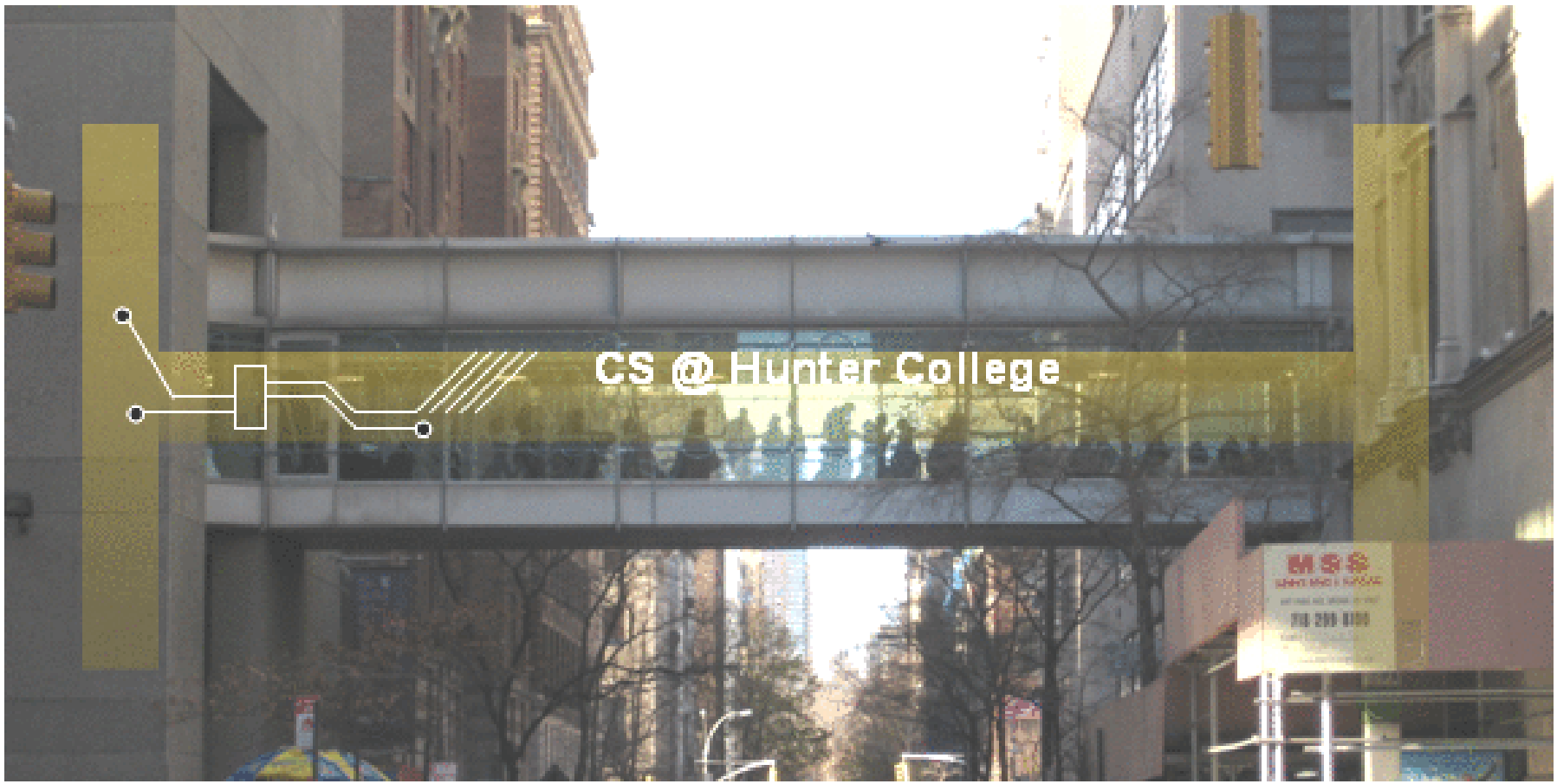
CSci 127: Introduction to Computer Science



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Today's Topics

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

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

Challenge Problem:

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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")
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```

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Python Tutor

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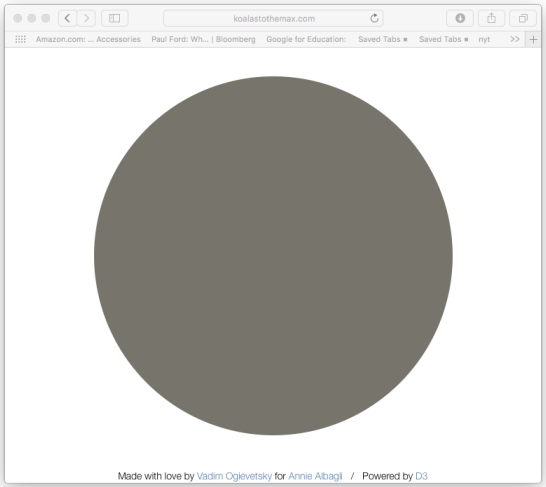
(Demo with pythonTutor)

