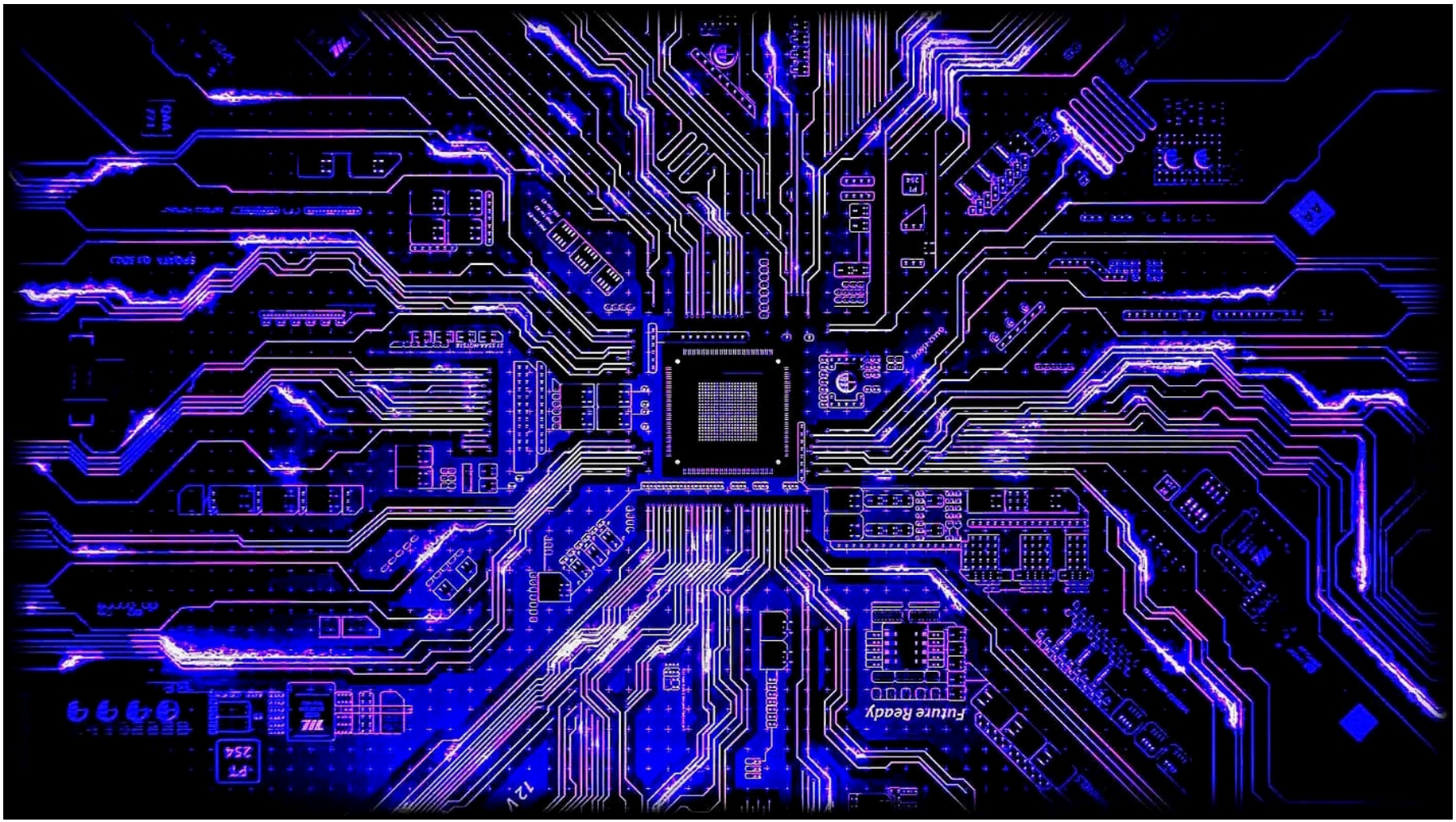
CSci 127: Introduction to Computer Science



hunter.cuny.edu/csci

Frequently Asked Questions

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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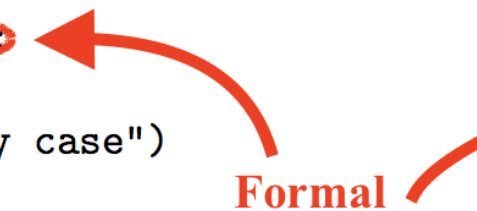

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Complex case
0 : c
Building s: c
1 : i
2 : t
Building s: ct
3 : y
Return: ct

- What is the output of:

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

Complex case
0 : u
Building s: u
1 : n
Return: u

Python Tutor

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(Demo with pythonTutor)

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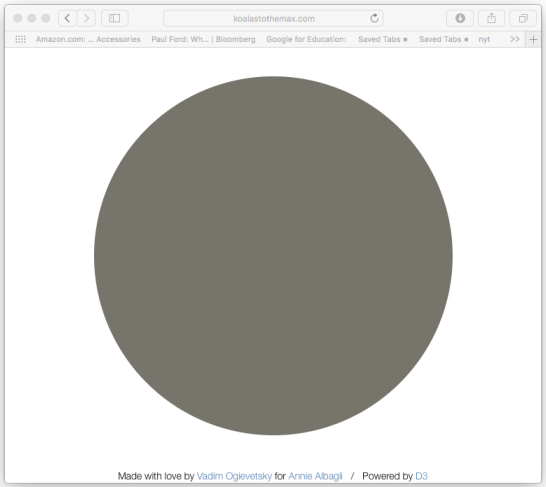

