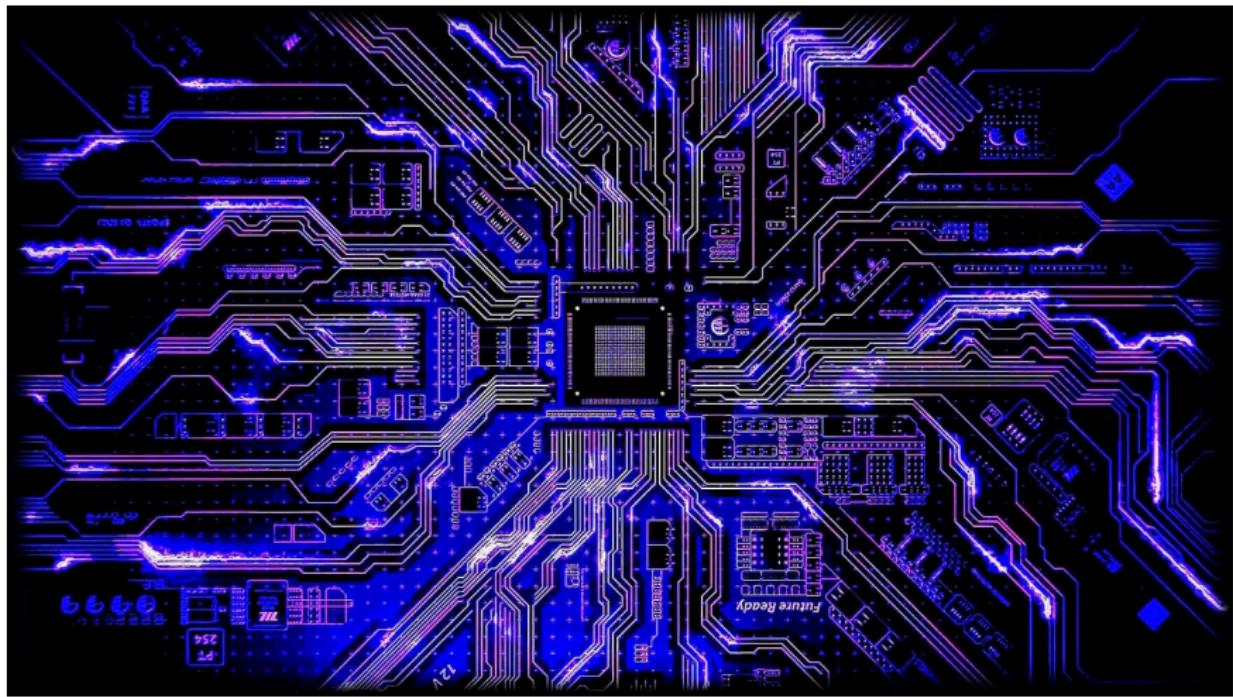


CSci 127: Introduction to Computer Science



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
- 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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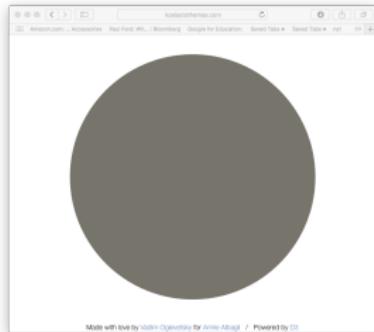
Python Tutor

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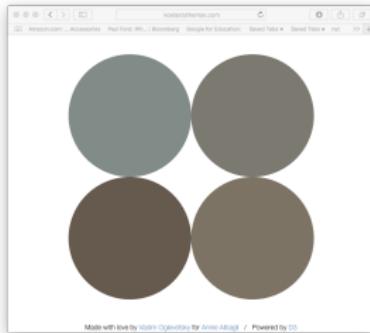
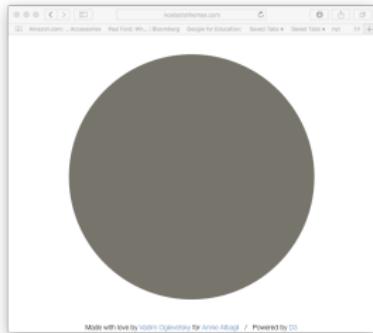
(Demo with pythonTutor)