From Last Time: koalas



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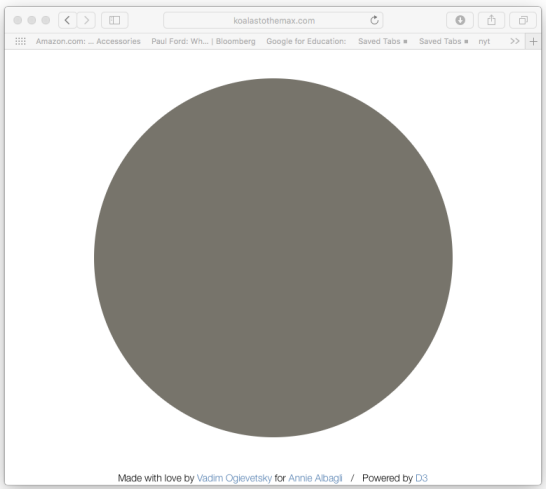

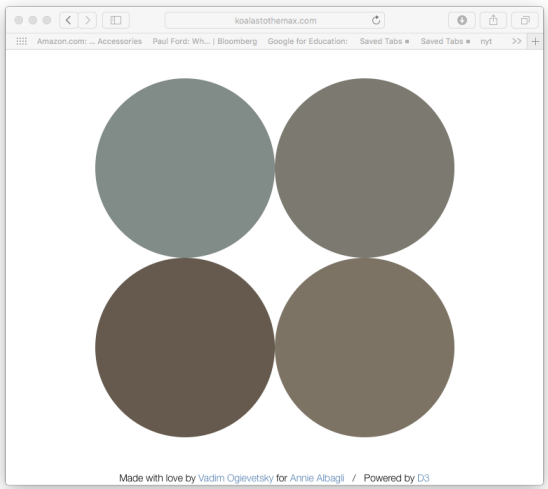

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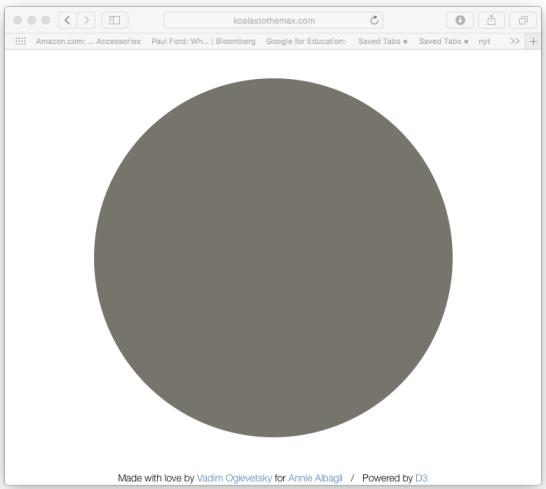

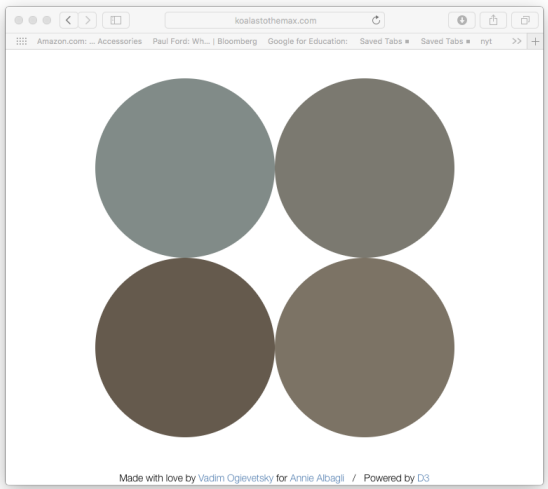

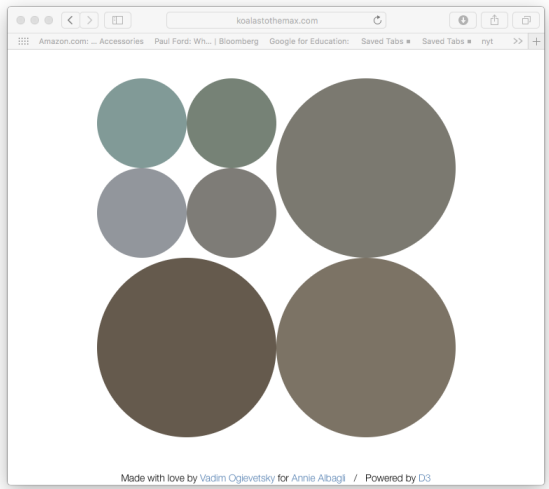

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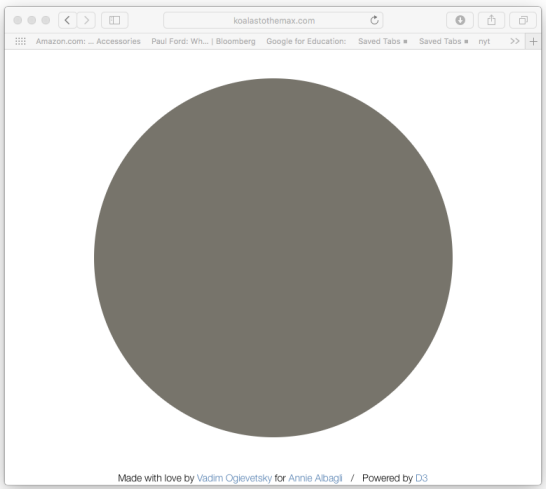

