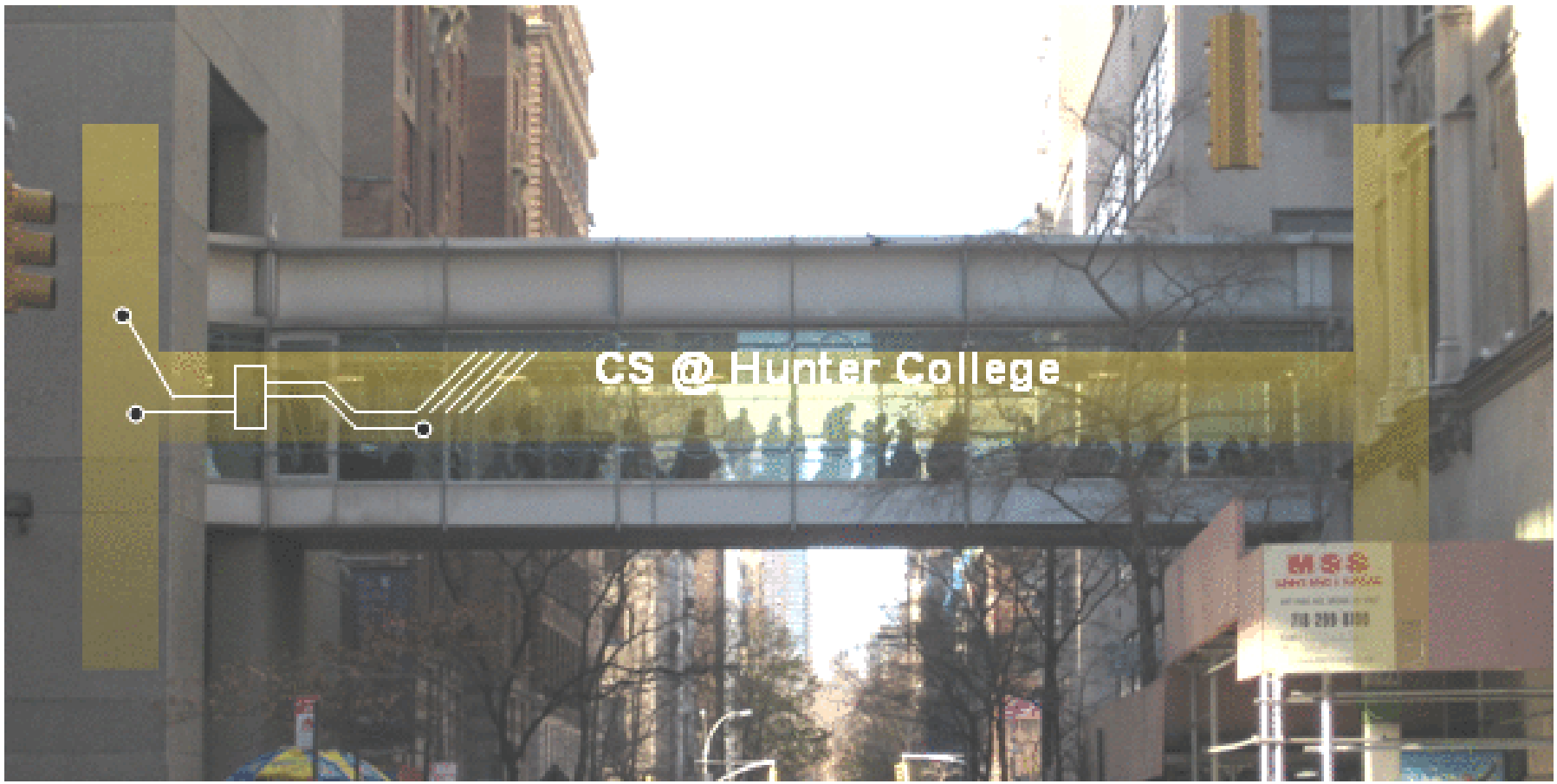
CSci 127: Introduction to Computer Science



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Today's Topics

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

Today's Topics

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

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

dinner= float(input('Enter dinner total: '))
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Input Parameters & Return Values

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- The "placeholders" in the function definition: **formal parameters**.

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

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Formal Parameters

Actual 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")`

Return: _____

(b) `enigma1(3,"cupcake","vanilla")`

Return: _____

(c) `enigma1(10,"pie","nomel")`

Return: _____

Python Tutor

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(Demo with `pythonTutor`)

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Formal Parameters

Actual Parameters

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

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

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Formal Parameters

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

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- 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?

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

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- The address of the list, but not the individual elements.