From Last Time: koalas

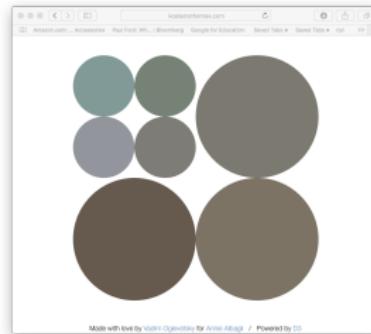
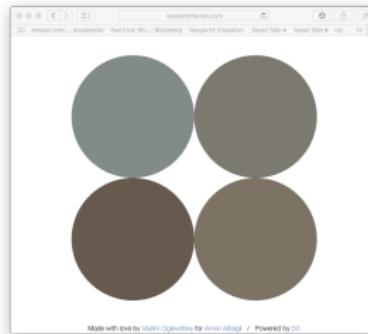
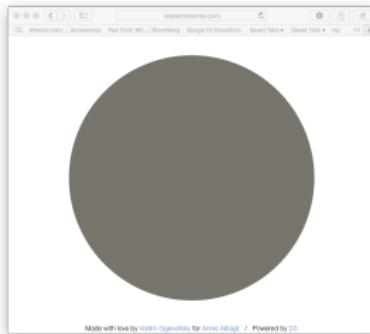


Made with love by [Vidya Vyavahar](#) for [Archie Atulap](#) / Powered by [DD](#)

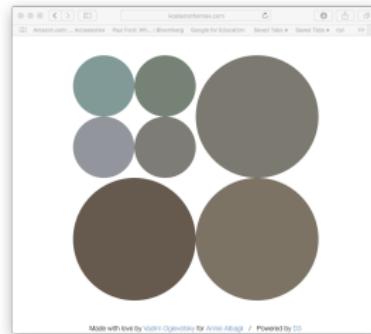
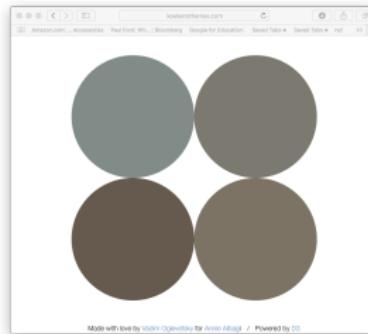
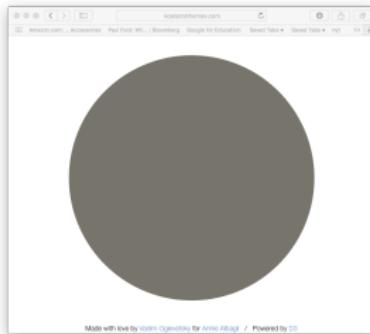
From Last Time: koalas



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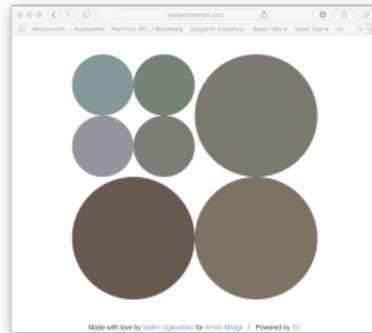
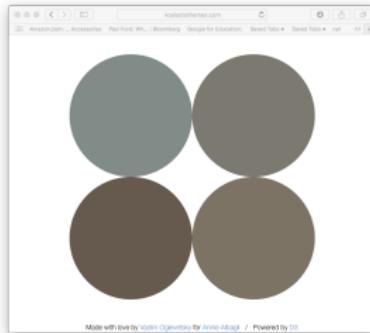
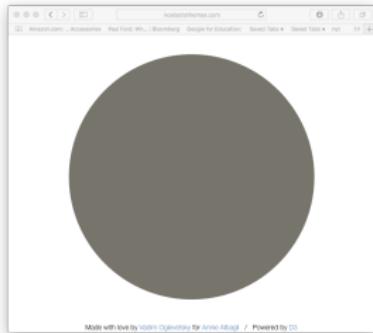


