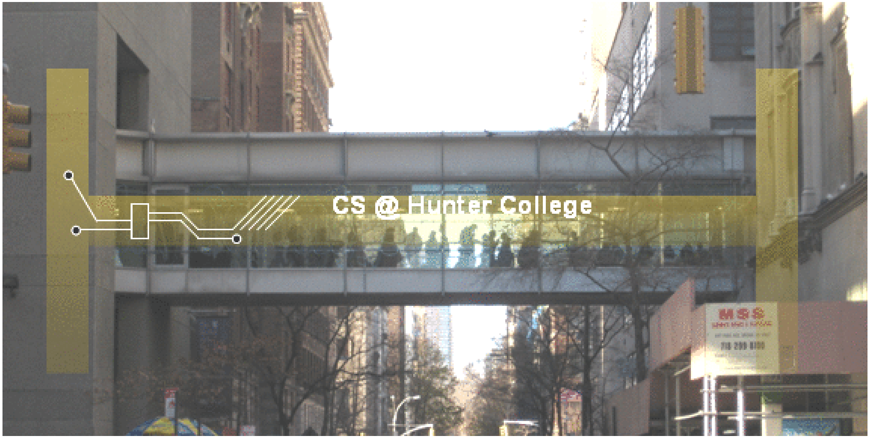
CSci 127: Introduction to Computer Science

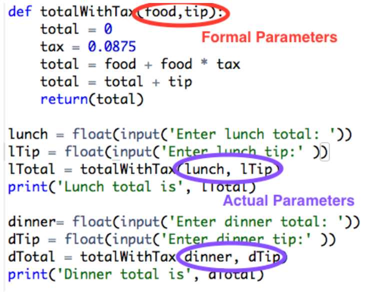


hunter.cuny.edu/csci

Today's Topics

- Recap: Parameters & Functions
- Top-down Design
- Mapping GIS Data
- Code Reuse
- Final Exam Overview

Recap: Input Parameters & Return Values



```
def totalWithTax(food,tip):
    total = 0
    tax = 0.0875
    total = food + food * tax
    total = total + tip
    return(total)

lunch = float(input('Enter lunch total: '))
lTip = float(input('Enter lunch tip:' ))
lTotal = totalWithTax(lunch, lTip)
print('Lunch total is', lTotal)

dinner= float(input('Enter dinner total: '))
dTip = float(input('Enter dinner tip:' ))
dTotal = totalWithTax(dinner, dTip)
print('Dinner total is', dTotal)
```

- When called, the actual parameter values are copied to the formal parameters.
- All the commands inside the function are performed on the copies.
- The actual parameters do not change.
- The copies are discarded when the function is done.
- The time a variable exists is called its **scope**.

In Pairs or Triples:

- What are the formal parameters? What is returned?

```
def enigma1(x,y,z):
    if x == len(y):
        return(z)
    elif x < len(y):
        return(y[0:x])
    else:
        s = cont1(z)
        return(s+y)
```

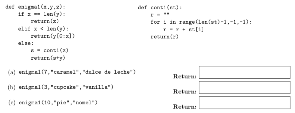
```
def cont1(st):
    r = ""
    for i in range(len(st)-1,-1,-1):
        r = r + st[i]
    return(r)
```

(a) `enigma1(7,"caramel","dulce de leche")` **Return:**

(b) `enigma1(3,"cupcake","vanilla")` **Return:**

(c) `enigma1(10,"pie","nomel")` **Return:**

Python Tutor



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(Demo with `pythonTutor`)

In Pairs or Triples:

- 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.
```

Group Work: Fill in Missing Pieces

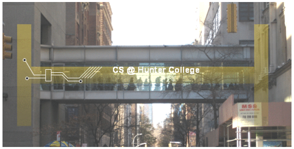
```
def main():
    tess = setUp()    #Returns a purple turtle with pen up.
    for i in range(5):
        x,y = getInput()       #Asks user for two numbers.
        markLocation(tess,x,y) #Move tess to (x,y) and stamp.
```

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.

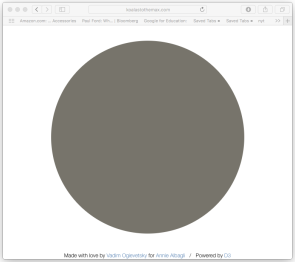
```
import turtle
def setUp():
    newTurtle = turtle.Turtle()
    newTurtle.penup()
    return(newTurtle)
def getInput():
    x = int(input('Enter x: '))
    y = int(input('Enter y: '))
    return(x,y)
def markLocation(t,x,y):
    t.goto(x,y)
    t.stamp()
def main():
    tess = setUp()    #Returns a purple turtle with pen up.
    for i in range(5):
        x,y = getInput()       #Asks user for two numbers.
```

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.

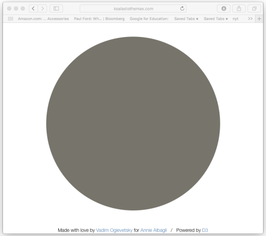
In Pairs or Triples:


koalastothemax.com
Made with love by Vadim Ogievetsky for Annie Albagli / Powered by D3

`http://koalastothemax.com`

- Top-down design puzzle:
  - What does `koalastomax` do?
  - What does each circle represent?
- Write a high-level design for it.
- Translate into a `main()` with function calls.

Demo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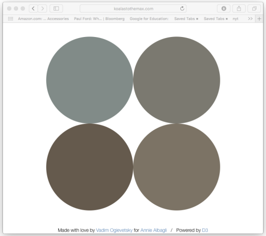
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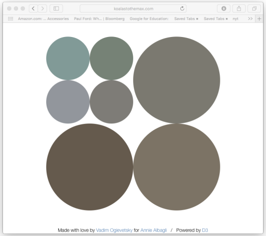
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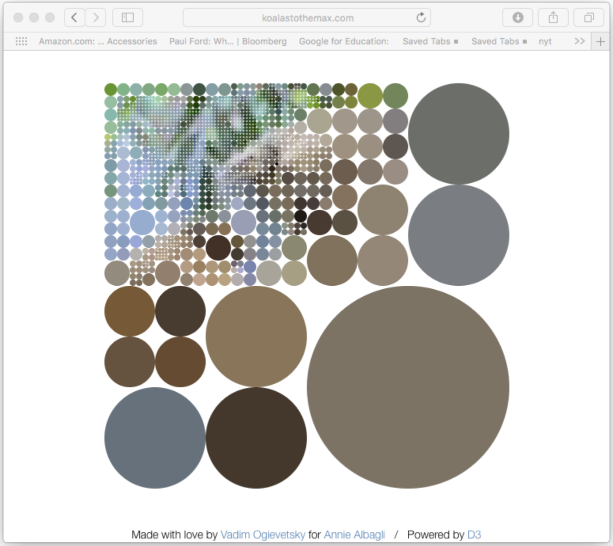
Demo



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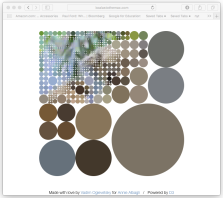
Design: Koalas to the Max


koalastothemax.com
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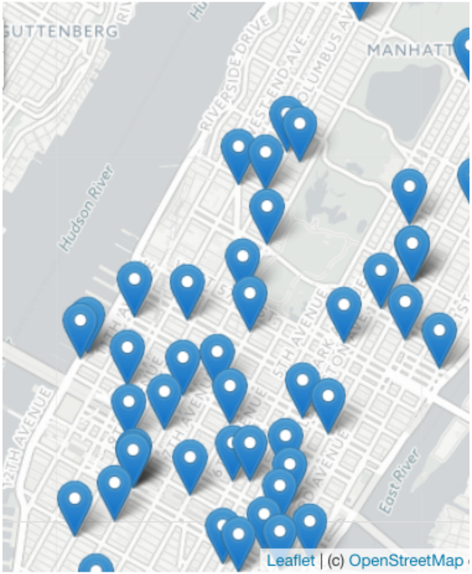
- **Input:** Image & mouse movements
- **Output:** Completed image
- **Design:**
  - Every mouse movement,
  - Divide the region into 4 quarters.
  - Average the color of each region.
  - Set each region to its average.

(Demo program from github.)

Folium

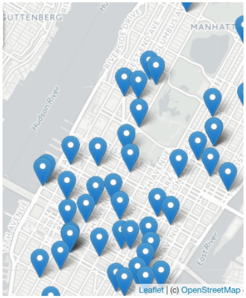

GUTTENBERG
MANHATTAN
Hudson River
East River
RIVERSIDE DRIVE
WEST END AVE.
COLUMBUS AVE
5TH AVENUE
12TH AVENUE
Leaflet | (c) OpenStreetMap

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:

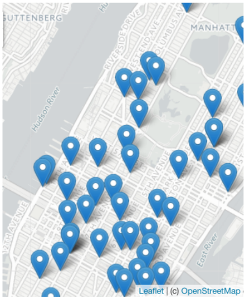
  `import folium`
- Create a map:

  `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.

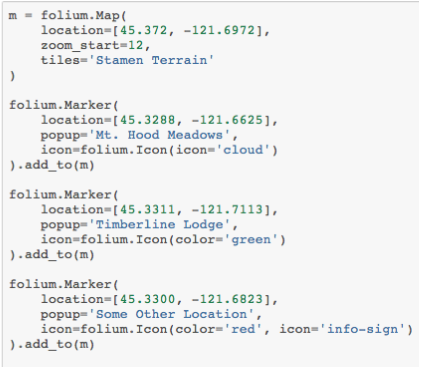
Demo



(Python program using Folium.)

In Pairs of Triples

- Predict which each line of code does:

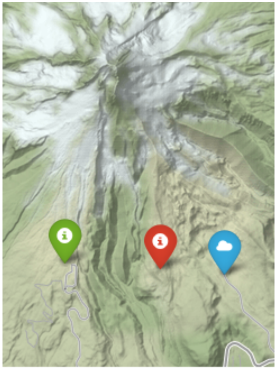


