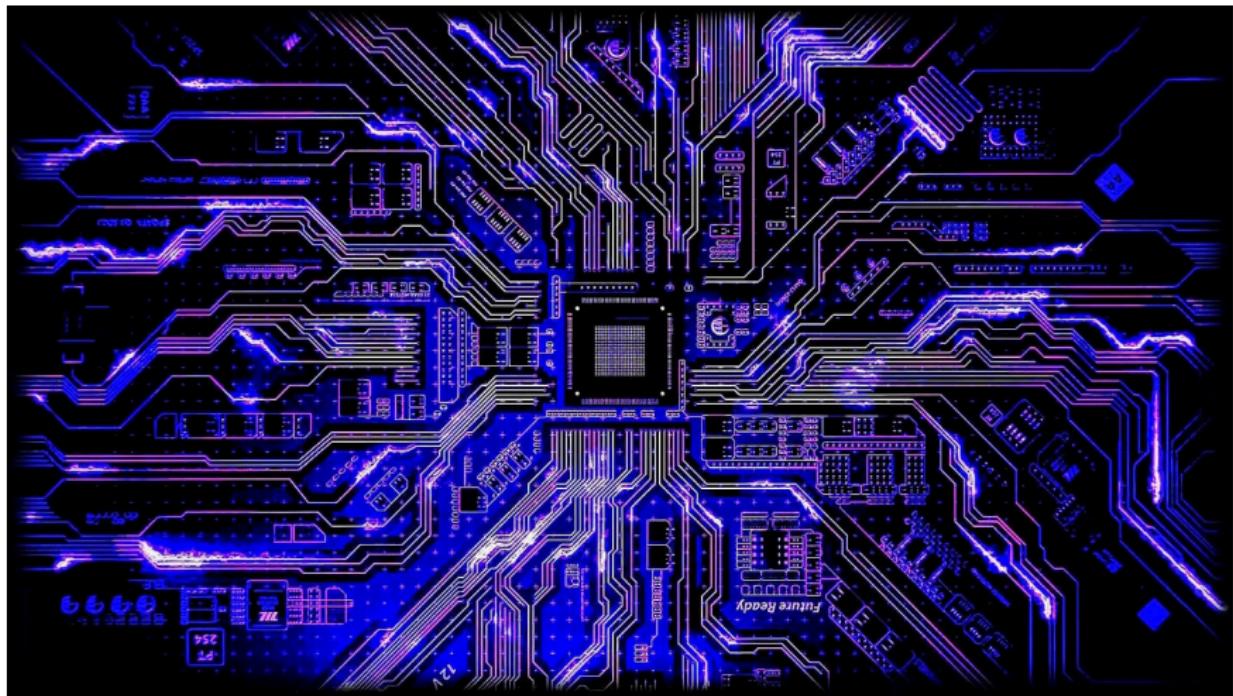


CSci 127: Introduction to Computer Science



hunter.cuny.edu/csci

Today's Topics



- More on Functions
- Recap: Open Data
- Top Down Design
- Design Challenge

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- **More on Functions**
- Recap: Open Data
- Top Down Design
- Design Challenge

Recap: Input Parameters & Return Values

- Functions can have **input parameters**.

```
def totalWithTax(food,tip):  
    total = 0  
    tax = 0.0875  
    total = food + food * tax  
    total = total + tip  
    return(total)  
  
lunch = float(input('Enter lunch total: '))  
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lTotal = totalWithTax(lunch, lTip)  
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```

Recap: Input Parameters & Return Values

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- Functions can also **return values** to where it was called.

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                                Actual Parameters

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- Functions can have **input parameters**.
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- The “placeholders” in the function definition: **formal parameters**.
- The ones in the function call: **actual parameters**.
- Functions can also **return values** to where it was called.

Challenge:

- 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")`
- (b) `enigma1(3,"cupcake","vanilla")`
- (c) `enigma1(10,"pie","nomel")`

Return:

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Return:

Python Tutor

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

(a) enigma(7,"caramelo","dulce de leche")
(b) enigma(3,"cupcake","vanilla")
(c) enigma(10,"pie","torta")
```

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

Return:	<input type="text"/>
Return:	<input type="text"/>
Return:	<input type="text"/>

(Demo with pythonTutor)

Input Parameters

- When called, the actual parameter values are copied to the formal parameters.