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- When called, the actual parameter values are copied to the formal parameters.
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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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foo( [2, 4, 6, 8] )

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(Demo with pythonTutor)

Challenge:

```
def bar(n):
    if n <= 8:
        return 1
    else:
        return 0

def foo(l):
    n = bar(l[-1])
    return l[n]
```

- What are the formal parameters for the functions?
- What is the output of:

```
r = foo([1,2,3,4])
print("Return:  ", r)
```

- What is the output of:

```
r = foo([1024,512,256,128])
print("Return:  ", r)
```

Python Tutor

```
def bar(n):
    if n <= 8:
        return 1
    else:
        return 0

def foo(l):
    n = bar(l[-1])
    return l[n]
```

(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)

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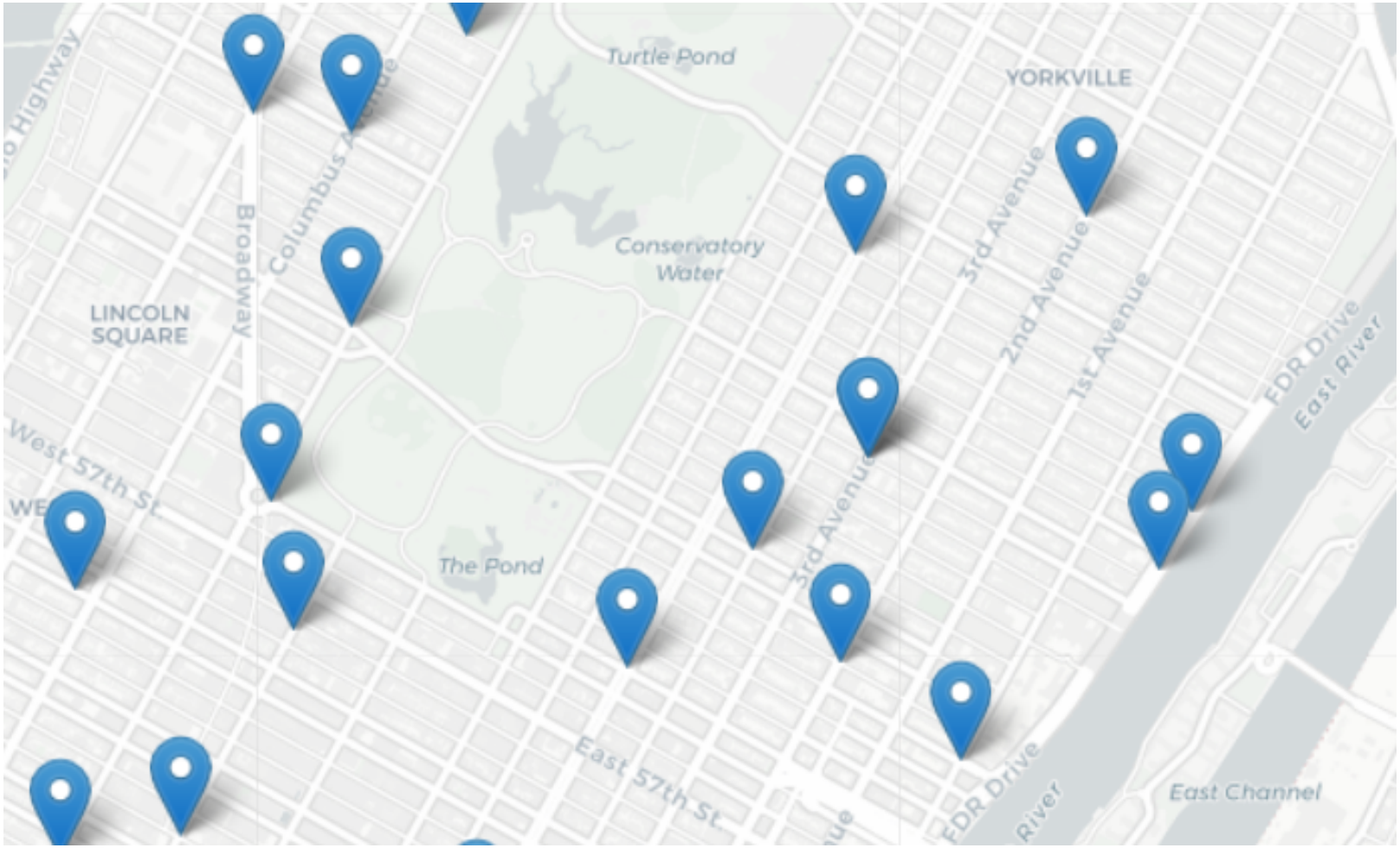
- **Recap: Open Data**
- Top Down Design
- Github
- Design Challenge:

OpenData Design Question



Design an algorithm that finds the closest collision.

(Sample NYC OpenData collision data file on back of lecture slip.)

