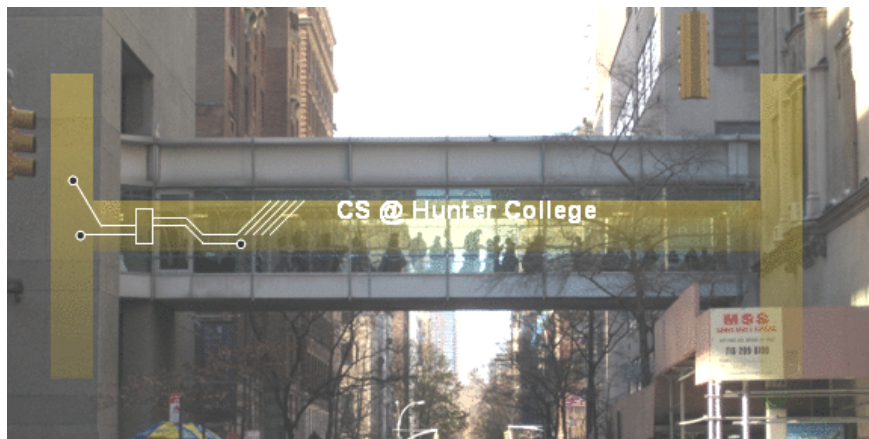


# CSci 127: Introduction to Computer Science



[hunter.cuny.edu/csci](http://hunter.cuny.edu/csci)

# Frequently Asked Questions

From lecture slips & recitation sections.

- I have two finals scheduled at the same time. What do I do?  
*The registrar scheduled multiple classes for the same time slot. We are working with the dean's office to get this resolved.*
- I'm worried about the final since I've never taken a programming exam before. Help!  
*We understand. Like we did last week, we'll be working through questions from the previous final exams.*
- I still don't get indices and the brackets. Could you spend more time on that?  
*Yes, we will, since 1) it's fundamental, and 2) the same ideas are used for accessing formatted data (today's topic).*
- Could you spend more time on circuits/logical expressions/truth tables/decisions?  
*We will do a bit today, but much more in the following weeks.*
- Is it okay to work ahead?  
*Yes! It's great to try things before lecture/lab (builds a "mental scaffold" to hold new material covered). All the labs are up for the rest of the semester, and programs open on gradescope 4 weeks before the deadline.*

# Today's Topics



- Recap: Logical Expressions & Circuits
- Design: Cropping Images
- Accessing Formatted Data
- CS Survey: Computational Biology

# Recap: Logical Operators

## and

in1		in2	returns:
False	and	False	False
False	and	True	False
True	and	False	False
True	and	True	True

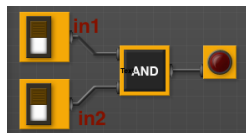
## or

in1		in2	returns:
False	or	False	False
False	or	True	True
True	or	False	True
True	or	True	True

## not

	in1	returns:
not	False	True
not	True	False

# Logical Operators & Circuits

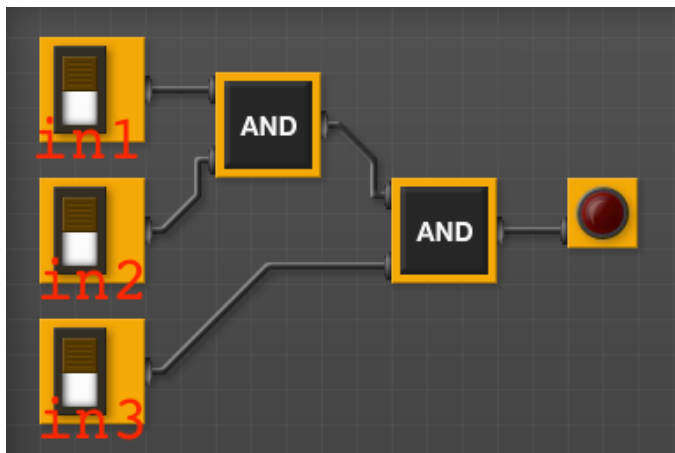


- Each logical operator (and, or, & not) can be used to join together expressions.

Example: in1 and in2

- Each logical operator (and, or, & not) has a corresponding logical circuit that can be used to join together inputs.