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def totalWithTax(food,tip):
    total = 0          Formal Parameters
    tax = 0.0875
    total = food + food * tax
    total = total + tip
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lTip = float(input('Enter lunch tip: '))
lTotal = totalWithTax(lunch, lTip)
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Actual Parameters

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- All the commands inside the function are performed on the copies.

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- All the commands inside the function are performed on the copies.
- The actual parameters do not change.

Input Parameters

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- 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**.

Input Parameters: What about Lists?

- When called, the actual parameter values are copied to the formal parameters.

```
#Fall 2013 Final Exam, 5

def kuwae( inLst ):
    tot = 1
    for item in inLst:
        tot = tot * item
    return tot

def foo( inLst ):
    if ( inLst[-1] > inLst[0] ):
        return kuwae( inLst )
    else:
        return -1

foo( [2, 4, 6, 8] )

foo( [4002, 328, 457, 1] )
```

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- The address of the list, but not the individual elements.
- The actual parameters do not change, but the inside elements might.
- Easier to see with a demo.

Python Tutor

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        return -1

foo( [2, 4, 6, 8] )

foo( [4002, 328, 457, 1] )
```

(Demo with pythonTutor)

Challenge:

Predict what the code will do:

```
#CSci 127 Teaching Staff
#Triangles two ways...
import turtle

def setUp(t, dist, col):
    t.penup()
    t.forward(dist)
    t.pendown()
    t.color(col)

def nestedTriangle(t, side):
    if side > 10:
        for i in range(3):
            t.forward(side)
            t.left(120)
        nestedTriangle(t, side/2)

def fractalTriangle(t, side):
    if side > 10:
        for i in range(3):
            t.forward(side)
            t.left(120)
        fractalTriangle(t, side/2)
```

```
def main():
    nessa = turtle.Turtle()
    setUp(nessa, 100, "violet")
    nestedTriangle(nessa, 160)

    frank = turtle.Turtle()
    setUp(frank, -100, "red")
    fractalTriangle(frank, 160)

if __name__ == "__main__":
    main()
```

IDLE

```
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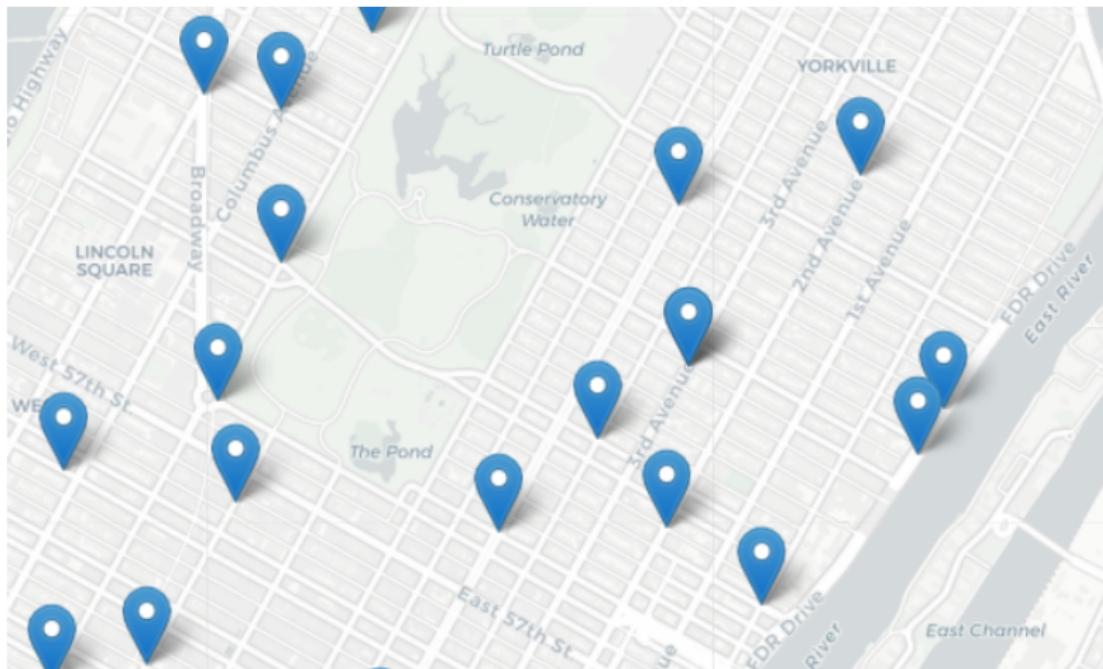
(Demo with IDLE)

Today's Topics



- More on Functions
- **Recap: Open Data**
- Top Down Design
- Design Challenge

OpenData Design Question



Design an algorithm that finds the closest collision.