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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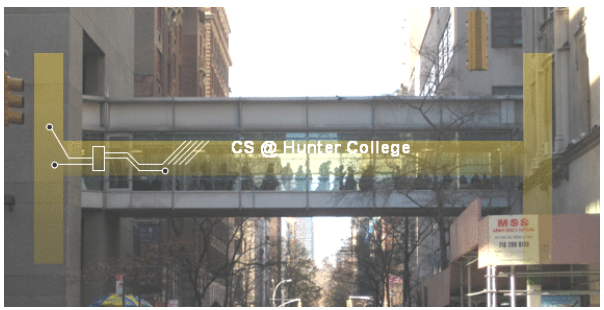
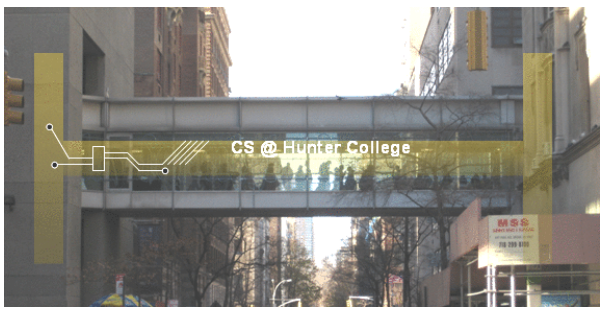


- The last example demonstrates **top-down design**: breaking into subproblems, and implementing each part separately.

Top-Down Design



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  - Break the problem into tasks for a "To Do" list.

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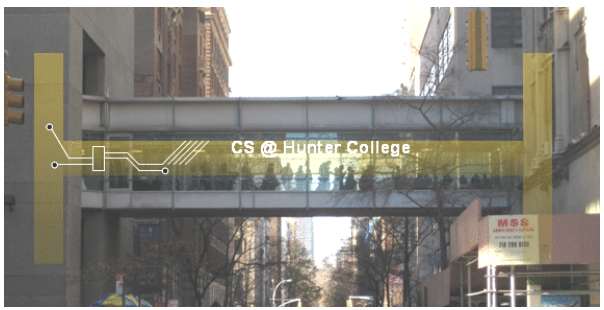

- The last example demonstrates **top-down design**: breaking into subproblems, and implementing each part separately.
  - Break the problem into tasks for a "To Do" list.
  - Translate list into function names & inputs/returns.

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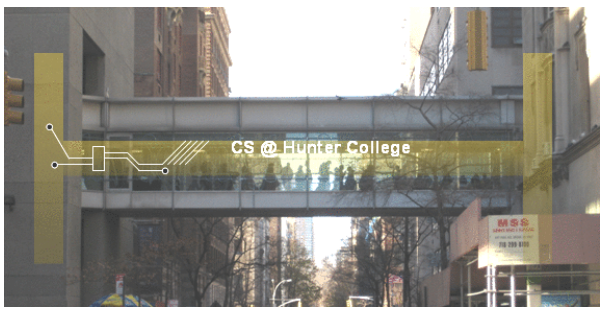

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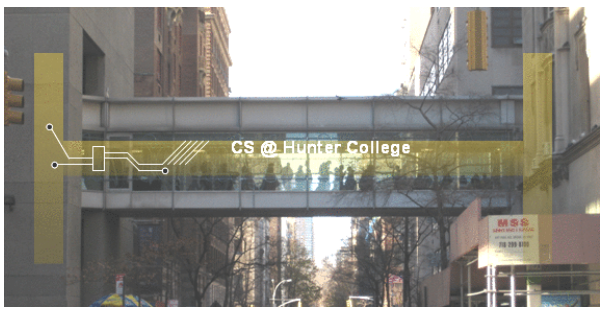

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  - Break the problem into tasks for a "To Do" list.
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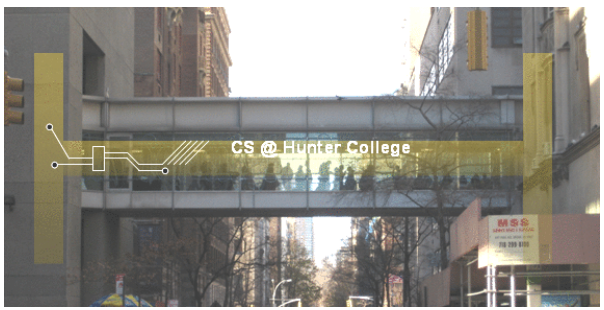
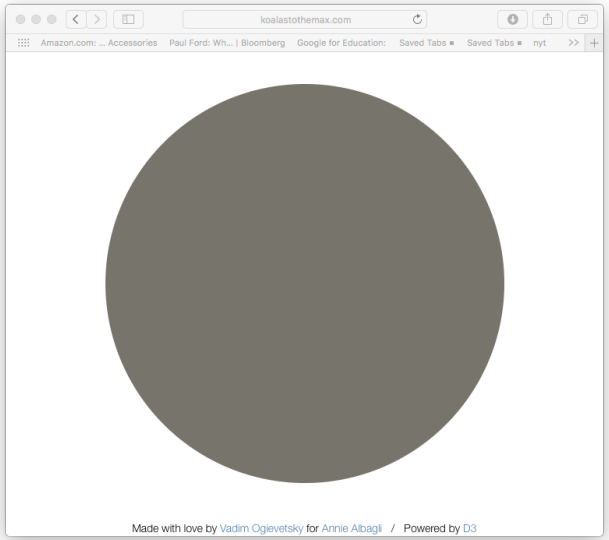
  - Implement the functions, one-by-one.
- Excellent approach since you can then test each part separately before adding it to a large program.