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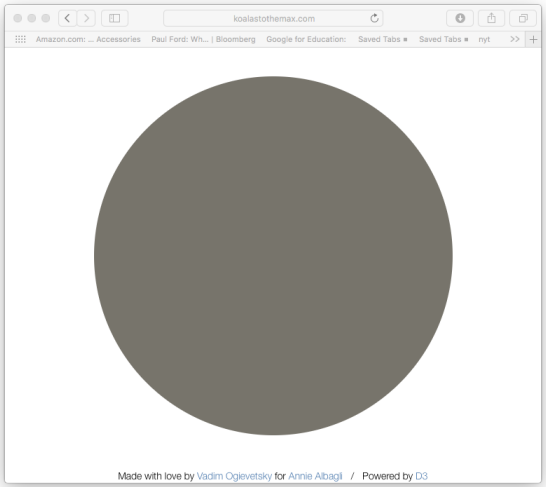

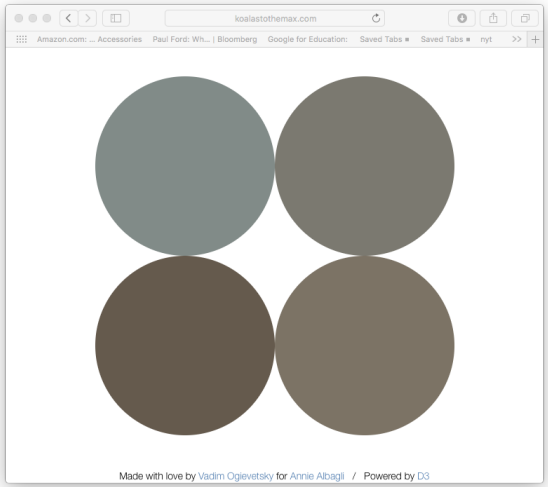

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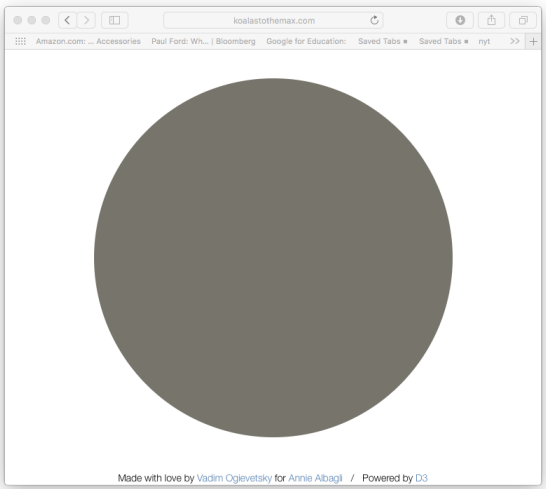

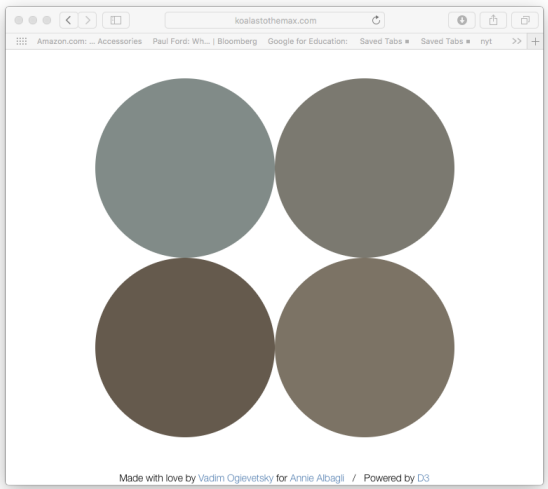

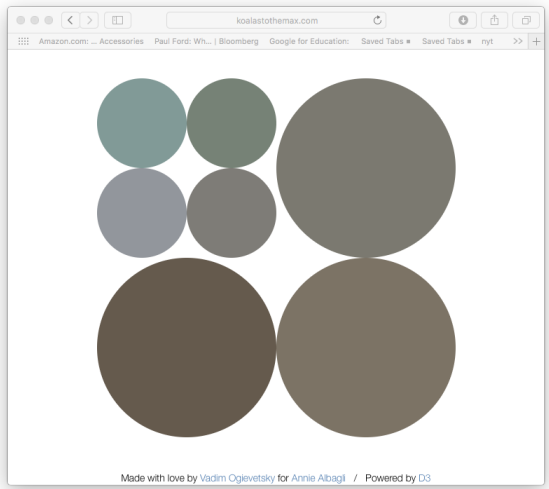

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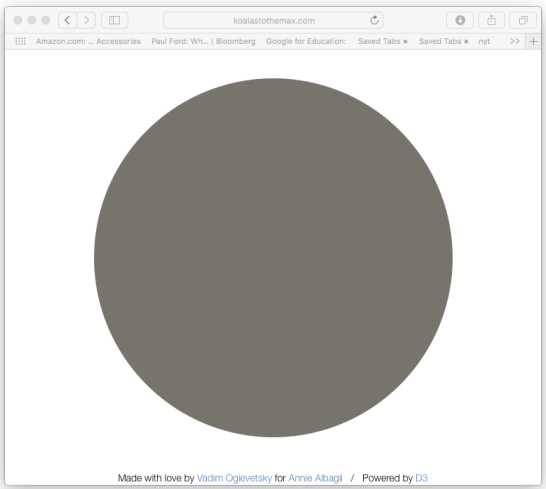