OpenData Design Question

Design an algorithm that uses NYC OpenData collision data and computes the closest collision to the location the user provides.

How to approach this:

- Create a “To Do” list of what your program has to accomplish.
- Read through the problem, and break it into “To Do” items.
- Don’t worry if you don’t know how to do all the items you write down.
- Example:
 - ① Find data set (great place to look: NYC OpenData).
 - ② Ask user for current location.
 - ③ Open up the CSV file.
 - ④ Check distance to each to user’s location.
 - ⑤ Print the location with the smallest distance.

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- Let’s use function names as placeholders for the ones we’re unsure...

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```
collisions = pd.read_csv(inF)
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```
closestLat, closestLon = findClosest(collisions, lat, lon)
```

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collisions = pd.read_csv(inF)
```

- ④ Check distance to each to user's location.

```
closestLat, closestLon = findClosest(collisions, lat, lon)
```

- ⑤ Print the location with the smallest distance.

```
print("The closest is at lat:", lat, "and lon:", lon)
```

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- **Top Down Design**
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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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 - ▶ Break the problem into tasks for a “To Do” list.



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.

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.

Top-Down Design



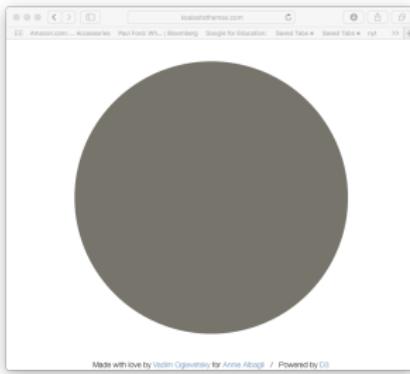
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- Excellent approach since you can then test each part separately before adding it to a large program.

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:



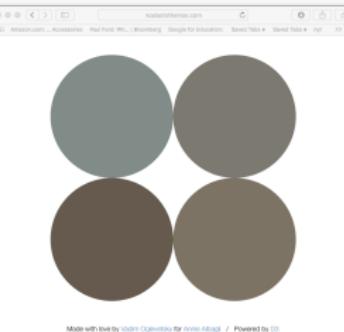
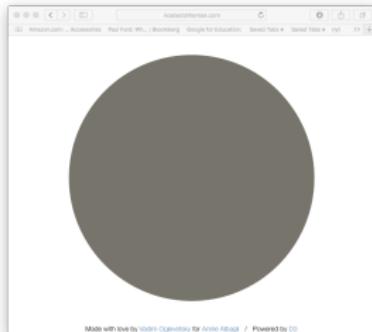
<http://koalastothemax.com>

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

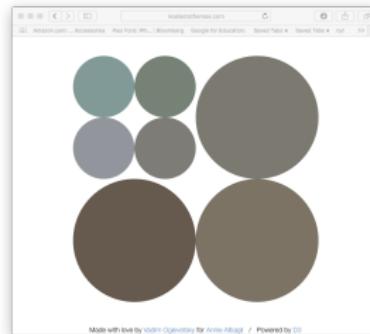
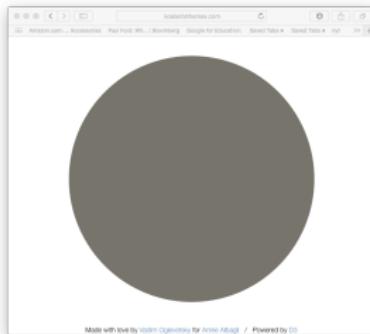
Demo