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.

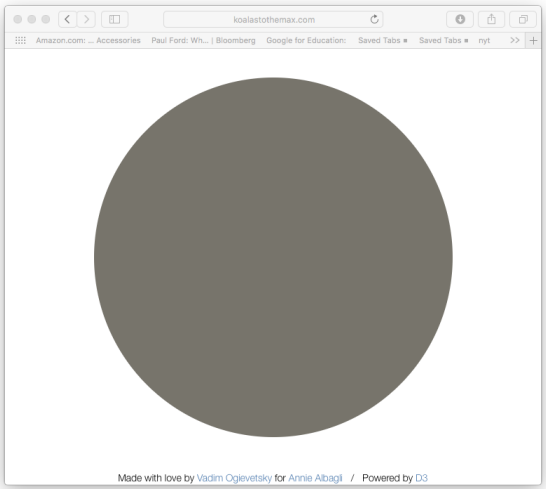
Challenge:



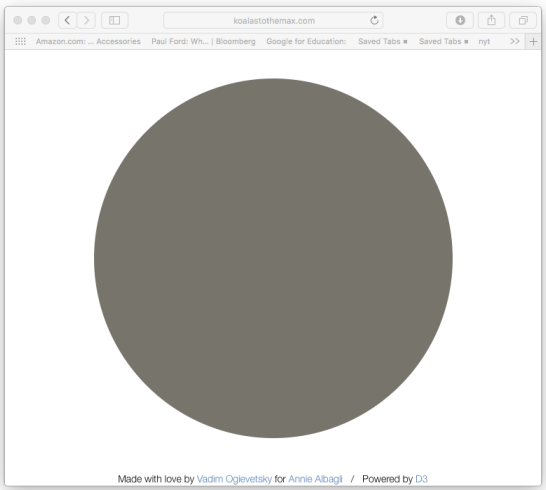
`http://koalastothemax.com`

- 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


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

Demo


koalastothemax.com
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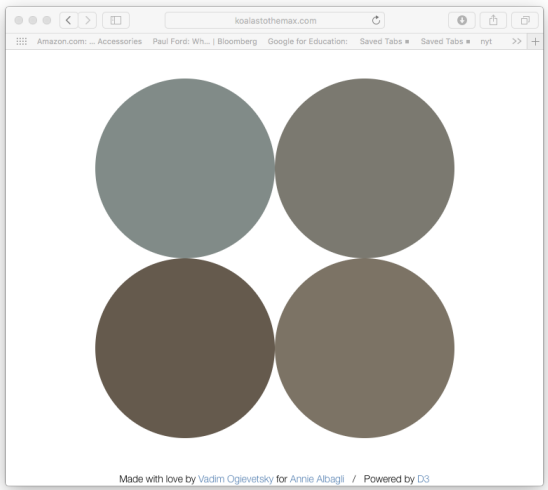
koalastothemax.com
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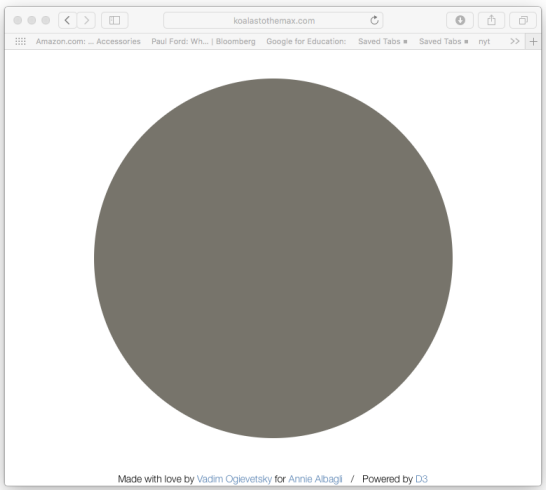
Demo