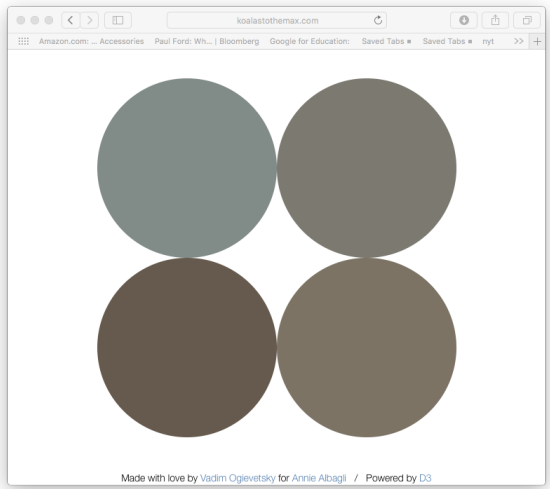

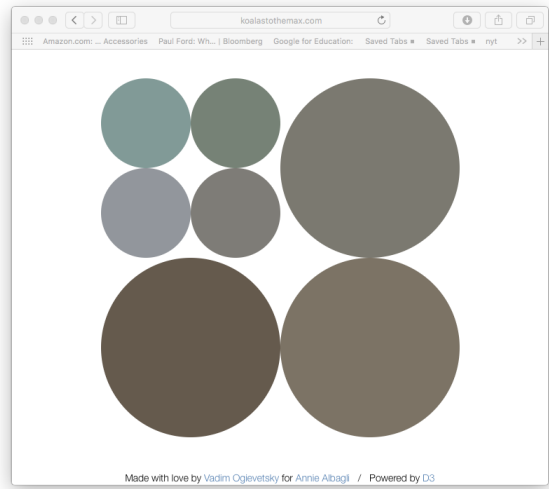

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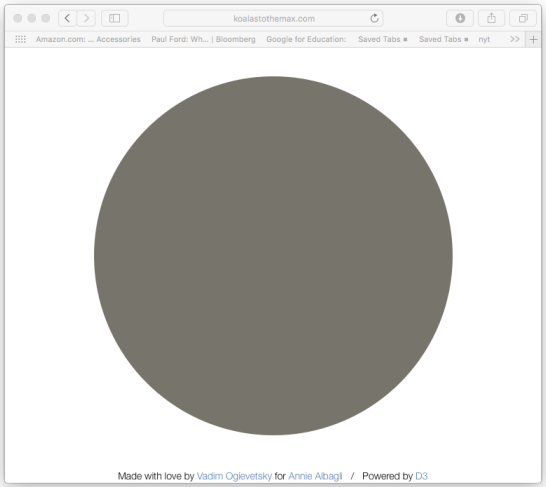

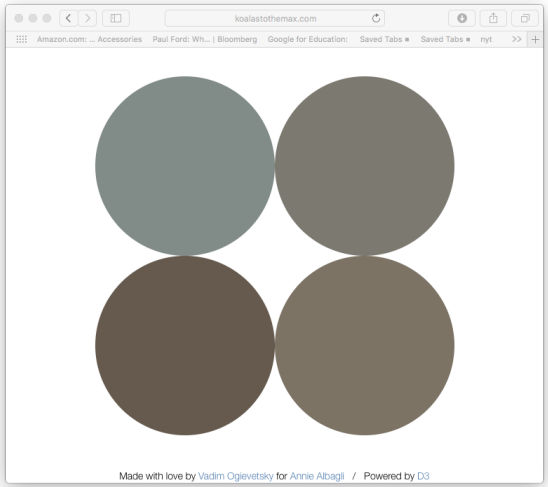

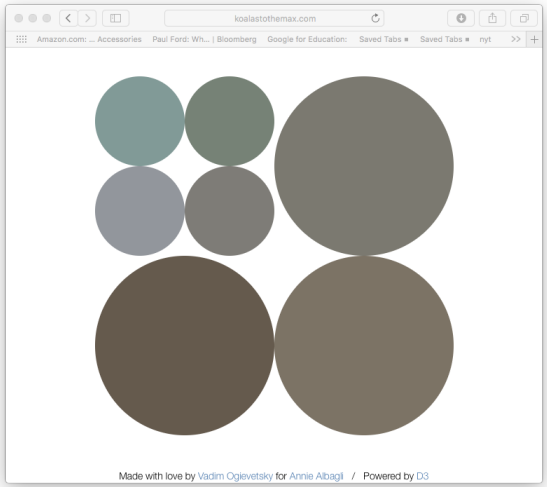

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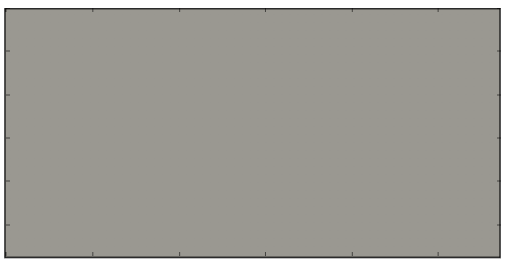

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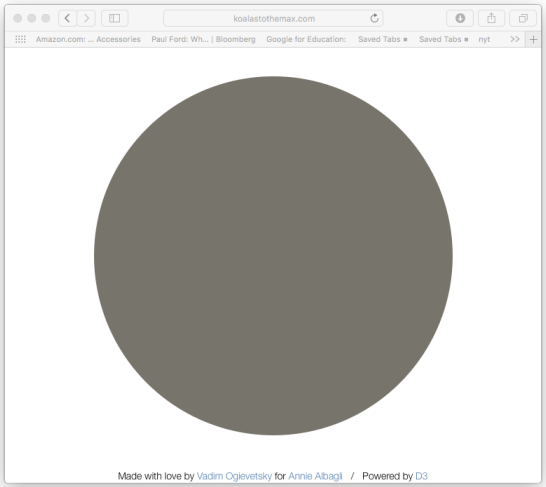