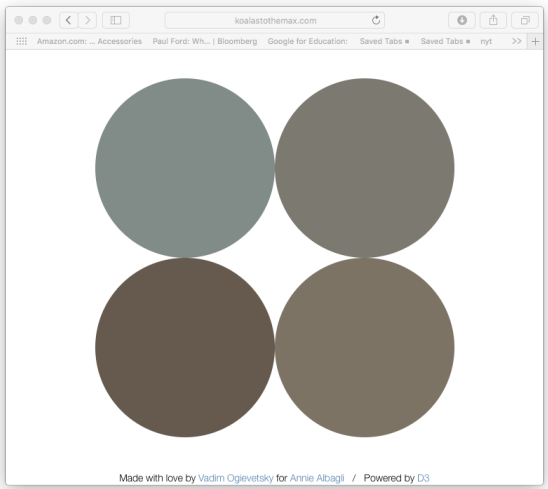

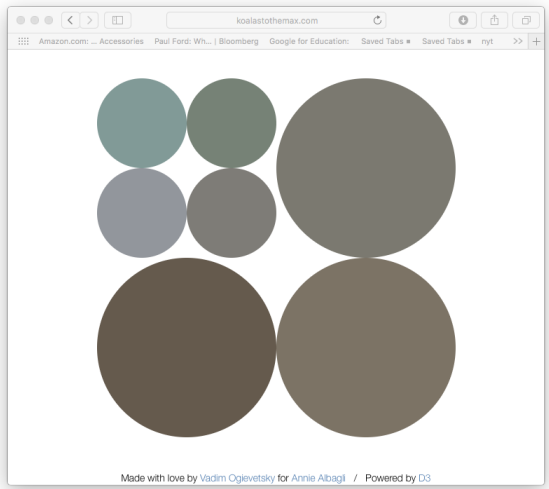

`http://koalastothemax.com`

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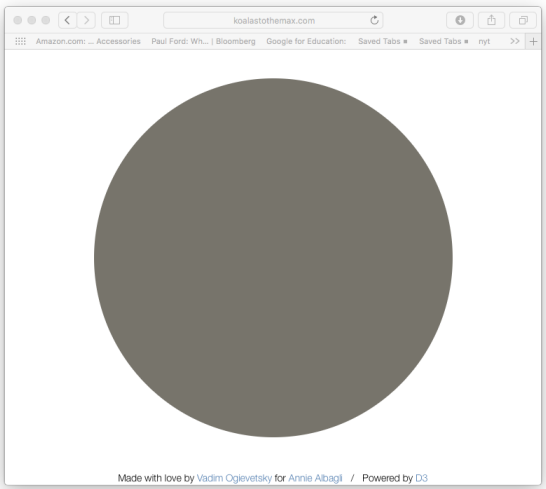

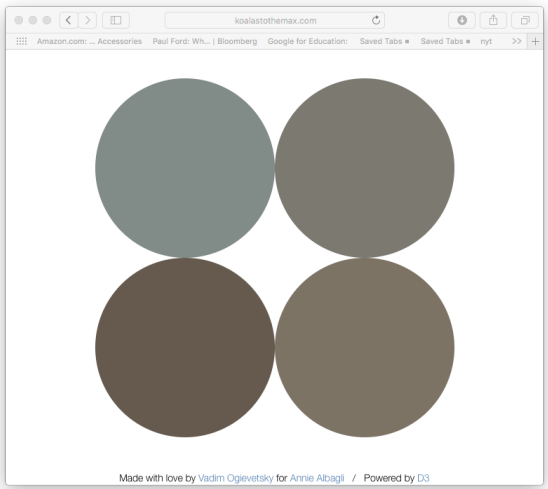

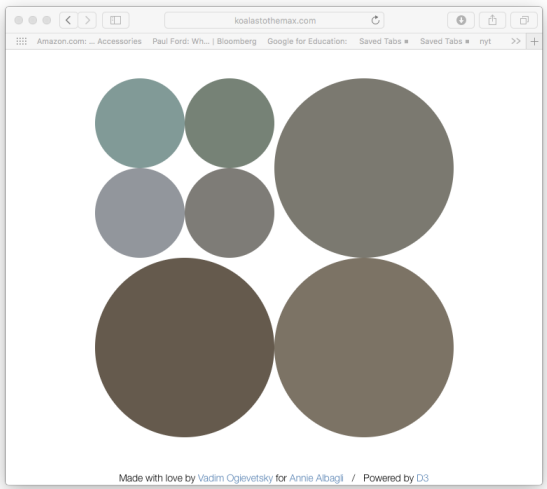

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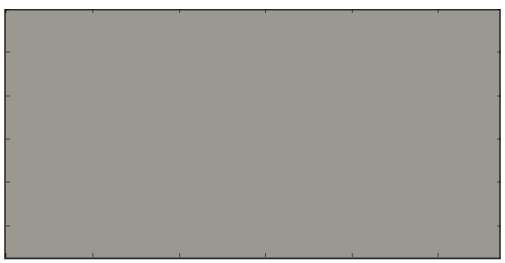