koalastothemax.com
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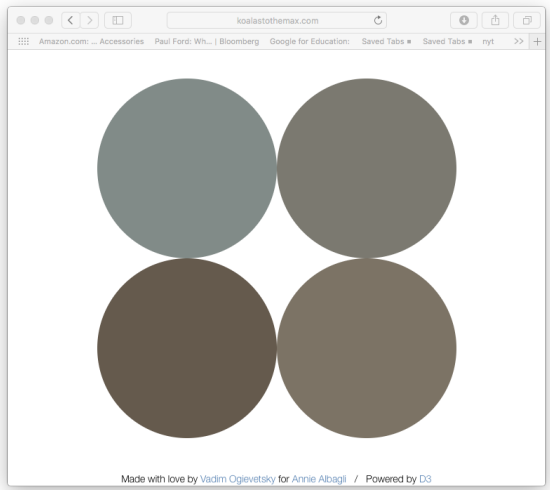
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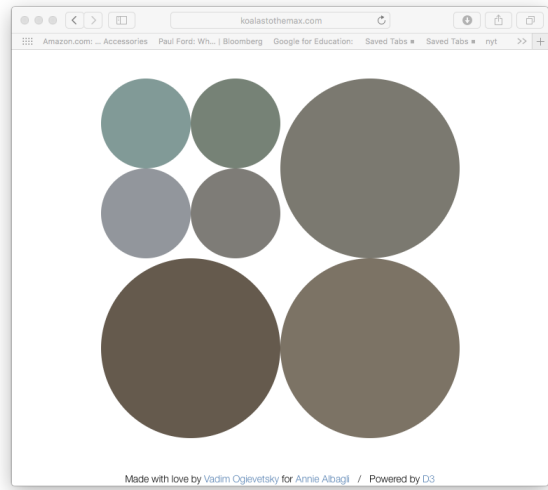
koalastothemax.com
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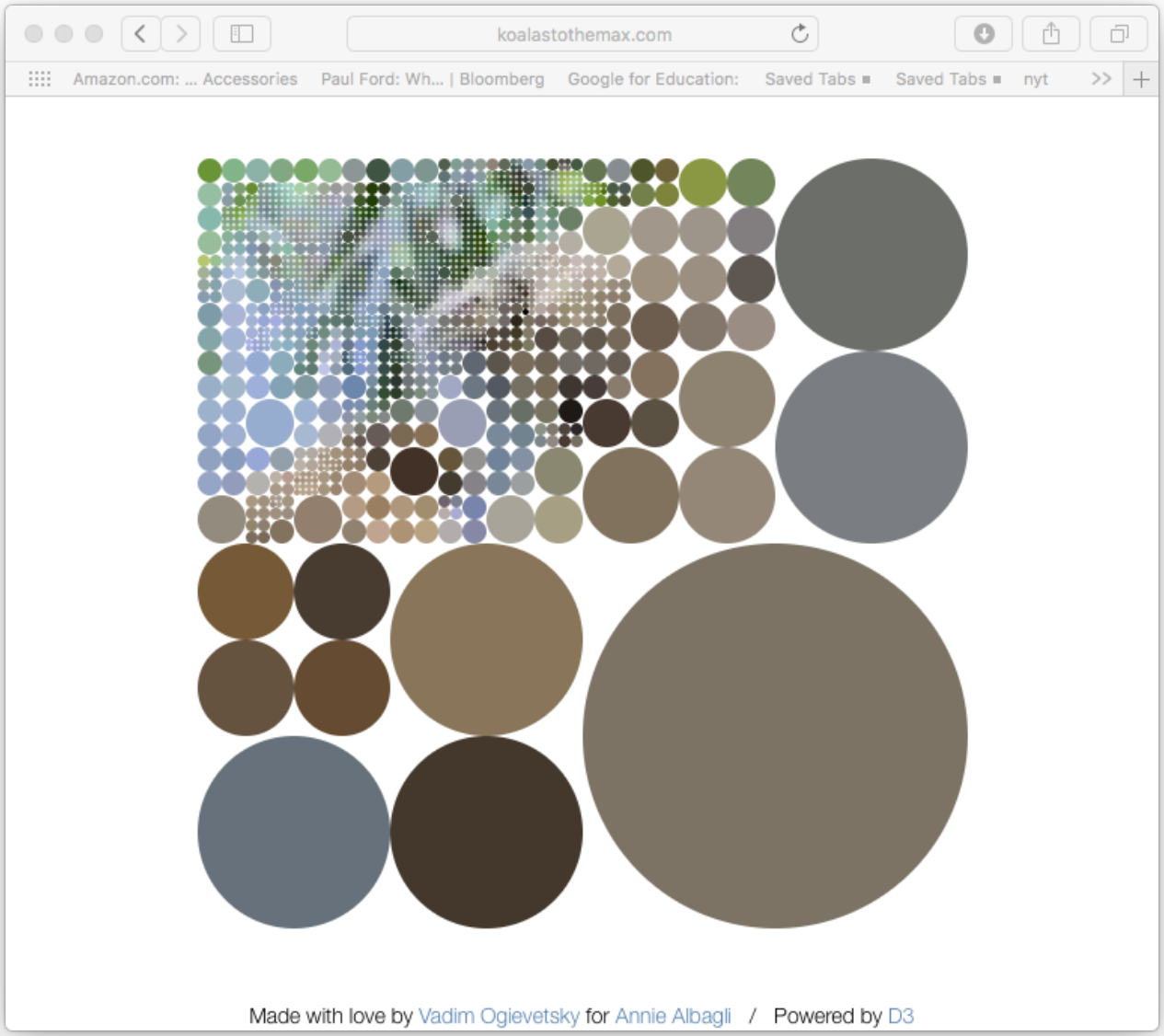
Demo