From Last Time: koalas



<http://koalastothemax.com>

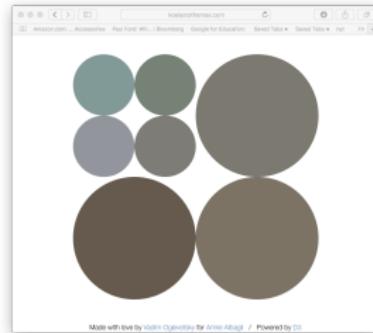
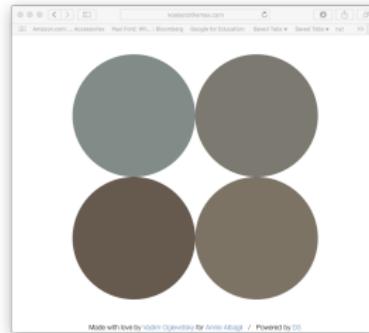
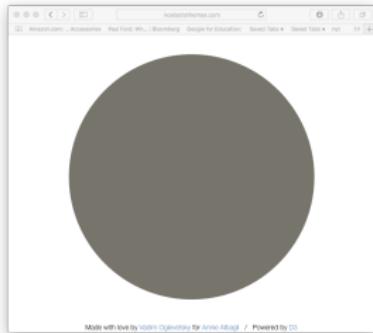
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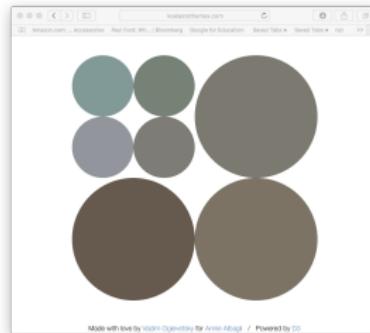
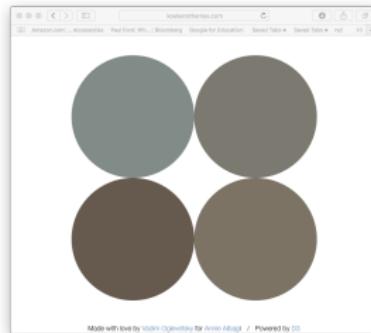
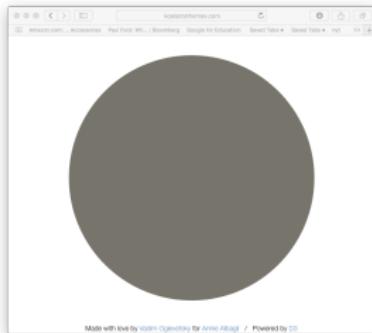
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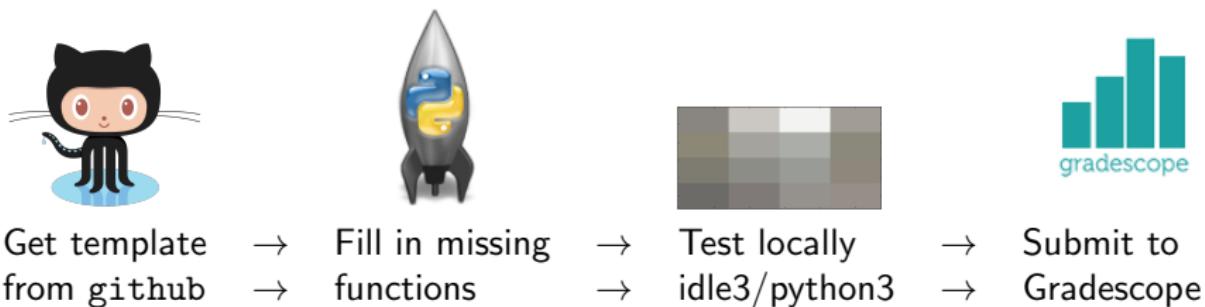


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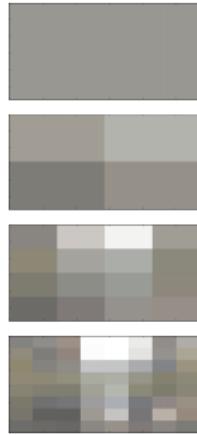


From Last Time: koalas

Process:

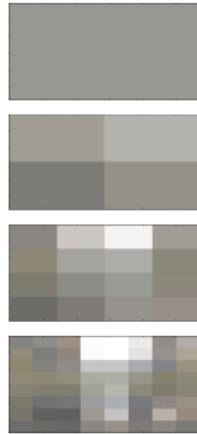


From Last Time: koalas



```
69  def main():
70      inFile = input('Enter image file name: ')
71      img = plt.imread(inFile)
72
73      #Divides the image in 1/2, 1/4, 1/8, ... 1/2^8, and displays each:
74      for i in range(8):
75          img2 = img.copy()    #Make a copy to average
76          quarter(img2,i)    #Split in half i times, and average regions
77
78          plt.imshow(img2)    #Load our new image into pyplot
79          plt.show()           #Show the image (waits until closed to continue)
80
81      #Shows the original image:
82      plt.imshow(img)        #Load image into pyplot
83      plt.show()             #Show the image (waits until closed to continue)
84
85
```

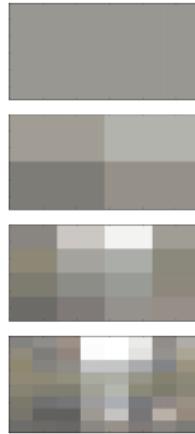
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```

- 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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 - ▶ 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.