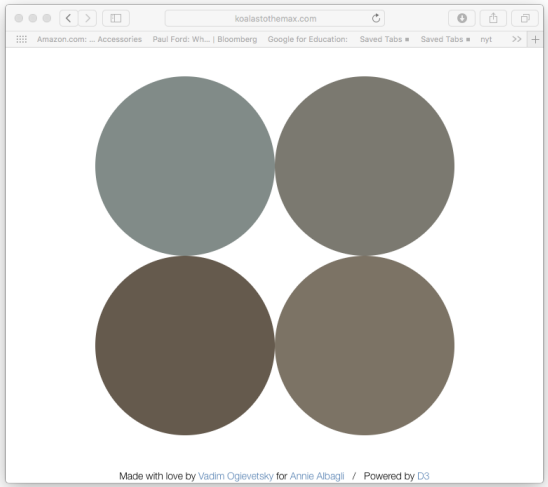

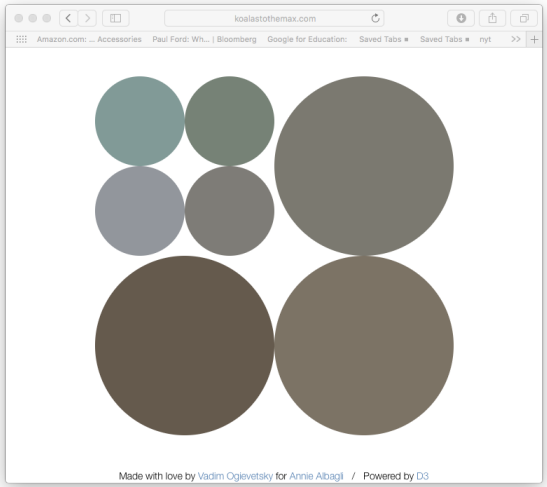

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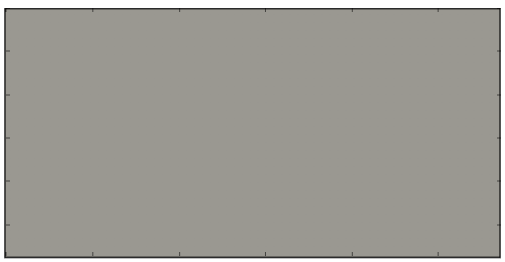

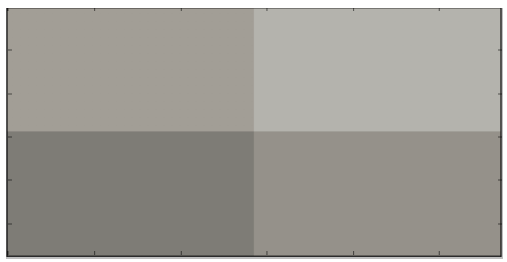

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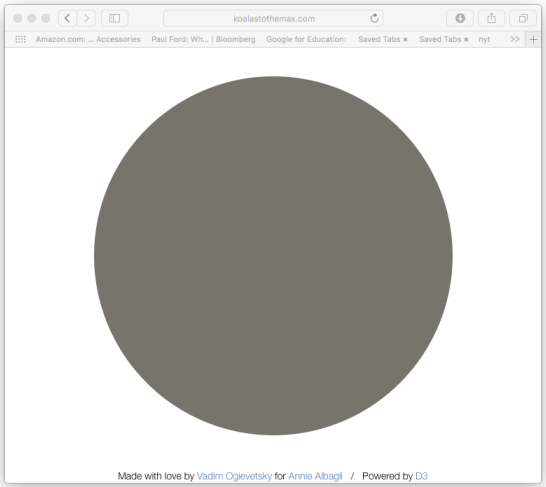

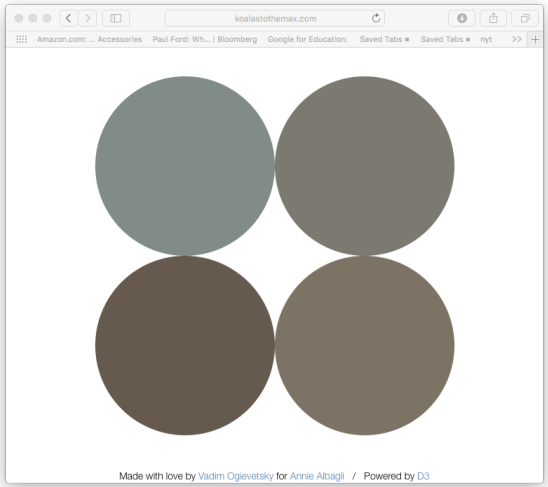

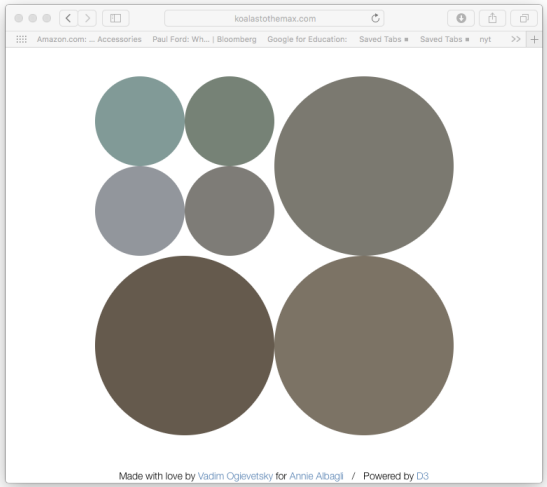

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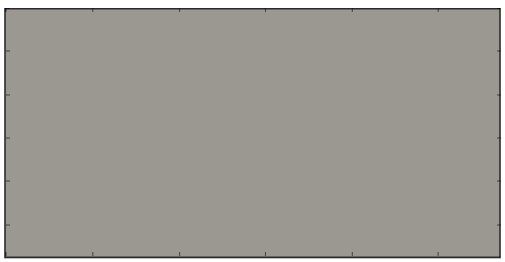