koalastothemax.com
Amazon.com: ... Accessories
Paul Ford: Wh... | Bloomberg
Google for Education:
Saved Tabs
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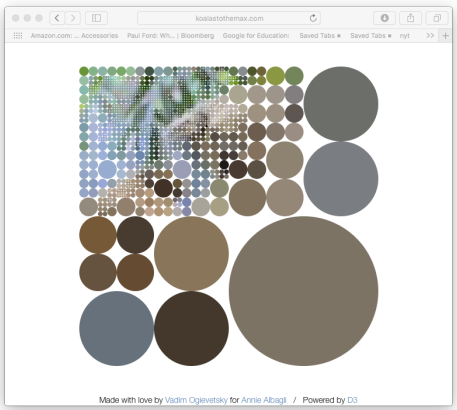
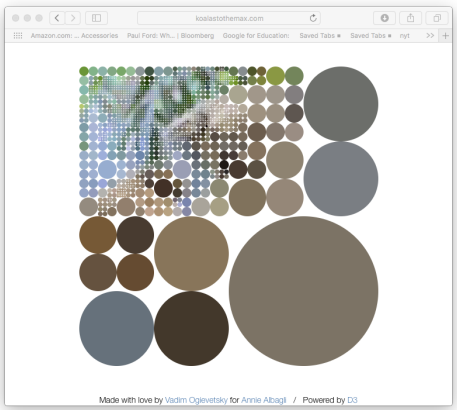
Design: Koalas to the Max



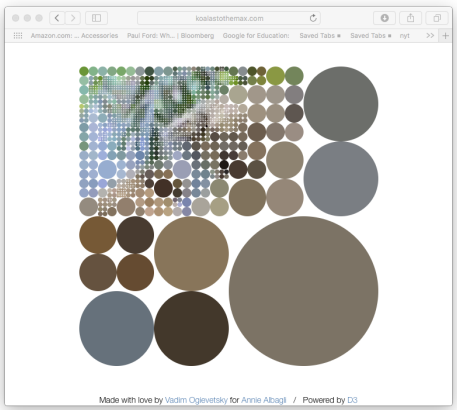
- **Input:** Image & mouse movements

Design: Koalas to the Max



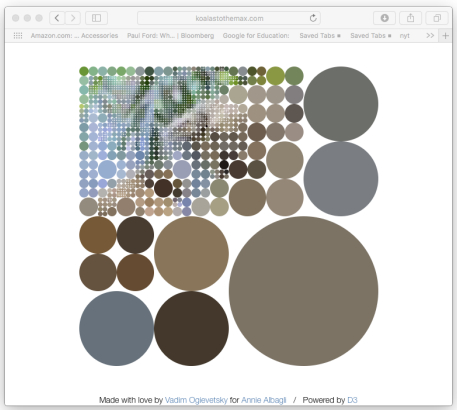
- **Input:** Image & mouse movements
- **Output:** Completed image

Design: Koalas to the Max



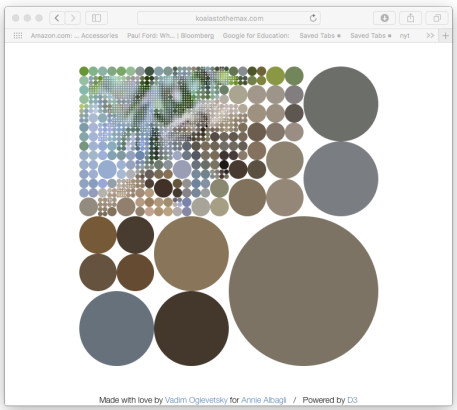
- **Input:** Image & mouse movements
- **Output:** Completed image
- **Design:**