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



Third Part: Fill in Missing Pieces

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

```
import turtle
def setUp():
    newTurtle = turtle.Turtle()
    newTurtle.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.
        tess.goto(x,y)
```

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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



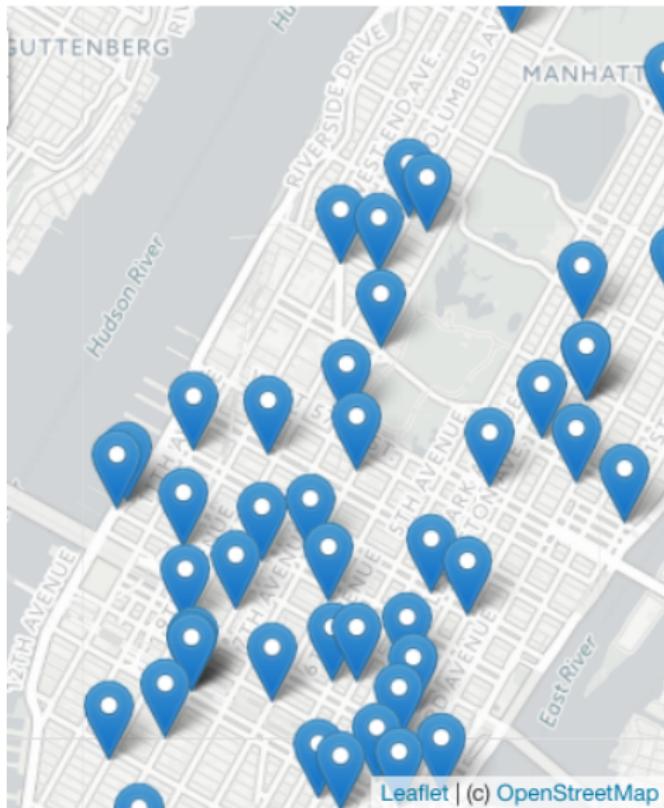
(numsConvert.py on On github)

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- Random Numbers
- Indefinite Loops

Folium



Folium

- A module for making HTML maps.

Folium



Folium

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- An extra step:

Folium

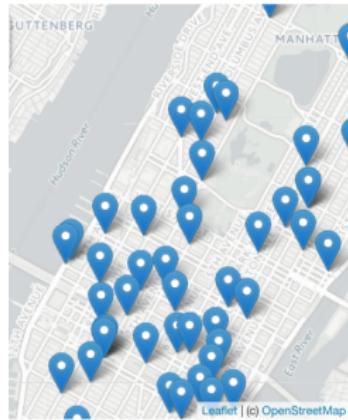
Folium



- 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. → *Run program.* → *Open .html in browser.*

Demo



(Map created by Folium.)

Folium

- To use:

```
import folium
```

Folium



Folium

Folium



- To use:

```
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```

- Create a map:

```
myMap = folium.Map()
```

Folium

Folium



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newMark = folium.Marker([lat,lon],popup=name)
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Folium

Folium



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myMap = folium.Map()
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newMark = folium.Marker([lat,lon],popup=name)
```

- Add to the map:

```
newMark.add_to(myMap)
```

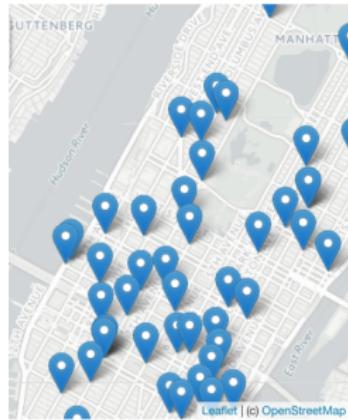
Folium

Folium



- To use:
`import folium`
- Create a map:
`myMap = folium.Map()`
- Make markers:
`newMark = folium.Marker([lat,lon],popup=name)`
- Add to the map:
`newMark.add_to(myMap)`
- Many options to customize background map ("tiles")
and markers.