```
m = folium.Map(
    location=[45.372, -121.6972],
    zoom_start=12,
    tiles='Stamen Terrain'
)

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)

In Pairs or Triples:

5. (a) Write a function that takes number between 1 and 7 as a parameter and returns the corresponding ordinal number as a string. For example, if the parameter is 1, your function should return `"first"`. If the parameter is 2, your function should `"second"`, etc. If the parameter is not between 1 and 7, your function should return the empty string.

(Python Tutor)

Code Reuse

+
−
Hudson River
EHAWKEN
East River
Hell Gate
BROADWAY

- Goal: design your code to be reused.
- Example: code to make maps of CUNY locations from CSV files.
  - Same idea can be used for mapping traffic collisions data.
  - Or recycling bins, or wifi locations, or 311 calls,...
  - Small wrinkle: some call the columns "Latitude", while others use "LATITUDE", "latitude", or "lat".
  - Solution: ask user for column names and pass as parameters.

Code Reuse

Hudson River
EEHAWKEN
Hell Gate
East River
AVENUE
BROADWAY

```python
def main():
    dataF = getData()
    latColName, lonColName = getColumnNames()
    lat, lon = getLocale()
    cityMap = folium.Map(location = [lat,lon], tiles = 'cartodbpositron',zoom_start=11)
    dotAllPoints(cityMap,dataF,latColName,lonColName)
    markAndFindClosest(cityMap,dataF,latColName,lonColName,lat,lon)
    writeMap(cityMap)
```

In Pairs or Triples:

What does this code do?

```python
import folium
import pandas as pd

cuny = pd.read_csv('cunyLocations.csv')
mapCUNY = folium.Map(location=[40.75, -74.125])

for index,row in cuny.iterrows():
    lat = row["Latitude"]
    lon = row["Longitude"]
    name = row["Campus"]
    if row["College or Institution Type"] == "Senior Colleges":
        collegeIcon = folium.Icon(color="purple")
    else:
        collegeIcon = folium.Icon(color="blue")
    newMarker = folium.Marker([lat, lon], popup=name, icon=collegeIcon)
    newMarker.add_to(mapCUNY)

mapCUNY.save(outfile='cunyLocationsSenior.html')
```

Recap: Top-down Design & `Folium`

- On lecture slip, write down a topic you wish we had spent more time (and why).
- 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.