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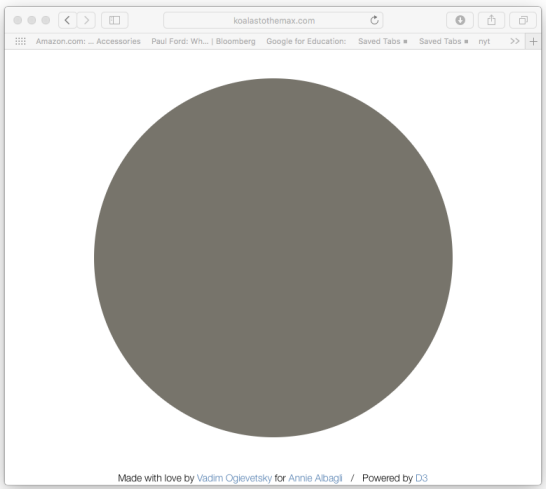

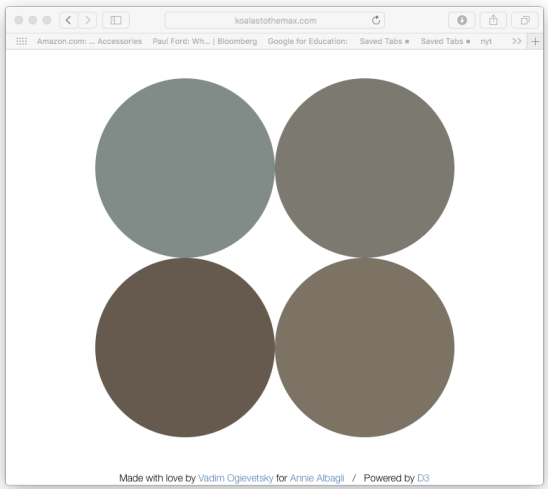

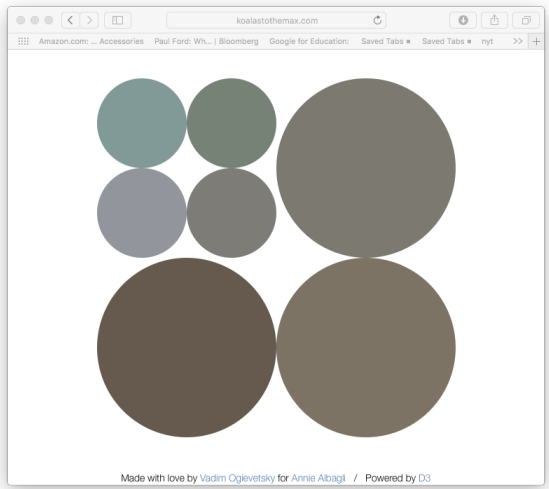

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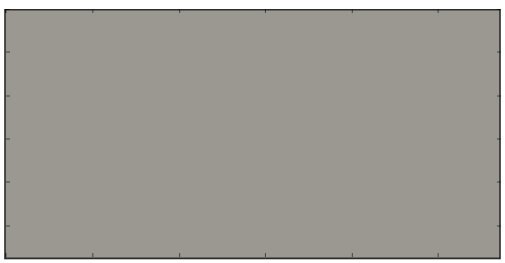

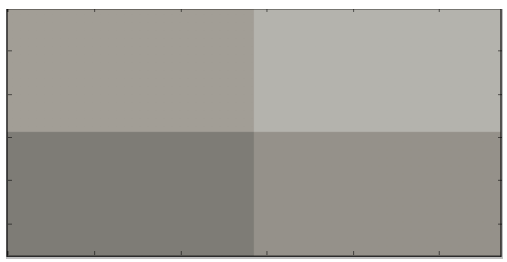

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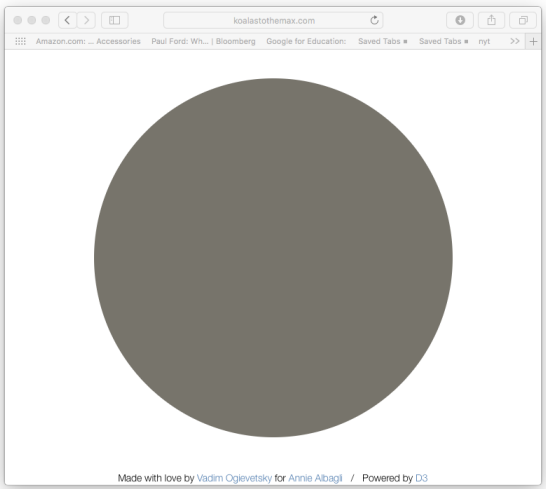