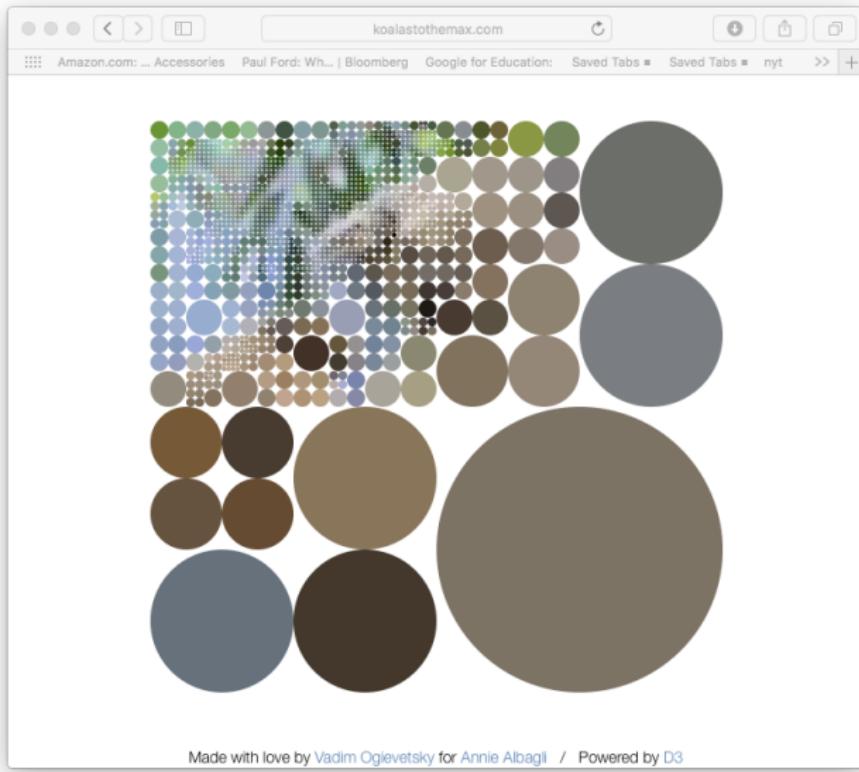
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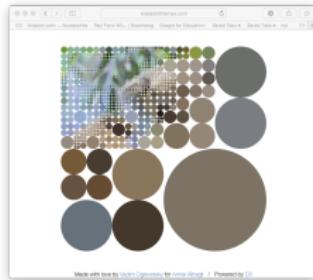
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Demo

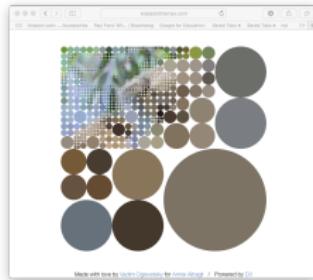


Design: Koalas to the Max



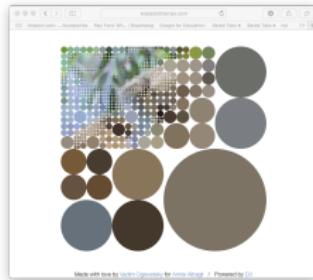
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Design: Koalas to the Max



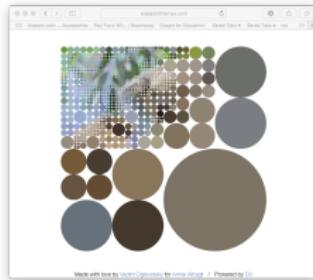
- **Input:** Image & mouse movements
- **Output:** Completed image

Design: Koalas to the Max



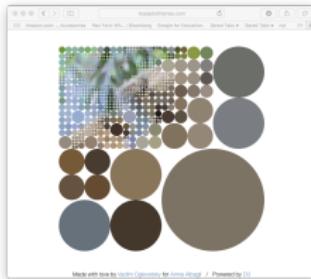
- **Input:** Image & mouse movements
- **Output:** Completed image
- **Design:**

Design: Koalas to the Max



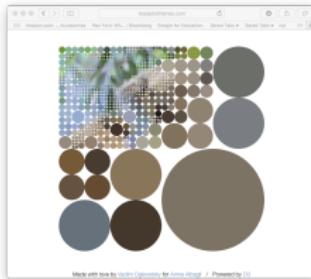
- **Input:** Image & mouse movements
- **Output:** Completed image
- **Design:**
 - ▶ Every mouse movement,

Design: Koalas to the Max



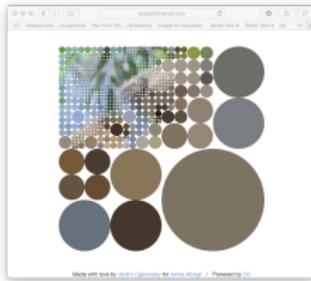
- **Input:** Image & mouse movements
- **Output:** Completed image
- **Design:**
 - ▶ Every mouse movement,
 - ▶ Divide the region into 4 quarters.