Demo

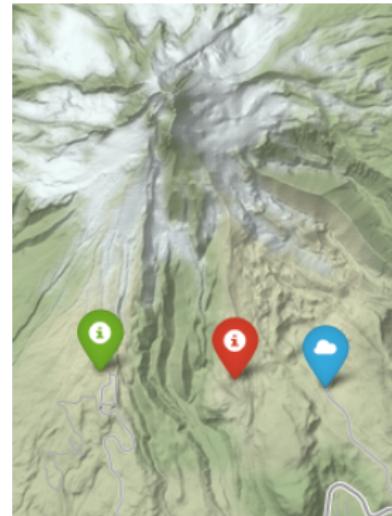


(Python program using Folium.)

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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- 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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(Demo with pythonTutor)

Indefinite Loops

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

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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

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

Indefinite Loops

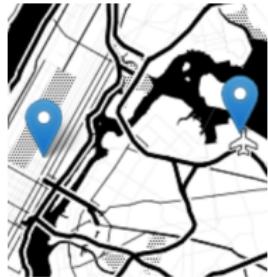
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- Very useful for checking input, simulations, and games.
- More details next lecture...

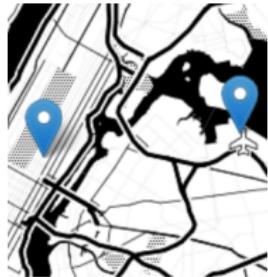
Recap

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

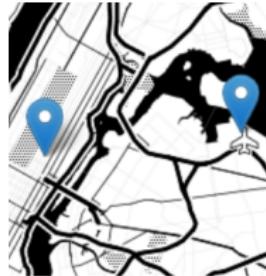


Recap

- 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.

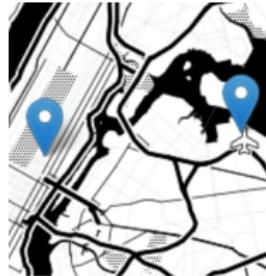


Recap



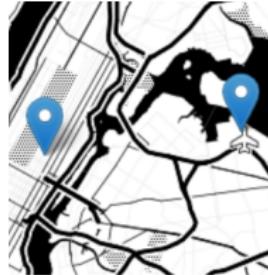
- Top-down design: breaking into subproblems, and implementing each part separately.
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- When possible, design so that your code is flexible to be reused (“code reuse”).

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.
- When possible, design so that your code is flexible to be reused (“code reuse”).
- Introduced a Python library, Folium for creating interactive HTML maps.

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.
- 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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- 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):

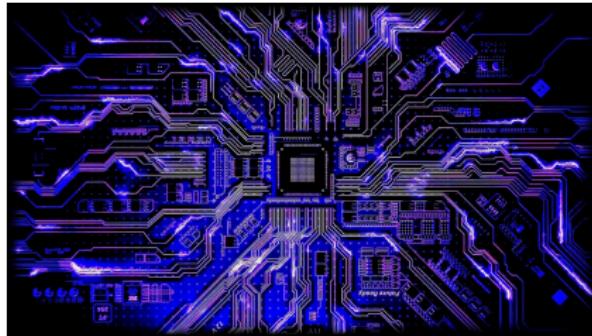
- `getData()`: asks the user for the name of the CSV file and returns a DataFrame of the contents.
- `biggestDiameter()`: returns the largest diameter (`tree_dbh`) in the DataFrame, and
- `makeGraph()`: makes a plot of the x versus y columns specified.

```
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
    """
```

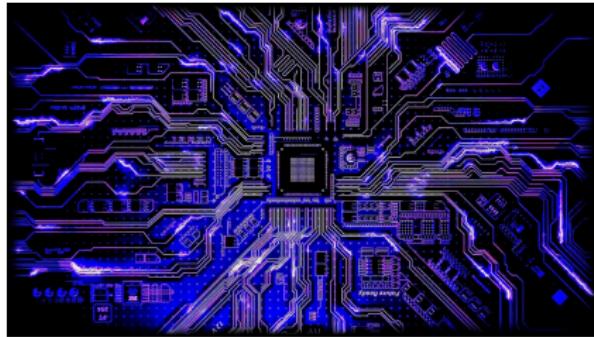
Class Reminders!



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)