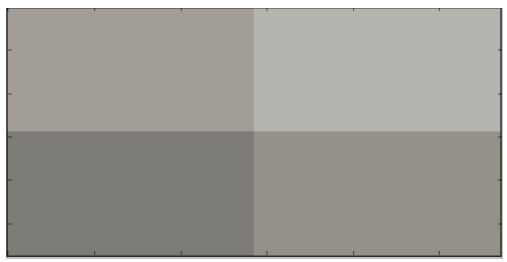

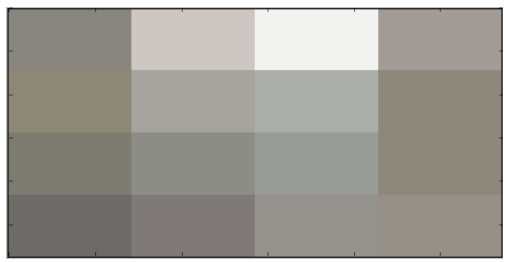

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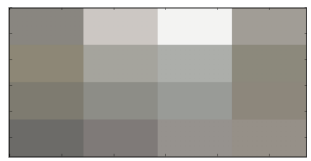
Process:






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

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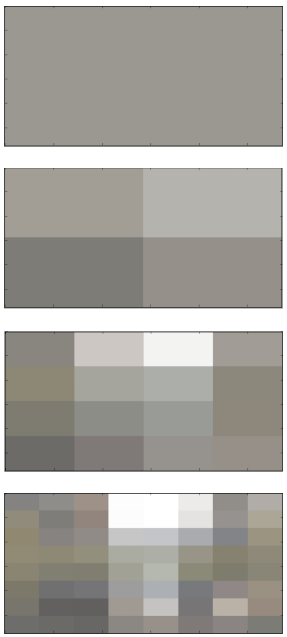

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70      inFile = input('Enter image file name: ')
71      img = plt.imread(inFile)
72
73      #Divides the image in 1/2, 1/4, 1/8, ... 1/2^8, and displays each:
74      for i in range(8):
75          img2 = img.copy()    #Make a copy to average
76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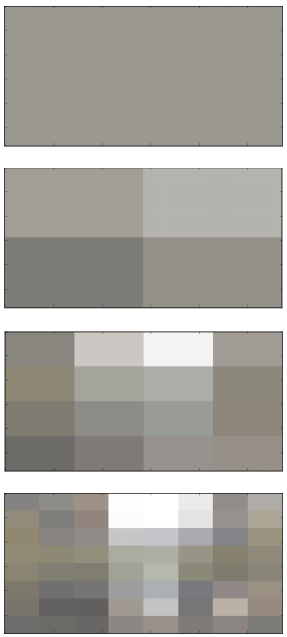

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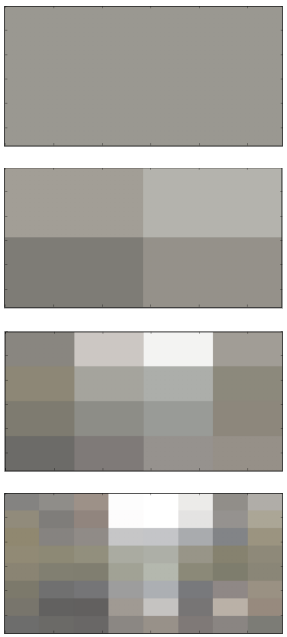

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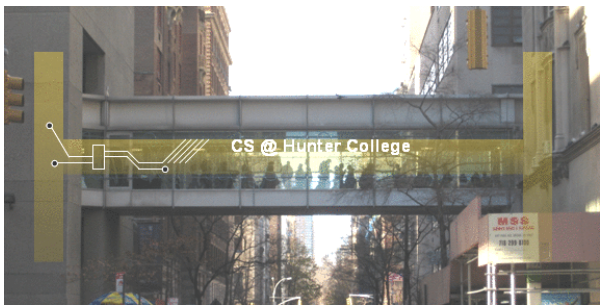
- The `main()` is written for you.
- Only fill in two functions: `average()` and `setRegion()`.

Top-Down Design

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



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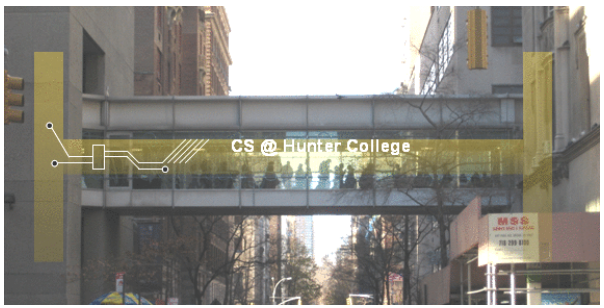

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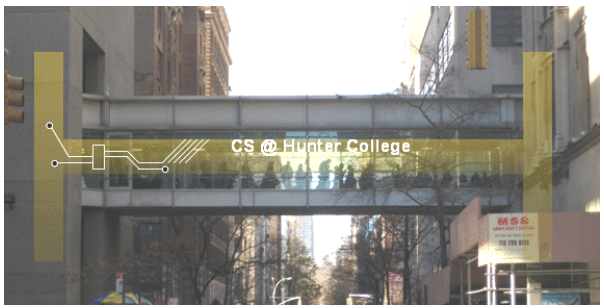

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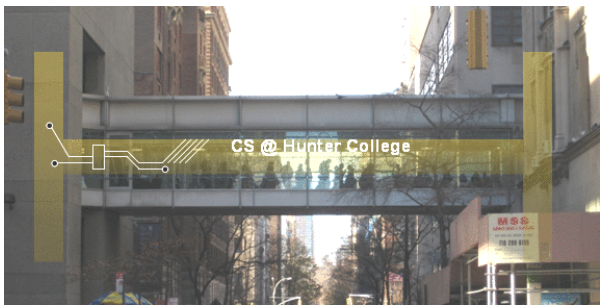

