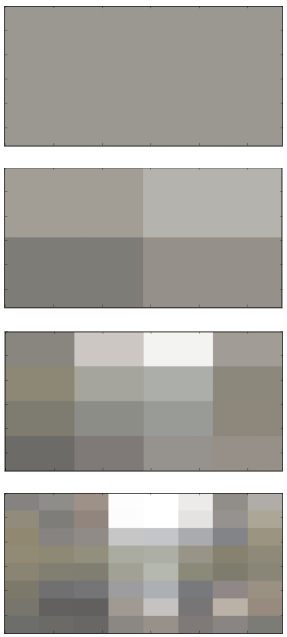

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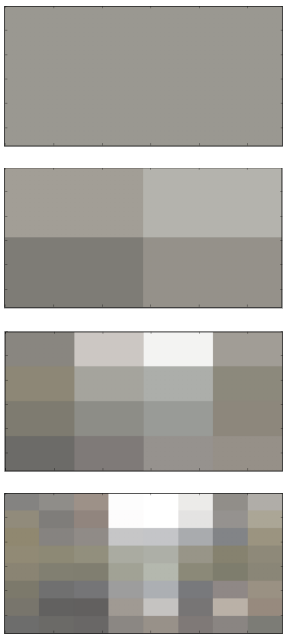

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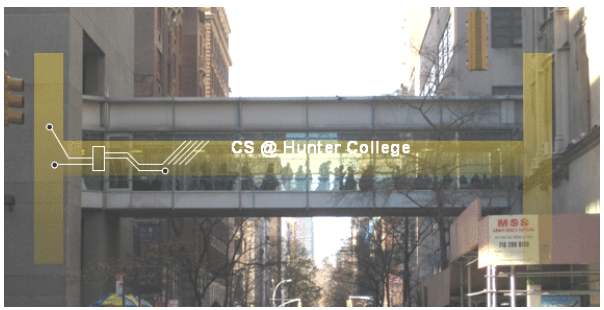
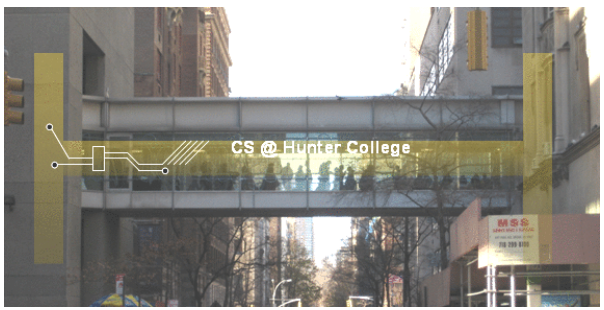
- Only fill in two functions: `average()` and `setRegion()`.

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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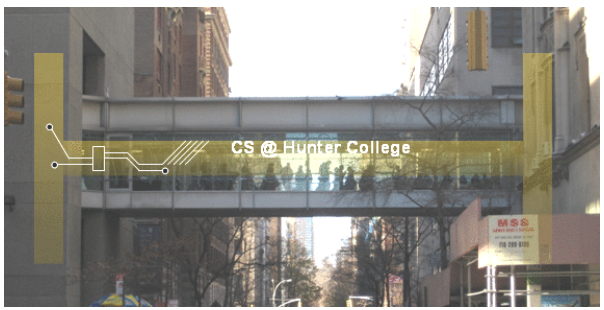

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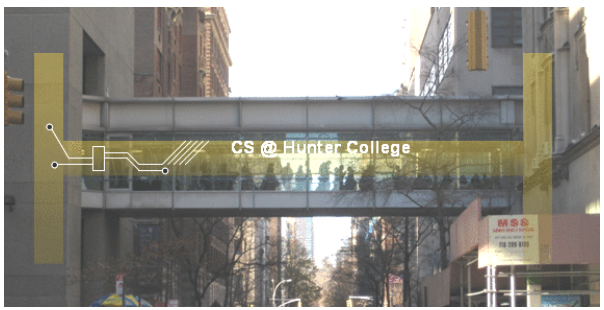

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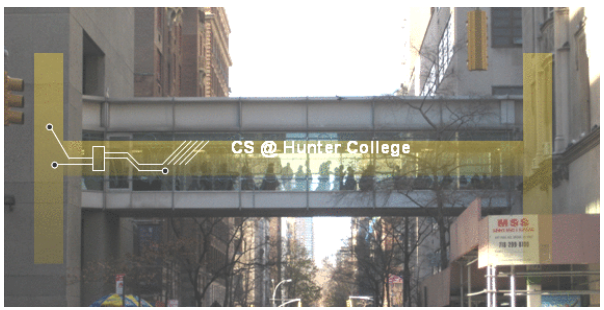