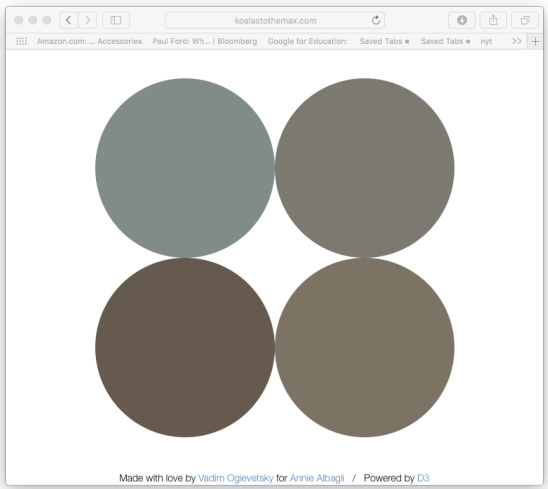

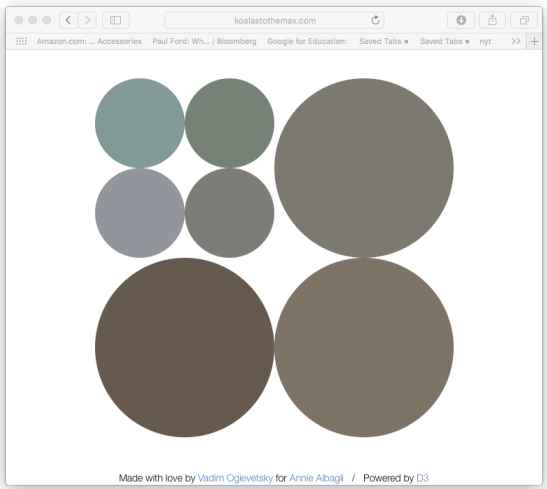

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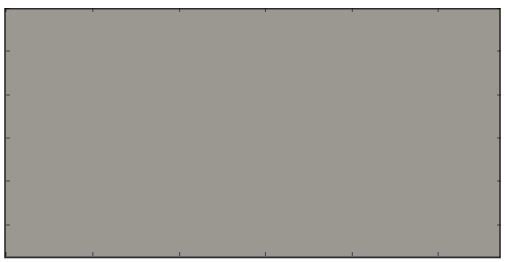

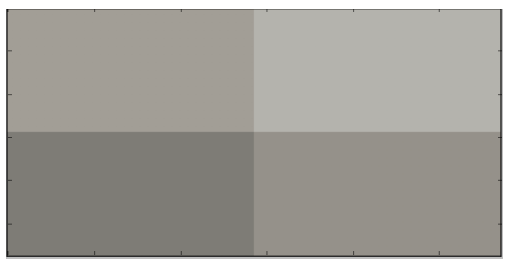

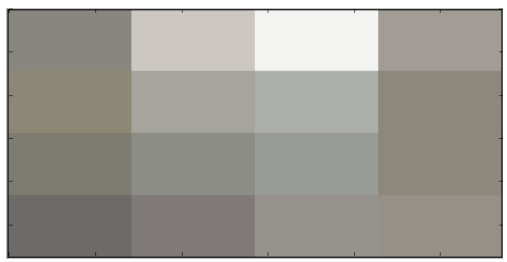

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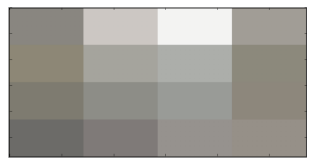
Process:






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

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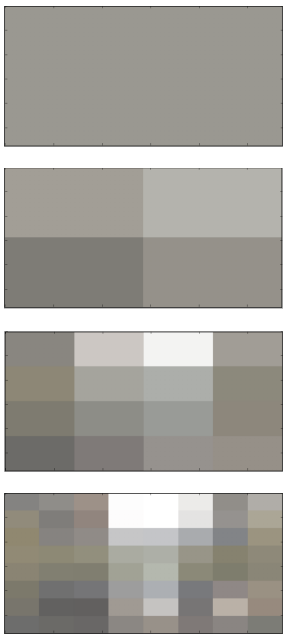

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71      img = plt.imread(inFile)
72
73      #Divides the image in 1/2, 1/4, 1/8, ... 1/2^8, and displays each:
74      for i in range(8):
75          img2 = img.copy()   #Make a copy to average
76          quarter(img2,i)     #Split in half i times, 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)
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81      #Shows the original image:
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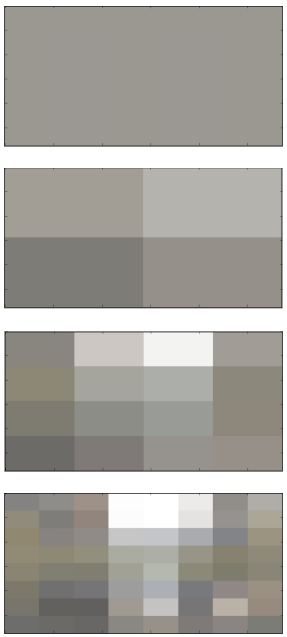

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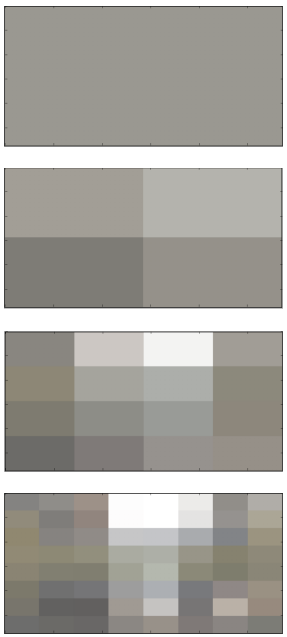