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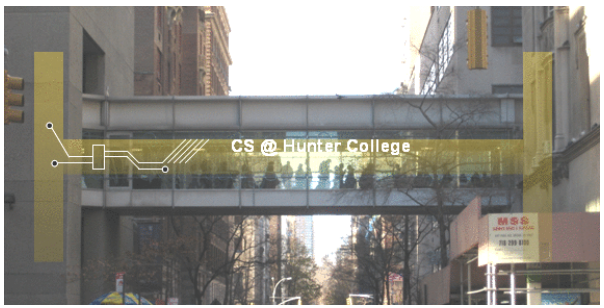

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  - Break the problem into tasks for a "To Do" list.
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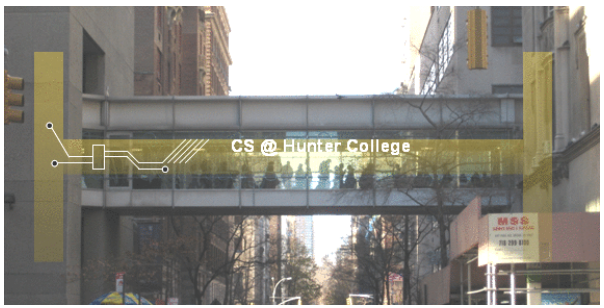
  - Implement the functions, one-by-one.
- Excellent approach since you can then test each part separately before adding it to a large program.

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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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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```

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):
        x,y = getInput()       #Asks user for two numbers.
```

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

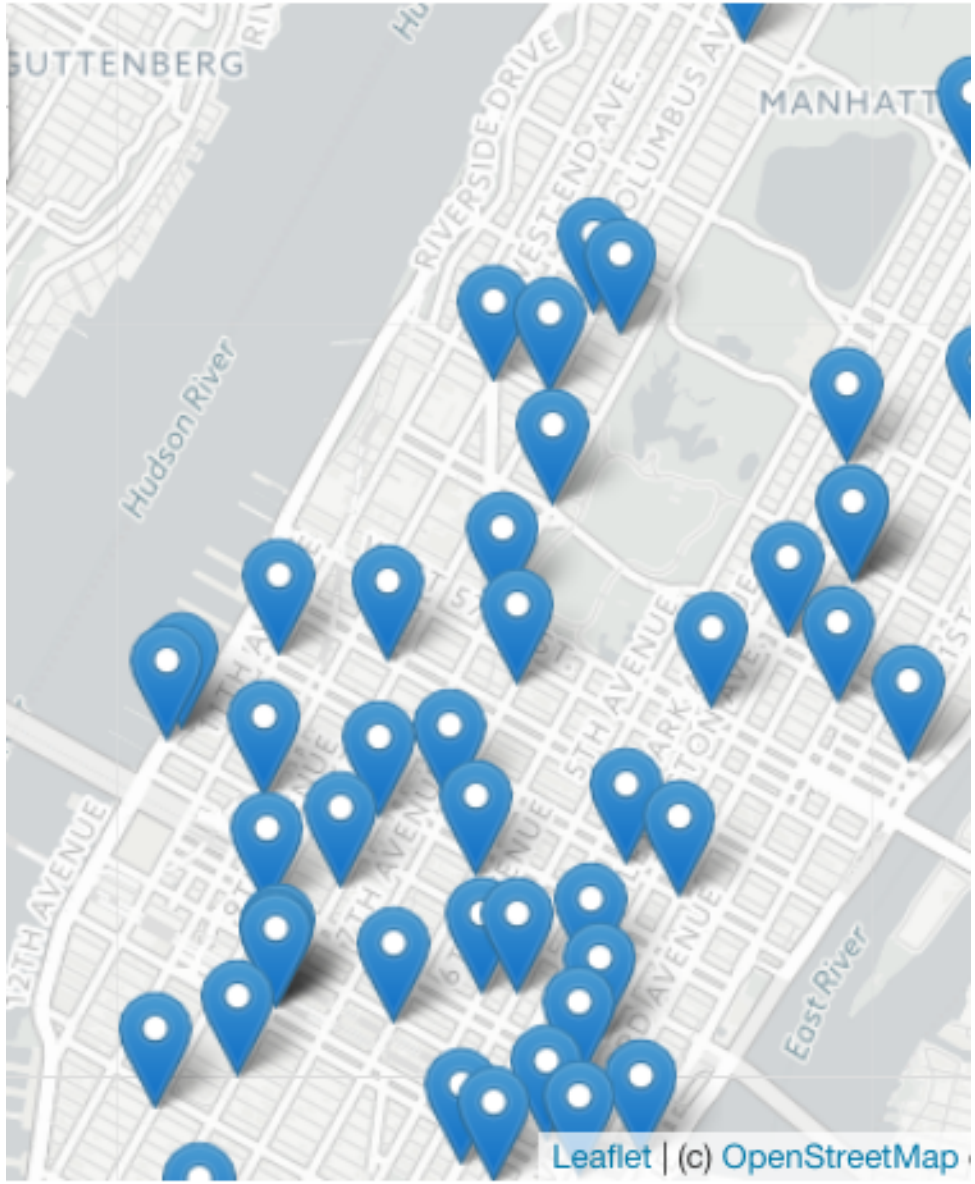
Python Tutor

(numsConvert.py on On github)

Today's Topics

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

Folium


Hudson River
East River
RIVERSIDE DRIVE
5TH AVENUE
12TH AVENUE
Leaflet | (c) OpenStreetMap

Folium

- A module for making HTML maps.

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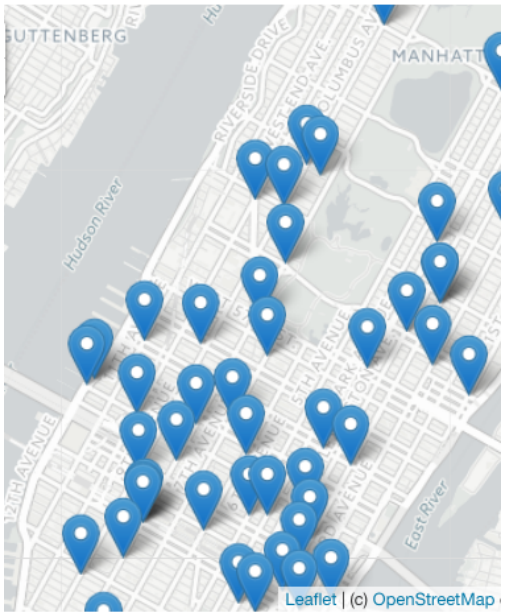
- An extra step:

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

Demo



(Map created by Folium.)

pip3 install folium

Folium

- To use:

```
import folium
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- Create a map:

  ```
  myMap = folium.Map()
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- Add to the map:

  ```
  newMark.add_to(myMap)
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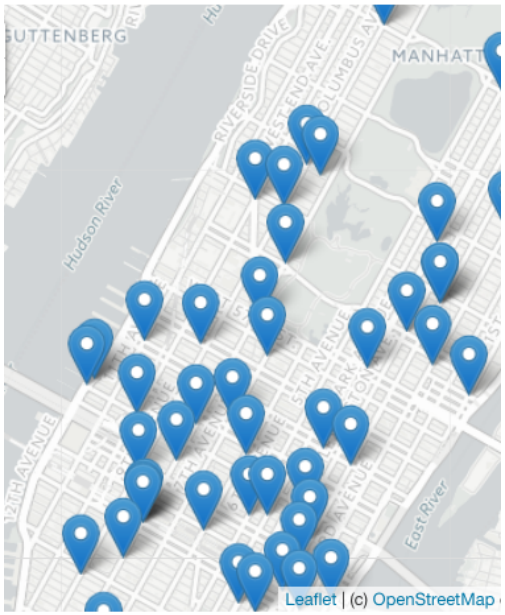
- Many options to customize background map ("tiles") and markers.

Demo



(Python program using Folium.)

In Pairs of Triples

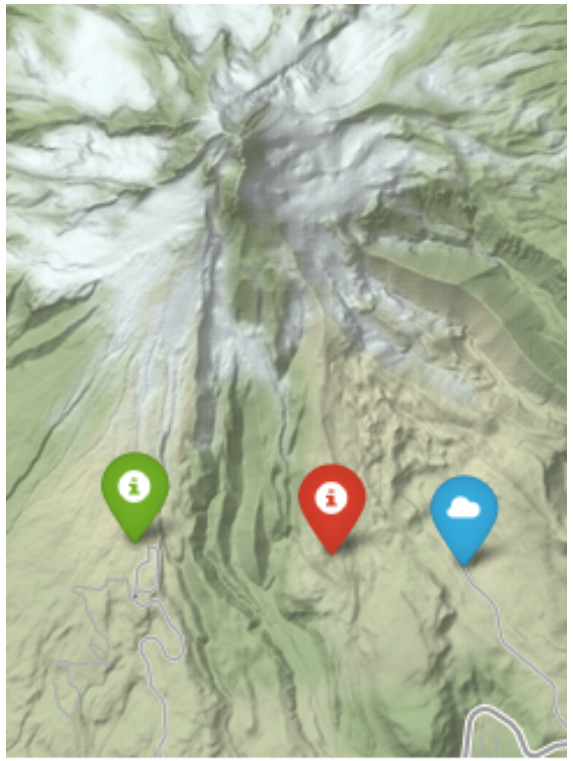
- Predict which each line of code does:

```
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

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)

0, 90, 180, 270

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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(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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- 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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- Very useful for checking input, simulations, and games.

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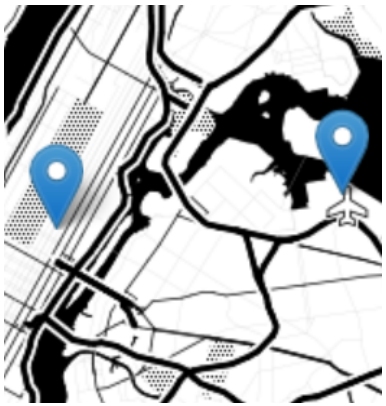
- Indefinite loops repeat as long as the condition is true.
- Could execute the body of the loop zero times, 10 times, infinite number of times.
- The condition determines how many times.
- Very useful for checking input, simulations, and games.
- More details next lecture...

Recap



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

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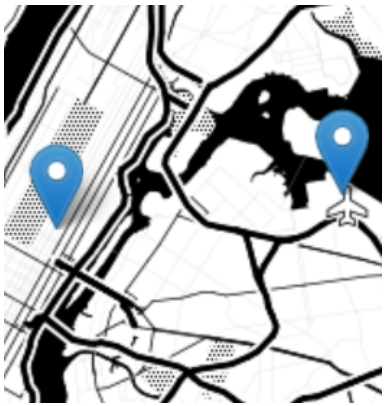

- Top-down design: breaking into subproblems, and implementing each part separately.
- Excellent approach: can then test each part separately before adding it to a large program.

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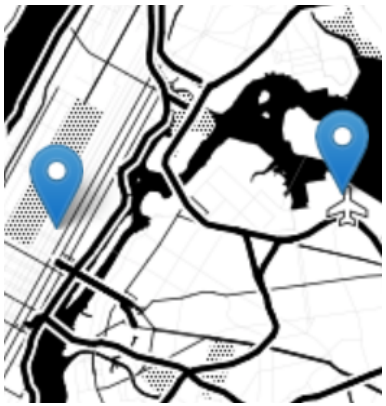

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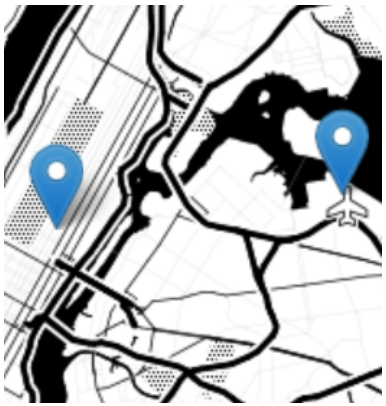
- When possible, design so that your code is flexible to be reused ("code reuse").

Recap



- Top-down design: breaking into subproblems, and implementing each part separately.
- Excellent approach: can then test each part separately before adding it to a large program.
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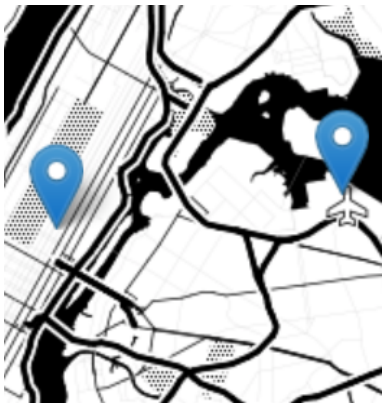
- Introduced a Python library, `Folium` for creating interactive HTML maps.

Recap



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- Excellent approach: can then test each part separately before adding it to a large program.
- 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:
  - write as much you can for 60 seconds;
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- Past exams are on the webpage (under Final Exam Information).
- Theme: Functions & Top-Down Design (Summer 18, #7).

7. Fill in the following functions that are part of a program that analyzes NYC Urban Forest of street trees (from NYC OpenData):

   - `getData()`: asks the user for the name of the CSV file and returns a DataFrame of the contents.
   - `biggestDiameter()`: returns the largest diameter (`tree_dbh`) in the DataFrame, and
   - `makeGraph()`: makes a plot of the x versus y columns specified.