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  - Break the problem into tasks for a "To Do" list.
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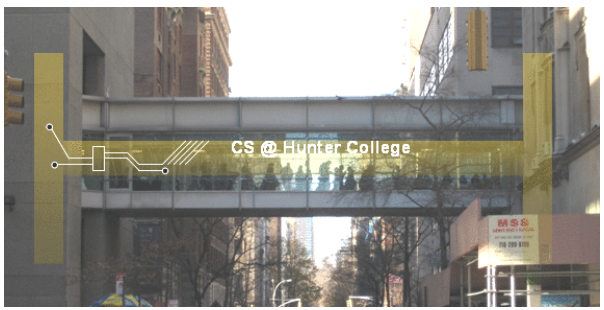
- Excellent approach since you can then test each part separately before adding it to a large program.

Top-Down Design



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

Challenge:

- 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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def main():
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Group Work: Fill in Missing Pieces

1. Write import statements.

```
import turtle
```

```
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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```

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.
    for i in range(5):
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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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```

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.color("purple")
    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):
```

Challenge:

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

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  - `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.

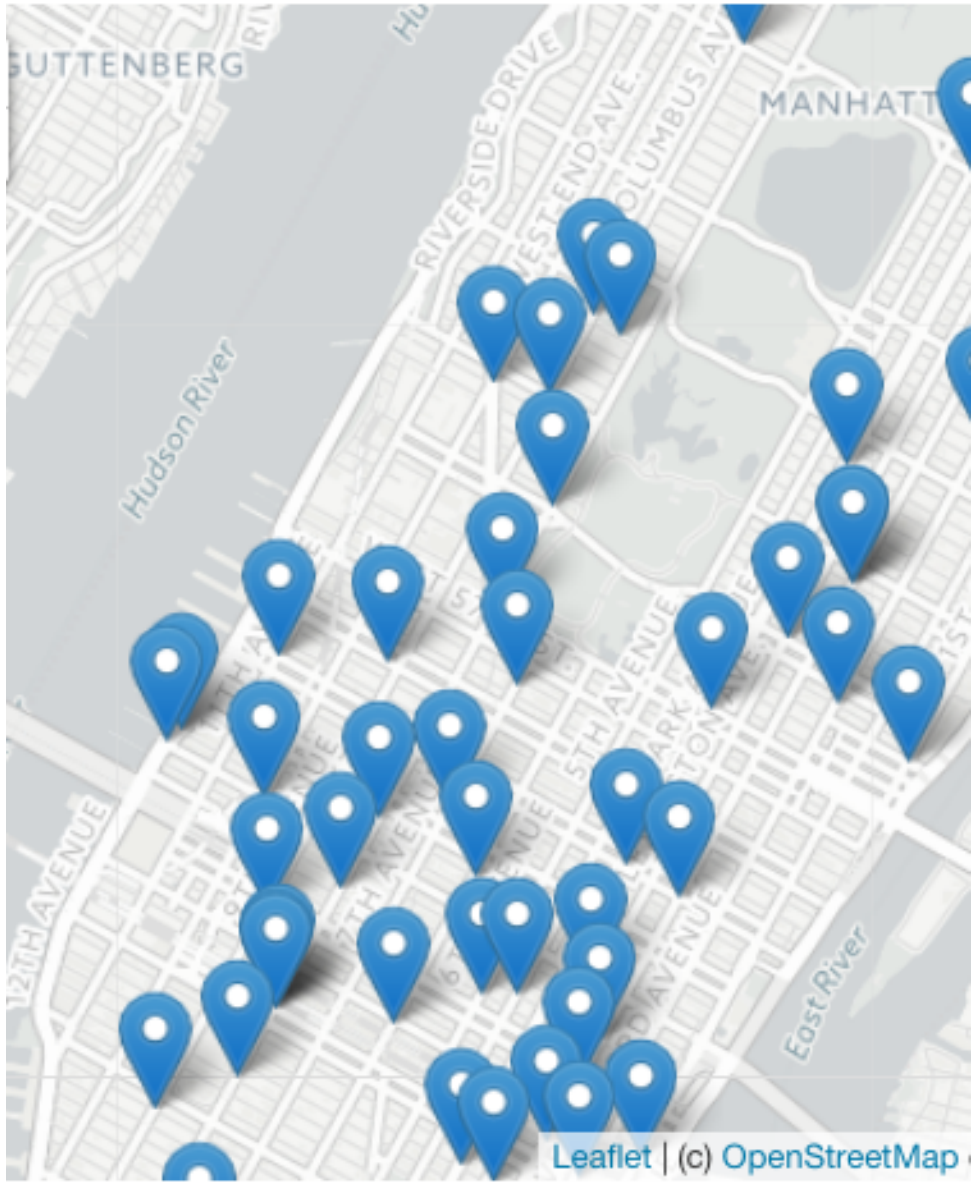
Python Tutor

(numsConvert.py on On github)

Today's Topics

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

Folium


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

Folium

- A module for making HTML maps.

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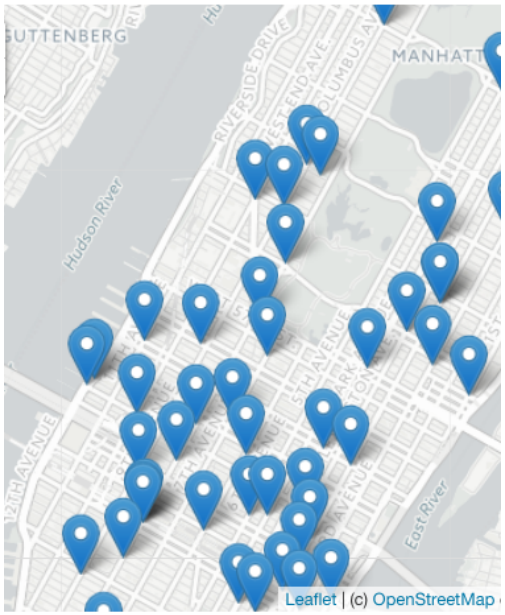
- An extra step:

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

Demo



(Map created by Folium.)

Folium

- To use:

  ```
  import folium
  ```

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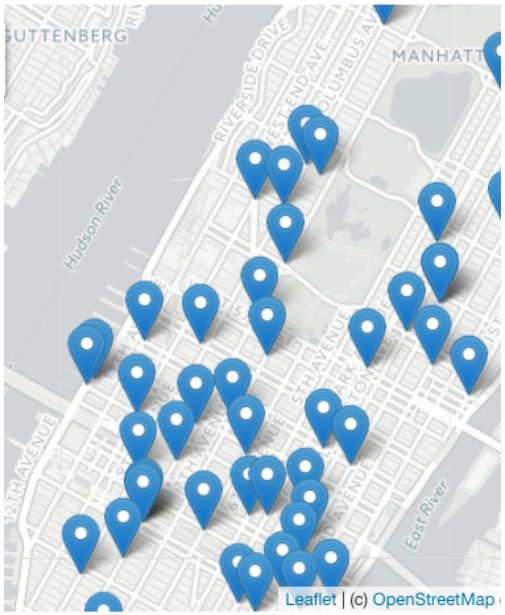
- Many options to customize background map ("tiles") and markers.

Demo



(Python program using Folium.)

In Pairs of Triples

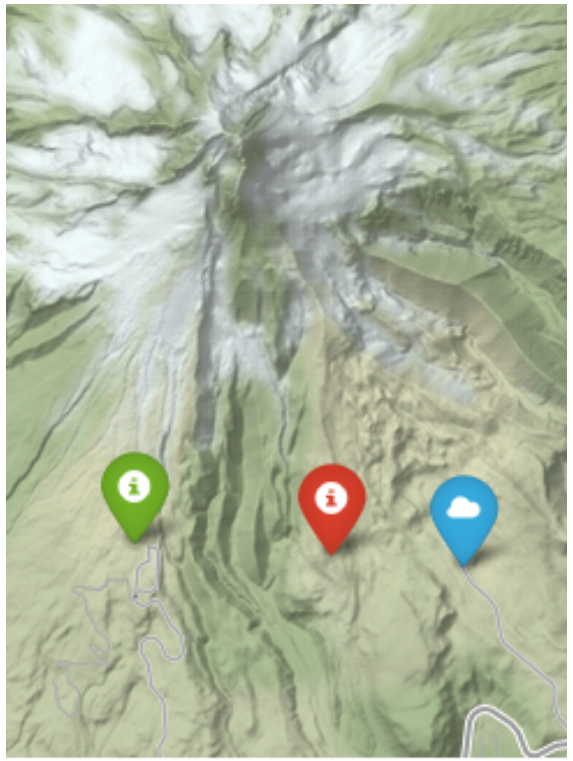
- Predict which each line of code does:

```
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

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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  `random.randrange(start,stop,step)`

  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**

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)
```