Design: Koalas to the Max



- **Input:** Image & mouse movements
- **Output:** Completed image
- **Design:**
 - ▶ Every mouse movement,
 - ▶ Divide the region into 4 quarters.
 - ▶ Average the color of each quarter.

Design: Koalas to the Max



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

Averaging numpy arrays

- Average each color channel of the image:

Averaging numpy arrays

- Average each color channel of the image:



Averaging numpy arrays

- Average each color channel of the image:



```
redAve = np.average(region[:, :, 0])
```

Averaging numpy arrays

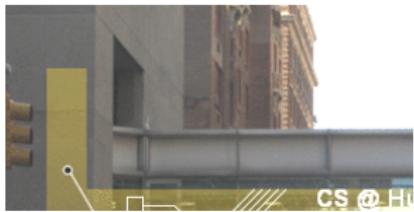
- Average each color channel of the image:



```
redAve = np.average(region[:, :, 0])  
greenAve = np.average(region[:, :, 1])
```

Averaging numpy arrays

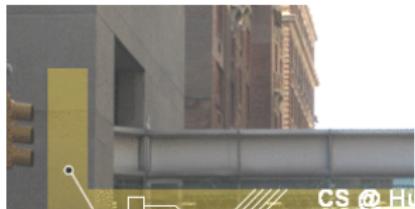
- Average each color channel of the image:



```
redAve = np.average(region[:, :, 0])
greenAve = np.average(region[:, :, 1])
blueAve = np.average(region[:, :, 2])
```

Averaging numpy arrays

- Average each color channel of the image:

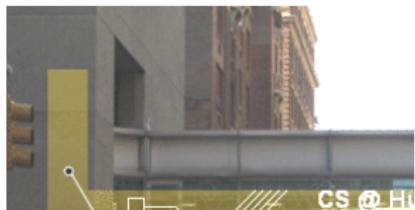


```
redAve = np.average(region[:, :, 0])
greenAve = np.average(region[:, :, 1])
blueAve = np.average(region[:, :, 2])
```

- Set each pixel to the average value:

Averaging numpy arrays

- Average each color channel of the image:



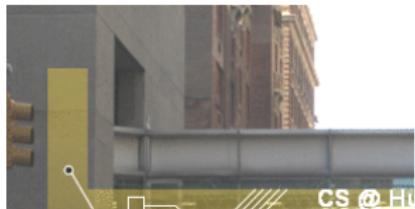
```
redAve = np.average(region[:, :, 0])
greenAve = np.average(region[:, :, 1])
blueAve = np.average(region[:, :, 2])
```

- Set each pixel to the average value:

```
region[:, :, 0] = redAve
```

Averaging numpy arrays

- Average each color channel of the image:



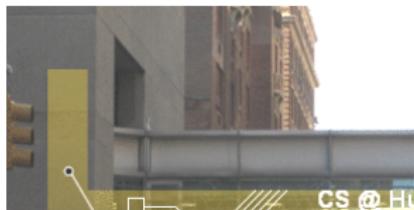
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redAve = np.average(region[:, :, 0])
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```

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```

Averaging numpy arrays

- Average each color channel of the image:



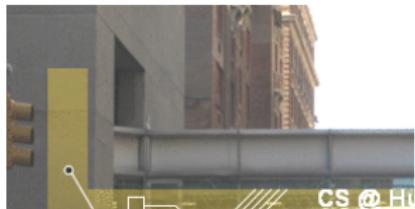
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```

- Set each pixel to the average value:

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```

Averaging numpy arrays

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```

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region[:, :, 0] = redAve
region[:, :, 1] = greenAve
region[:, :, 2] = blueAve
```



Today's Topics



- More on Functions
- Recap: Open Data
- Top Down Design
- **Design Challenge**

Design Challenge

Job ID	Agency	Posting T# O	Business Title	Civil Service	Title Code	Level	Job Category	Full- Sal
246814	DEPT OF INFO	External	1 Senior Architect Cloud Infrastructure Dev	SENIOR IT AF	6800	O	Information, F	
246814	DEPT OF INFO	Internal	1 Senior Architect Cloud Infrastructure Dev	SENIOR IT AF	6800	O	Information, F	
247320	DEPT OF ENVI	Internal	2 MECHANICAL ENGINEERING INTERN	MECHANICA	20403	O	Engineering, F	
247320	DEPT OF ENVI	External	2 MECHANICAL ENGINEERING INTERN	MECHANICA	20403	O	Engineering, F	
269885	DEPT OF ENVI	External	1 MECHANICAL ENGINEERING INTERN	MECHANICA	20403	O	Engineering, F	
269885	DEPT OF ENVI	Internal	1 MECHANICAL ENGINEERING INTERN	MECHANICA	20403	O	Engineering, F	
285120	NYC HOUSING	External	1 Deputy Director for Engineering	ADMINISTRATOR	10015	M3	Engineering, P	
285120	NYC HOUSING	Internal	1 Deputy Director for Engineering	ADMINISTRATOR	10015	M3	Engineering, P	
287202	DEPT OF ENVI	External	4 MECHANICAL ENGINEERING INTERN	MECHANICA	20403	O	Engineering, F	
287202	DEPT OF ENVI	Internal	4 MECHANICAL ENGINEERING INTERN	MECHANICA	20403	O	Engineering, F	

(data.cityofnewyork.us/City-Government/NYC-Jobs/kpav-sd4t)

Find all current city job postings for internship positions.

Design Challenge

Job ID	Agency	Posting T#	Business Title	Civil Service	Title Code	Level	Job Category	Full-Time	Salary Range	Salary Range
246814	DEPT OF INF/C External	1	Senior Architect Cloud Infrastructure	DI SENIOR IT AF	6800	O	Information, F	100000	130000	
246814	DEPT OF INF/C Internal	1	Senior Architect Cloud Infrastructure	DI SENIOR IT AF	6800	O	Information, F	100000	130000	
247320	DEPT OF ENVI Internal	2	MECHANICAL ENGINEERING INTERN	MECHANICA	20403	O	Engineering, F	52000	52000	
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(data.cityofnewyork.us/City-Government/NYC-Jobs/kpav-sd4t)

- **Input:** CSV file from NYC OpenData.

Design Challenge

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(data.cityofnewyork.us/City-Government/NYC-Jobs/kpav-sd4t)

- **Input:** CSV file from NYC OpenData.
- **Output:** A list of internships offered by the city.

Design Challenge

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(data.cityofnewyork.us/City-Government/NYC-Jobs/kpav-sd4t)

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(data.cityofnewyork.us/City-Government/NYC-Jobs/kpav-sd4t)

- **Input:** CSV file from NYC OpenData.
- **Output:** A list of internships offered by the city.
- **Process:**
 - ① Open the file.

Design Challenge

Job ID	Agency	Posting T#	Business Title	Civil Service	Title Code	Level	Job Category	Full-Time	Salary Range	Salary Range
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(data.cityofnewyork.us/City-Government/NYC-Jobs/kpav-sd4t)

- **Input:** CSV file from NYC OpenData.
- **Output:** A list of internships offered by the city.
- **Process:**
 - ① Open the file.
 - ② Select the rows that have “intern” in the business title.

Design Challenge

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246814	DEPT OF INFO External	1	Senior Architect Cloud Infrastructure	DI SENIOR IT AF	6800	O	Information, F	100000	130000	
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(data.cityofnewyork.us/City-Government/NYC-Jobs/kpav-sd4t)

- **Input:** CSV file from NYC OpenData.
- **Output:** A list of internships offered by the city.
- **Process:**
 - ① Open the file.
 - ② Select the rows that have “intern” in the business title.
 - ③ Print out those rows.

Recap

- Functions are a way to break code into pieces, that can be easily reused.