Design: Koalas to the Max



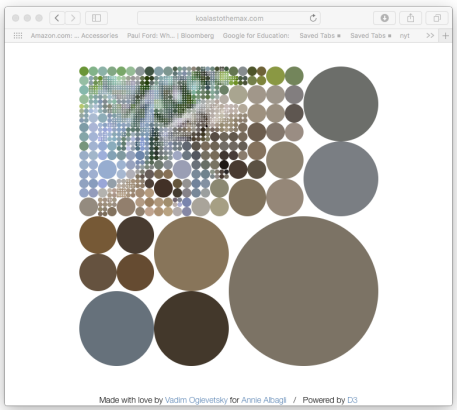
- **Input:** Image & mouse movements
- **Output:** Completed image
- **Design:**
  - Every mouse movement,

Design: Koalas to the Max



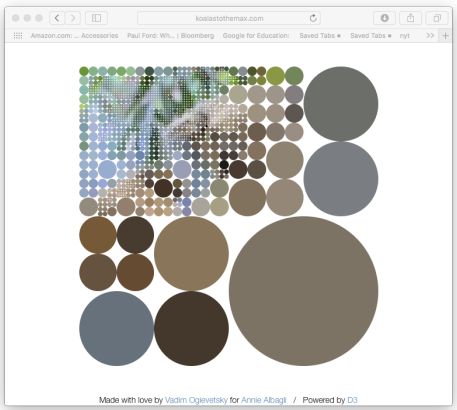
- **Input:** Image & mouse movements
- **Output:** Completed image
- **Design:**
  - Every mouse movement,
  - Divide the region into 4 quarters.

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

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

Averaging numpy arrays

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

Averaging numpy arrays

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```

- 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])
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```

- Set each pixel to the average value:

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

Averaging numpy arrays

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```

Today's Topics

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

Github

- Used to collaborate on and share code, documents, etc.

Octocat

Github

- Used to collaborate on and share code, documents, etc.
- Supporting Open-Source Software: original source code is made freely available and may be redistributed and modified under the same licencse.

Octocat

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- Github provides hosting for repositories (**'repos'**) of code.
- Also convenient place to host websites (i.e. `huntercsci127.github.io`).

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- More formally: `git` is a version control protocol for tracking changes and versions of documents.
- Github provides hosting for repositories (‘**repos**’) of code.
- Also convenient place to host websites (i.e. `huntercsci127.github.io`).
- In Lab6 you set up github accounts to copy (‘**clone**’) documents from the class repo. (More in future courses.)

Design Challenge

Job ID	Agency	Posting T	# O	Business Title	Civil Service	Title Cod	Level	Job Category	Full-	Sal
246814	DEPT OF INFO	External	1	Senior Architect Cloud Infrastructure D	SENIOR IT AF	6800	0	Information	F	
246814	DEPT OF INFO	Internal	1	Senior Architect Cloud Infrastructure D	SENIOR IT AF	6800	0	Information	F	
247320	DEPT OF ENVI	Internal	2	MECHANICAL ENGINEERING INTERN	MECHANICA	20403	0	Engineering,	F	
247320	DEPT OF ENVI	External	2	MECHANICAL ENGINEERING INTERN	MECHANICA	20403	0	Engineering,	F	
269885	DEPT OF ENVI	External	1	MECHANICAL ENGINEERING INTERN	MECHANICA	20403	0	Engineering,	F	
269885	DEPT OF ENVI	Internal	1	MECHANICAL ENGINEERING INTERN	MECHANICA	20403	0	Engineering,	F	
285120	NYC HOUSING	External	1	Deputy Director for Engineering	ADMINISTRA	10015	M3	Engineering,	P	
285120	NYC HOUSING	Internal	1	Deputy Director for Engineering	ADMINISTRA	10015	M3	Engineering,	P	
287202	DEPT OF ENVI	External	4	MECHANICAL ENGINEERING INTERN	MECHANICA	20403	0	Engineering,	F	
287202	DEPT OF ENVI	Internal	4	MECHANICAL ENGINEERING INTERN	MECHANICA	20403	0	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	# O	Business Title	Civil Service	Title Cod	Level	Job Category	Full-	Salary Range	Salary Range
246814	DEPT OF INFO	External	1	Senior Architect Cloud Infrastructure D	SENIOR IT AF	6800	0	Information	F	100000	130000
246814	DEPT OF INFO	Internal	1	Senior Architect Cloud Infrastructure D	SENIOR IT AF	6800	0	Information	F	100000	130000
247320	DEPT OF ENVI	Internal	2	MECHANICAL ENGINEERING INTERN	MECHANICA	20403	0	Engineering,	F	52000	52000
247320	DEPT OF ENVI	External	2	MECHANICAL ENGINEERING INTERN	MECHANICA	20403	0	Engineering,	F	52000	52000
269885	DEPT OF ENVI	External	1	MECHANICAL ENGINEERING INTERN	MECHANICA	20403	0	Engineering,	F	52000	52000
269885	DEPT OF ENVI	Internal	1	MECHANICAL ENGINEERING INTERN	MECHANICA	20403	0	Engineering,	F	52000	52000
285120	NYC HOUSING	External	1	Deputy Director for Engineering	ADMINISTRA	10015	M3	Engineering,	P	115000	130000
285120	NYC HOUSING	Internal	1	Deputy Director for Engineering	ADMINISTRA	10015	M3	Engineering,	P	115000	130000
287202	DEPT OF ENVI	External	4	MECHANICAL ENGINEERING INTERN	MECHANICA	20403	0	Engineering,	F	52000	52000
287202	DEPT OF ENVI	Internal	4	MECHANICAL ENGINEERING INTERN	MECHANICA	20403	0	Engineering,	F	52000	52000