Python Tutor

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dist = int(input('Enter distance: '))
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(Demo with pythonTutor)

Indefinite Loops

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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]
    i=i+1

print(nums)
```

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

Indefinite Loops

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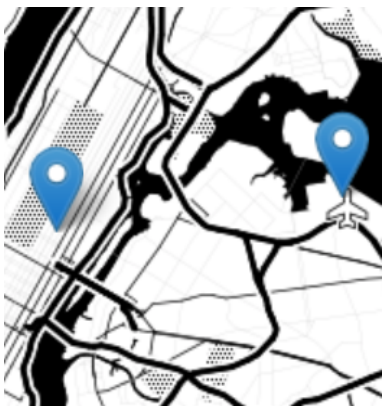
- Very useful for checking input, simulations, and games.
- More details next lecture...

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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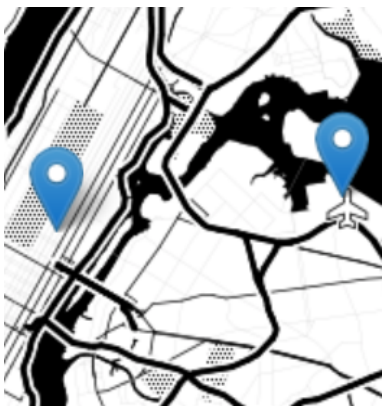

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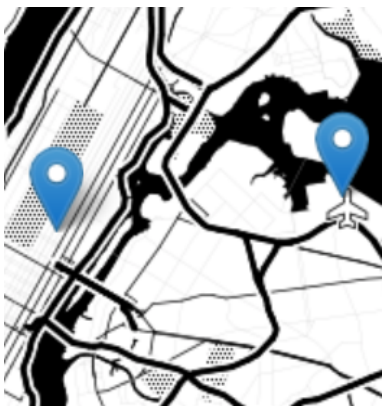
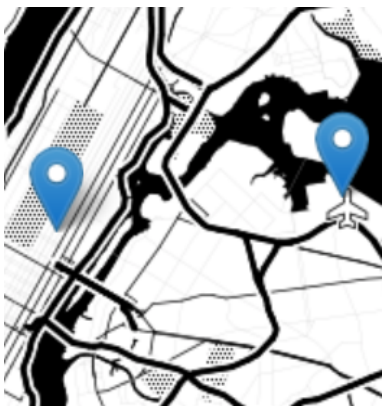
1. Assuming no traffic (i.e. $x = 0$), which is fastest?
2. How many cars would slow that route to make another route faster?
3. Should you always route all cars to the current fastest route? Why or why not?