```
#Name: your name here
#Date: October 2017
#This program, uses functions,
#      says hello to the world!

def main():
    print("Hello, World!")

if __name__ == "__main__":
    main()
```

Recap

- Functions are a way to break code into pieces, that can be easily reused.
- Functions can have **input parameters** that bring information into the function,

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- Functions are a way to break code into pieces, that can be easily reused.
- Functions can have **input parameters** that bring information into the function,
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- Top-down design: breaking into subproblems, and implementing each part separately.

Recap

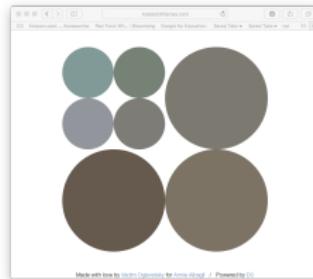
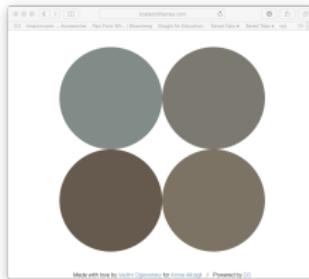
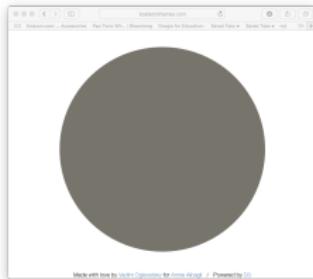
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- Functions are a way to break code into pieces, that can be easily reused.
- Functions can have **input parameters** that bring information into the function,
- And **return values** that send information back.
- Top-down design: breaking into subproblems, and implementing each part separately.
- Excellent approach: can then test each part separately before adding it to a large program.

Practice Quiz & Final Questions



- Since you must pass the final exam to pass the course, we end every lecture with final exam review.
- Pull out something to write on (not to be turned in).
- 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](#)).
- Theme: Functions! Starting with S18, V1, #4a and #4b.

Final Exam: Spring 2018, Version 1, #4a

Name:

EmpID:

CSci 127 Final, S18, V1

4. (a) Draw the output for the function calls:

```
import turtle
tess = turtle.Turtle()
tess.shape("turtle")

def ramble(t,side):
    if side == 0:
        t.stamp()
    else:
        for i in range(side):
            t.forward(50)
            t.left(360/side)
```

i. `ramble(tess,0)`

ii. `ramble(tess,6)`

Final Exam: Spring 2018, Version 1, #4a

Name: _____ Room #: _____ CS-127 Final, S18, V1

4. (a) Draw the output for the function calls:

```
import turtle
tess = turtle.Turtle()
tess.shape("turtle")

def rookS(t,side):
    if side > 0:
        t.stamp()
    else:
        for i in range(side):
            t.forward(10)
            t.left(360/abs(side))
```



(Demo with trinket)

Final Exam: Spring 2018, Version 1, #4b

(b) For the following code:

```
def v1(vincent, munem):  
    if vincent + munem > 0:  
        return vincent  
    else:  
        return -1
```

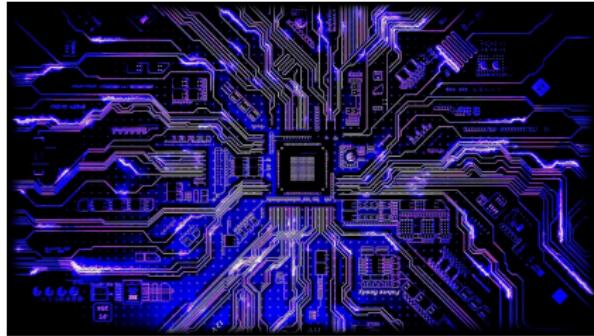
```
def start():  
    panda = 20  
    minh = -30  
    qiuqun = v1(panda,minh)  
    return qiuqun
```

i. What are the formal parameters for **v1()**:

ii. What are the formal parameters for **start()**:

iii. What does **start()** return:

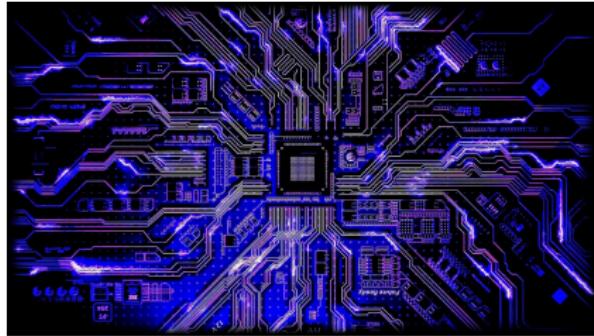
Reminders!



Before next lecture, don't forget to:

- Review this class's Lecture and Lab

Reminders!



Before next lecture, don't forget to:

- Review this class's Lecture and Lab
- Submit this class's 5 programming assignments