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

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

Design Challenge

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247320	DEPT OF ENVI	Internal	2	MECHANICAL ENGINEERING INTERN	MECHANICA	20403	0	Engineering,	F	52000	52000
247320	DEPT OF ENVI	External	2	MECHANICAL ENGINEERING INTERN	MECHANICA	20403	0	Engineering,	F	52000	52000
269885	DEPT OF ENVI	External	1	MECHANICAL ENGINEERING INTERN	MECHANICA	20403	0	Engineering,	F	52000	52000
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287202	DEPT OF ENVI	External	4	MECHANICAL ENGINEERING INTERN	MECHANICA	20403	0	Engineering,	F	52000	52000
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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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246814	DEPT OF INFO	External	1	Senior Architect Cloud Infrastructure D	SENIOR IT AF	6800	0	Information	F	100000	130000
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247320	DEPT OF ENVI	Internal	2	MECHANICAL ENGINEERING INTERN	MECHANICA	20403	0	Engineering,	F	52000	52000
247320	DEPT OF ENVI	External	2	MECHANICAL ENGINEERING INTERN	MECHANICA	20403	0	Engineering,	F	52000	52000
269885	DEPT OF ENVI	External	1	MECHANICAL ENGINEERING INTERN	MECHANICA	20403	0	Engineering,	F	52000	52000
269885	DEPT OF ENVI	Internal	1	MECHANICAL ENGINEERING INTERN	MECHANICA	20403	0	Engineering,	F	52000	52000
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287202	DEPT OF ENVI	External	4	MECHANICAL ENGINEERING INTERN	MECHANICA	20403	0	Engineering,	F	52000	52000
287202	DEPT OF ENVI	Internal	4	MECHANICAL ENGINEERING INTERN	MECHANICA	20403	0	Engineering,	F	52000	52000

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

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

Design Challenge

Job ID	Agency	Posting T	# O	Business Title	Civil Service	Title Cod	Level	Job Category	Full-	Salary Range	Salary Range
246814	DEPT OF INFO	External	1	Senior Architect Cloud Infrastructure D	SENIOR IT AF	6800	0	Information	F	100000	130000
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247320	DEPT OF ENVI	Internal	2	MECHANICAL ENGINEERING INTERN	MECHANICA	20403	0	Engineering,	F	52000	52000
247320	DEPT OF ENVI	External	2	MECHANICAL ENGINEERING INTERN	MECHANICA	20403	0	Engineering,	F	52000	52000
269885	DEPT OF ENVI	External	1	MECHANICAL ENGINEERING INTERN	MECHANICA	20403	0	Engineering,	F	52000	52000
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285120	NYC HOUSING	External	1	Deputy Director for Engineering	ADMINISTRA	10015	M3	Engineering,	P	115000	130000
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287202	DEPT OF ENVI	External	4	MECHANICAL ENGINEERING INTERN	MECHANICA	20403	0	Engineering,	F	52000	52000
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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	# O	Business Title	Civil Service	Title Cod	Level	Job Category	Full-	Salary Range	Salary Range
246814	DEPT OF INFO	External	1	Senior Architect Cloud Infrastructure D	SENIOR IT AF	6800	0	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.

Design Challenge

Job ID	Agency	Posting T	# O	Business Title	Civil Service	Title Cod	Level	Job Category	Full-	Salary Range	Salary Range
246814	DEPT OF INFO	External	1	Senior Architect Cloud Infrastructure D	SENIOR IT AF	6800	0	Information	F	100000	130000
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247320	DEPT OF ENVI	Internal	2	MECHANICAL ENGINEERING INTERN	MECHANICA	20403	0	Engineering,	F	52000	52000
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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.

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- Log in to Gradescope to take Quiz 8