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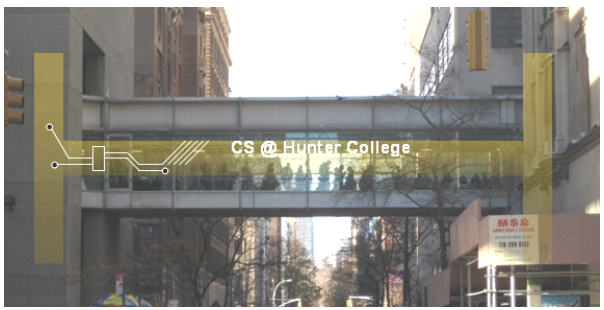
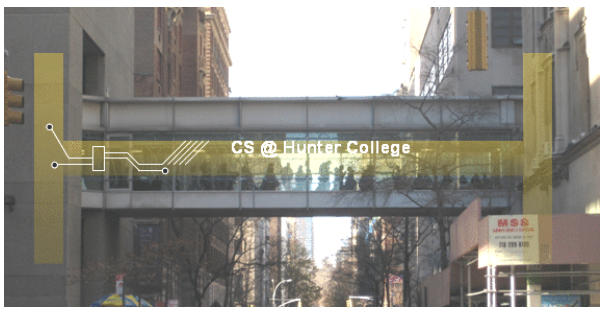
- The `main()` is written for you.
- Only fill in two functions: `average()` and `setRegion()`.

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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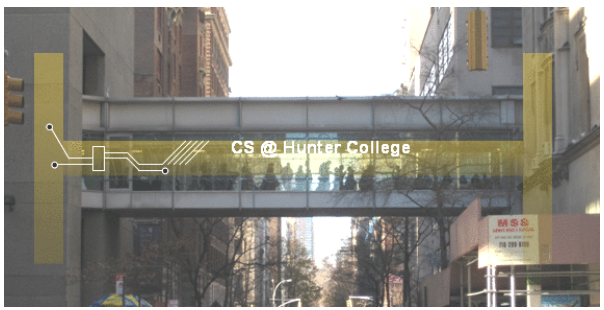

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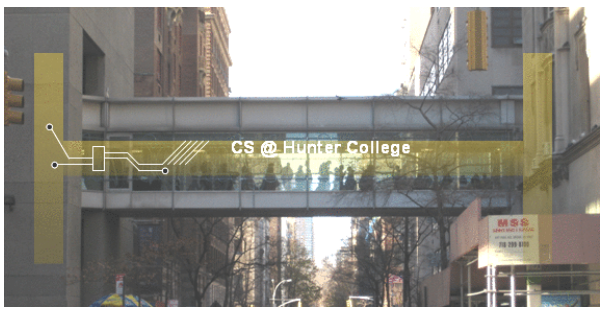

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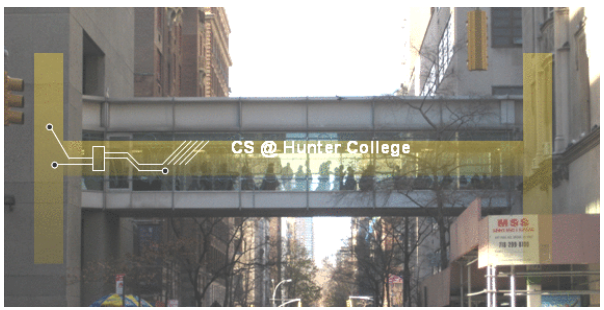

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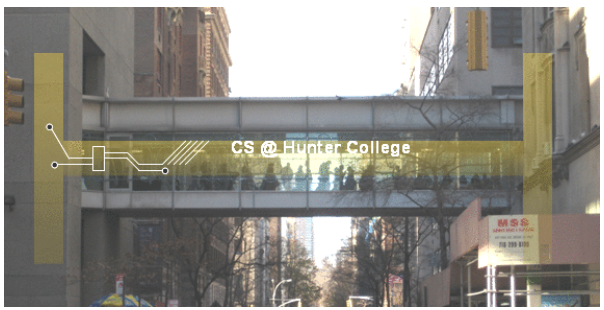

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  - Break the problem into tasks for a "To Do" list.
  - Translate list into function names & inputs/returns.
  - Implement the functions, one-by-one.
- Excellent approach since you can then test each part separately before adding it to a large program.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

Challenge Problem:

- 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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Fill in Missing Pieces

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Fill in Missing Pieces

1. Write import statements.

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import turtle
```

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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.
```

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):
        x,y = getInput()       #Asks user for two numbers.
        markLocation(tess,x,y) #Move tess to (x,y) and stamp.
```

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.
    for i in range(5):
        x,y = getInput()        #Asks user for two numbers.
        markLocation(tess,x,y) #Move tess to (x,y) and stamp.
```