4. How would you divide $50,000$ cars between the routes? Assume all start empty.

Recap



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

Recap



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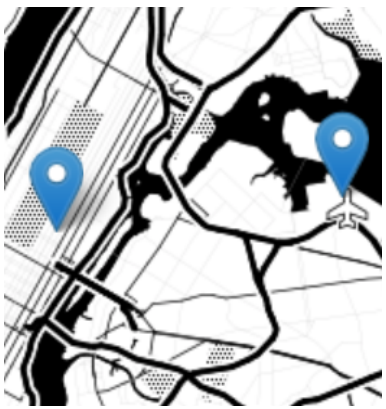

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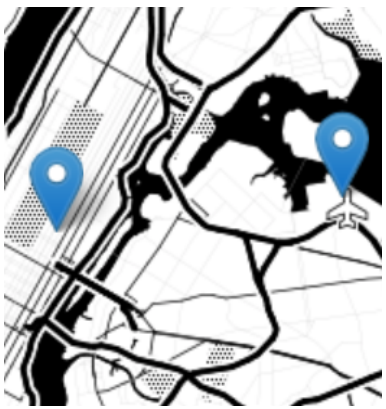
- When possible, design so that your code is flexible to be reused ("code reuse").

Recap



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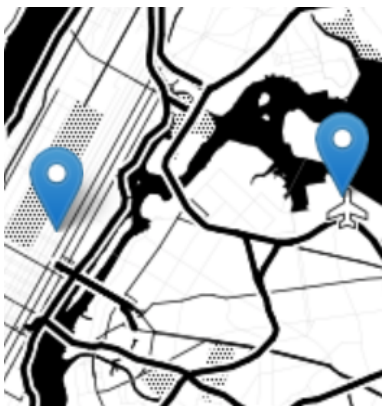
- Introduced a Python library, `Folium` for creating interactive HTML maps.

Recap



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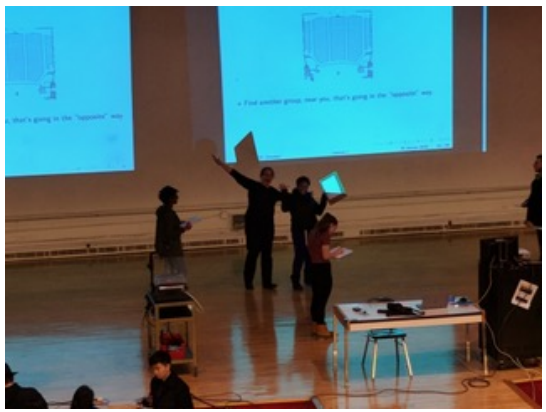
- When possible, design so that your code is flexible to be reused ("code reuse").
- Introduced a Python library, `Folium` for creating interactive HTML maps.
- Introduced `while` loops for repeating commands for an indefinite number of times.

Practice Quiz & Final Questions



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