```
import pandas as pd
def getData():
    """
    Asks the user for the name of the CSV and
    Returns a dataframe of the contents.
    """
```

```

```

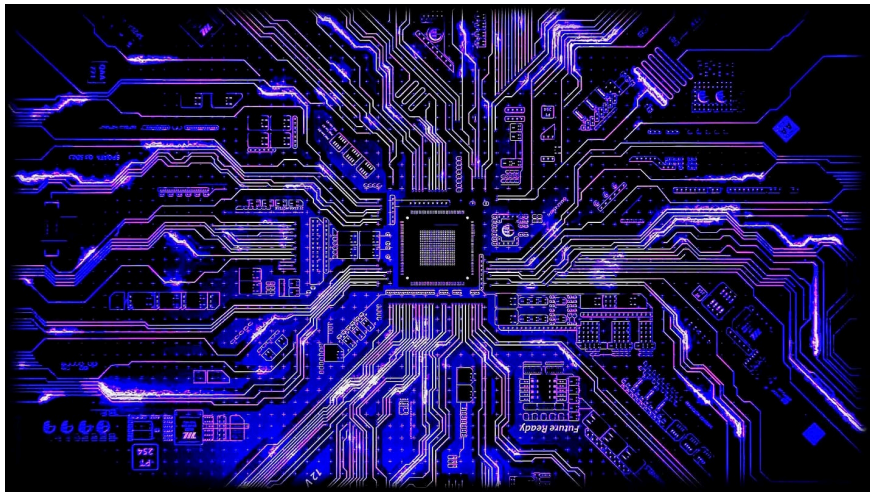
```
def biggestDiameter(df):
    """
    Takes a DataFrame as input.
    Returns the maximum value in the column, tree_dbh..
    """
```

```

```

```
def makeGraph(df,xCol,yCol):
    """
    Makes a pyplot plot of x versus y columns of DataFrame df
    """
```

```

```

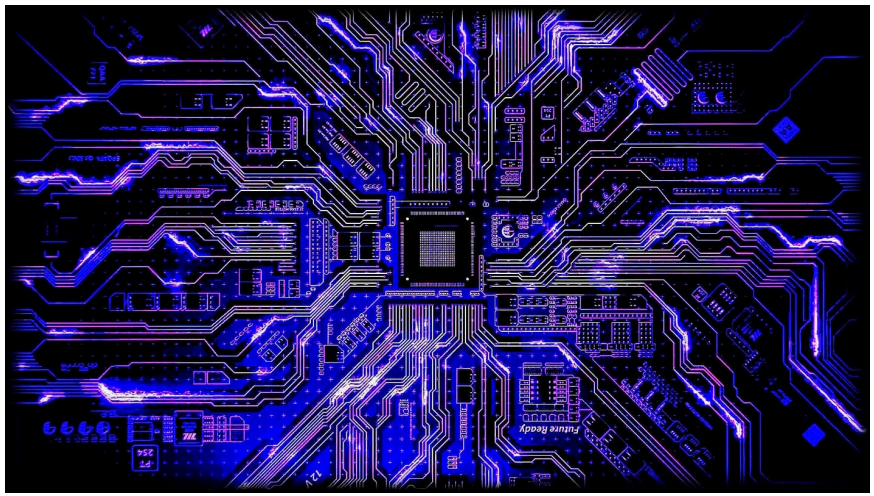
Class Reminders!



Before next lecture, don't forget to:

- REVIEW LAB 9!

Class Reminders!



Before next lecture, don't forget to:

- REVIEW LAB 9!
- Submit this programming assignments due Tomorrow (Batch 8)