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.
```

Challenge Problem:

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

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- 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`

Challenge Problem:

- 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`

Challenge Problem:

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- 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.

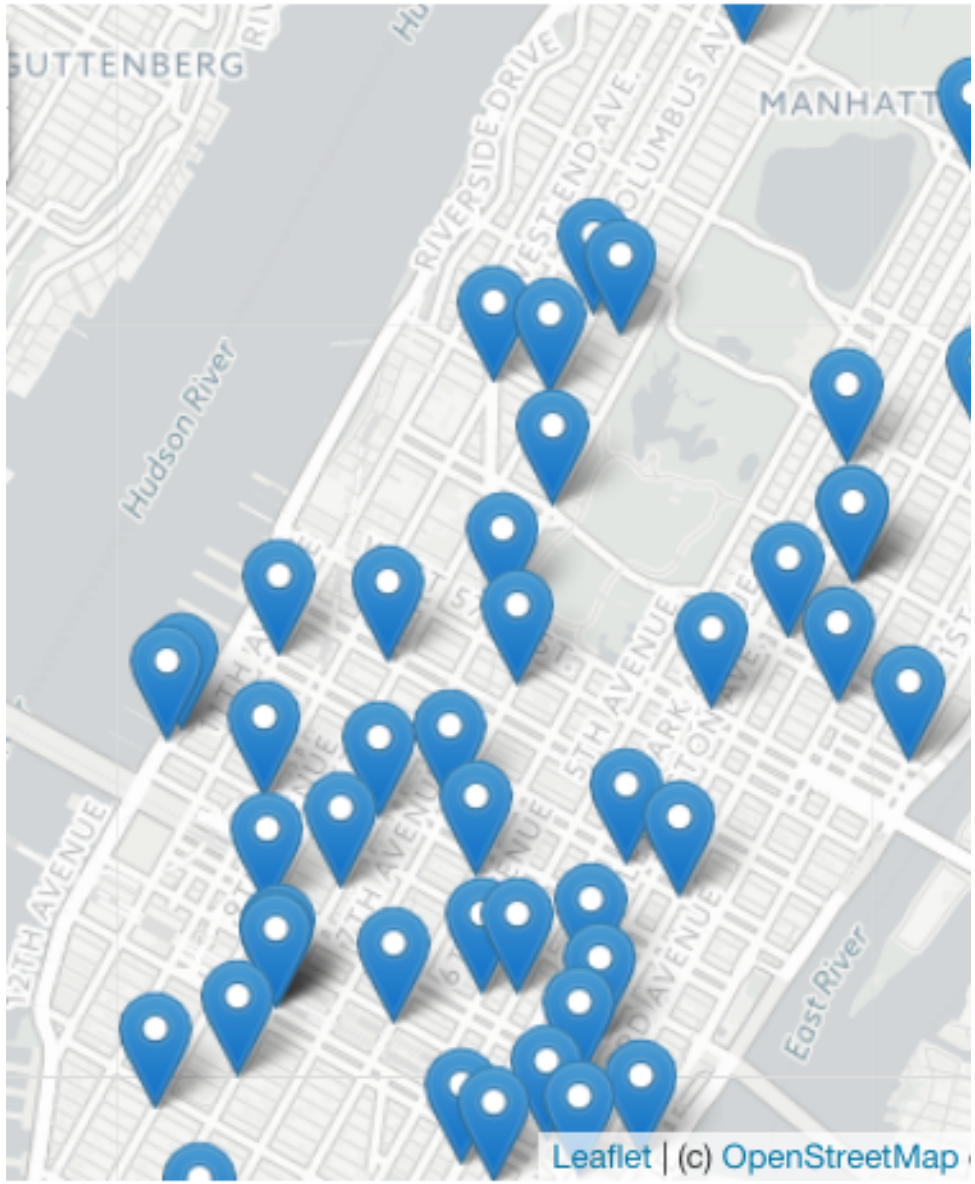
Python Tutor

(On github)

Today's Topics

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

Folium


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

Folium

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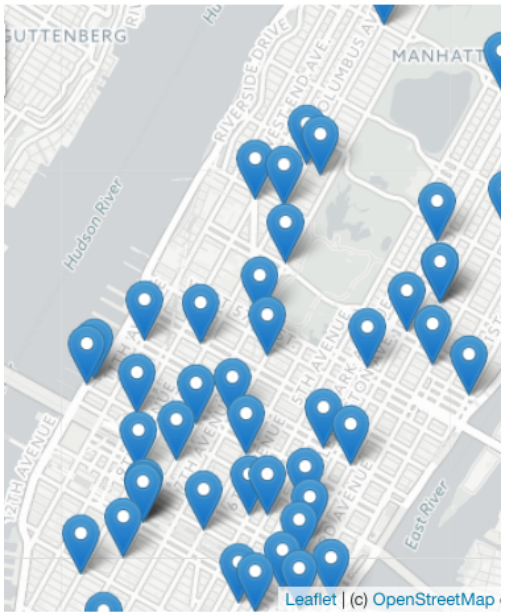
- An extra step:

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

Demo



(Map created by Folium.)

Folium

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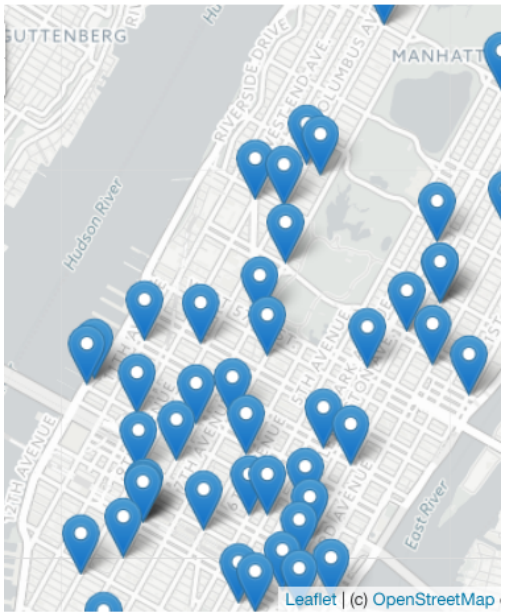
- Many options to customize background map ("tiles") and markers.

Demo



(Python program using Folium.)

Design Challenge

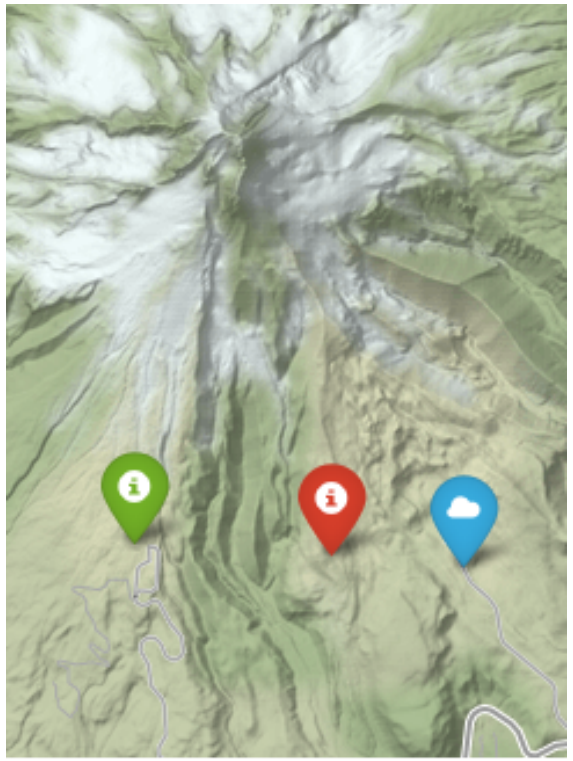
- Predict which each line of code does:

```
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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  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

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(Demo turtle random walk)

Today's Topics

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

Challenge Problem:

Predict what the code will do:

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

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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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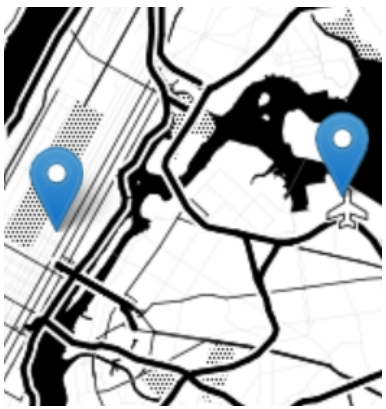
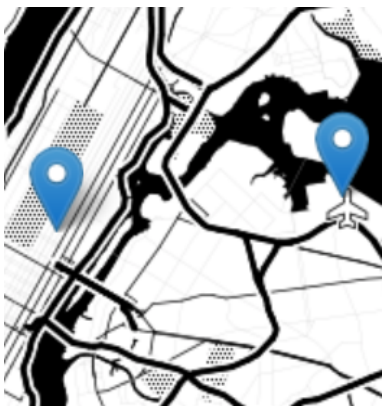
- More details next lecture...

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.

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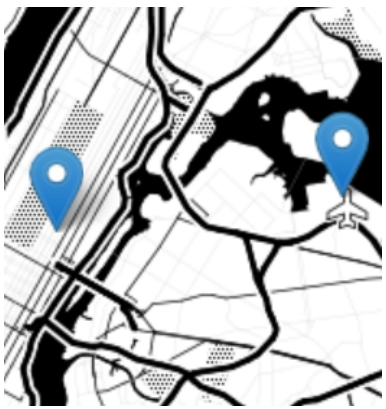

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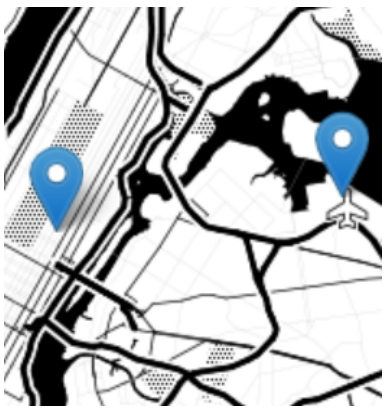

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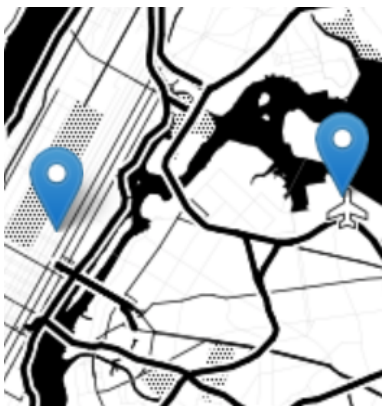

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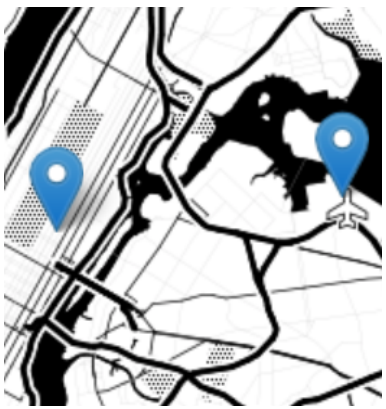

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- Introduced `while` loops for repeating commands for an indefinite number of times.
- Log in to Gradescope for Quiz 9