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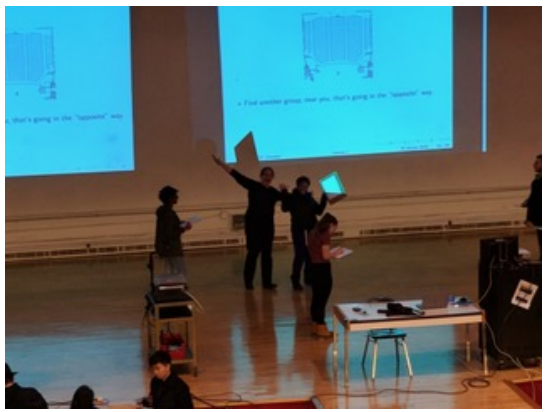

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- Theme: Functions & Top-Down Design (Summer 18, #7).

Weekly Reminders!

Before next lecture, don't forget to:

- Work on this week's Online Lab

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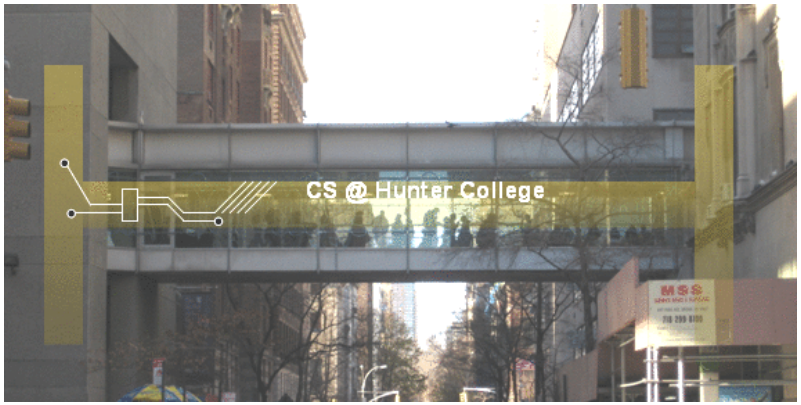

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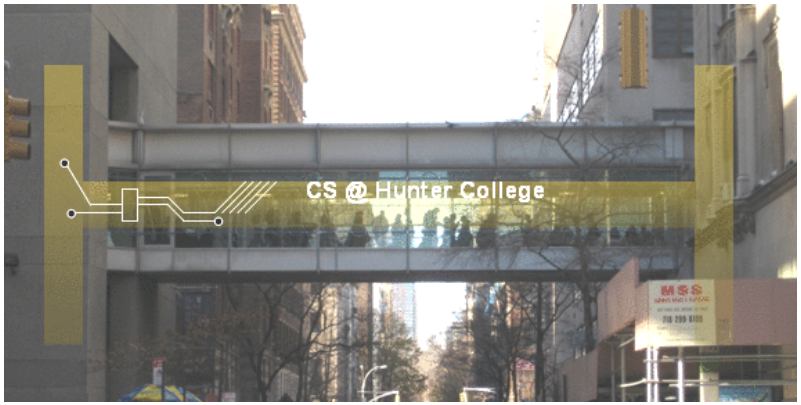

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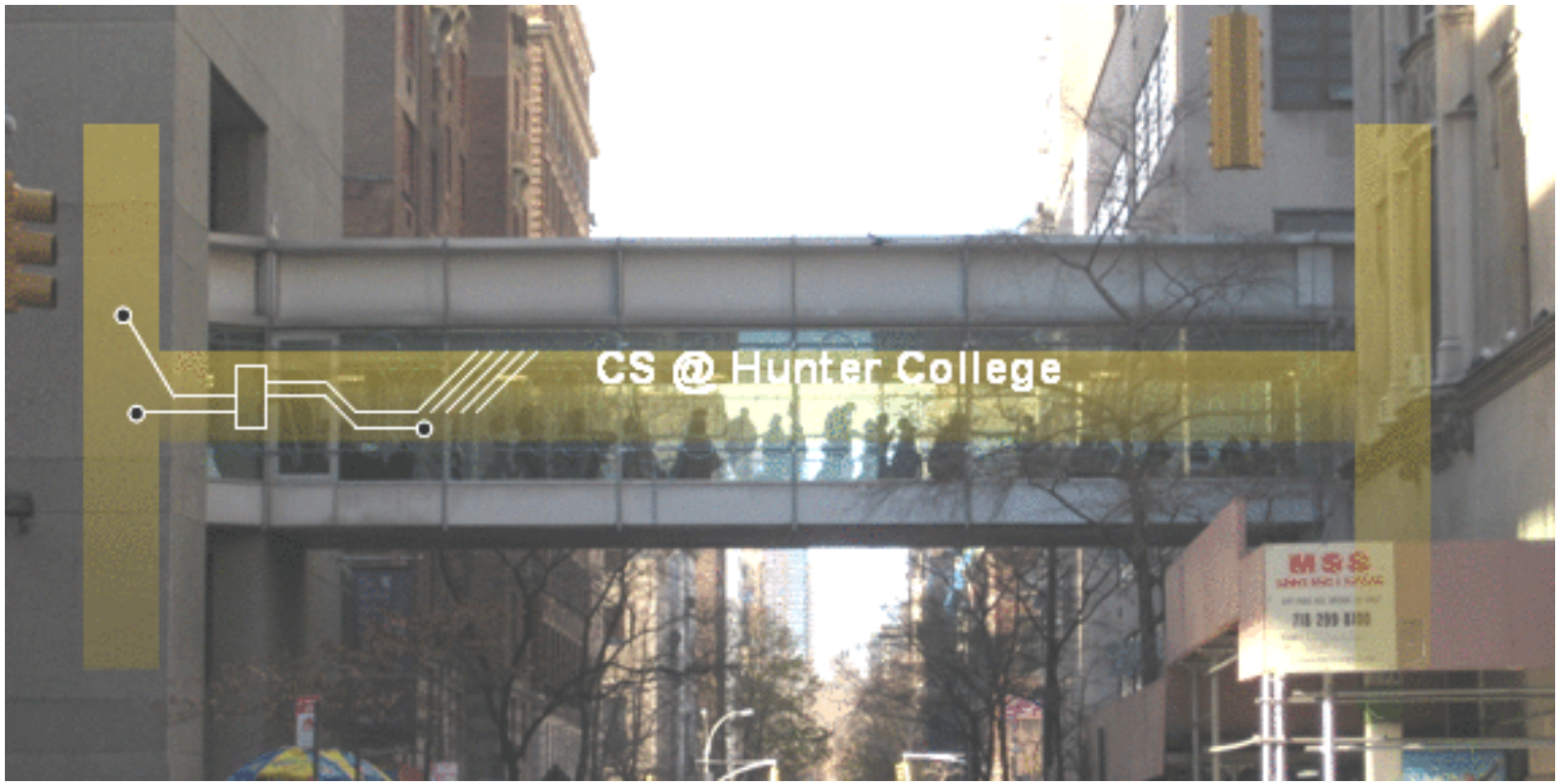
- If you need help, schedule an appointment for Tutoring in lab 1001G 11:30am-5pm

Weekly Reminders!

Before next lecture, don't forget to:

- Work on this week's Online Lab
- Schedule an appointment to take the Quiz in lab 1001G Hunter North
- If you haven't already, schedule an appointment to take the Code Review (**one every week**) in lab 1001G Hunter North
- 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 10am on Tuesday)

Lecture Slips & Writing Boards



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