# Examples: Logical Circuit



`(in1 and in2) and in3`

# Examples: Logical Expressions

*Examples from last lecture:*

```
origin = "Indian Ocean"
winds = 100
if (winds > 74):
    print("Major storm, called a ", end="")
    if origin == "Indian Ocean" or origin == "South Pacific":
        print("cyclone.")
    elif origin == "North Pacific":
        print("typhoon.")
    else:
        print("hurricane.")

visibility = 0.2
winds = 40
conditions = "blowing snow"
if (winds > 35) and (visibility < 0.25) and \
    (conditions == "blowing snow" or conditions == "heavy snow"):
    print("Blizzard!")
```

## In Pairs or Triples:

*Predict what the code will do:*

```
x = 6
y = x % 4
w = y**3
z = w // 2
print(x,y,w,z)
x,y = y,w
print(x,y,w,z)
x = y / 2
print(x,y,w,z)
```

```
sports = ["Field Hockey", "Swimming", "Water Polo"]
mess = "Qoauxca BrletRce crcx qvBnqa ocUxk"
result = ""
for i in range(len(mess)):
    if i % 3 == 0:
        print(mess[i])
        result = result + mess[i]
print(sports[1], result)
```



# Python Tutor

```
x = 6
y = x % 4
w = y**3
z = w // 2
print(x,y,w,z)
x,y = y,w
print(x,y,w,z)
x = y / 2
print(x,y,w,z)
```

(Demo with pythonTutor)

# In Pairs or Triples: Design Question

From Final Exam, Fall 2017, V4, #6.



Design an algorithm that reads in an image and displays the lower left corner of the image.

**Input:**

**Output:**

**Process:** (*Brainstorm for a "To Do" list to accomplish this.*)

# Design Question

Design a program that asks the user for an image and then display the upper left quarter of the image. (First, design the pseudocode, and if time, expand to a Python program.)

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 Import libraries.
  - 2 Ask user for an image name.
  - 3 Read in image.
  - 4 Figure out size of image.
  - 5 Make a new image that’s half the height and half the width.
  - 6 Display the new image.

# In Pairs or Triples: Design Question



- 1 Import libraries.

```
import matplotlib.pyplot as plt
import numpy as np
```

- 2 Ask user for an image name.

```
inF = input('Enter file name: ')
```

- 3 Read in image.

```
img = plt.imread(inF) #Read in image from inF
```

- 4 Figure out size of image.

```
height = img.shape[0] #Get height
width = img.shape[1] #Get width
```

- 5 Make a new image that's half the height and half the width.  
`img2 = img[height//2:, :width//2]` #Crop to lower left corner

- 6 Display the new image.

```
plt.imshow(img2) #Load our new image into pyplot
plt.show() #Show the image (waits until closed to continue)
```



# Structured Data

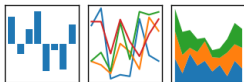
Undergraduate			
College	Full-time	Part-time	Total
Baruch	11,288	3,922	15,210
Brooklyn	10,198	4,208	14,406
City	10,067	3,250	13,317
Hunter	12,223	4,500	16,723
John Jay	9,831	2,843	12,674
Lehman	6,600	4,720	11,320
Medgar Evers	4,760	2,059	6,819
NYCCT	10,912	6,370	17,282
Queens	11,693	4,633	16,326
Staten Island	9,584	2,948	12,532
York	5,066	3,192	8,258

- Common to have data structured in a spread sheet.
- In the example above, we have the first line that says “Undergraduate”.
- Next line has the titles for the columns.
- Subsequent lines have a college and attributes about the college.
- Python has several ways to read in such data.
- We will use the popular Python Data Analysis Library (**Pandas**).

# Structured Data

pandas

$$y_{it} = \beta' x_{it} + \mu_i + \epsilon_{it}$$



- We will use the popular Python Data Analysis Library (**Pandas**).
- Open source and freely available (part of anaconda distribution).
- Already loaded on the machines in 1001E North.
- See end of Lab 6 for directions on downloading it to your home machine.
- To use, add to the top of your file:

```
import pandas as pd
```

# CSV Files

Undergraduate			
College	Full-time	Part-time	Total
Baruch	11,288	3,922	15,210
Brooklyn	10,198	4,208	14,406
City	10,067	3,250	13,317
Hunter	12,223	4,500	16,723
John Jay	9,831	2,843	12,674
Lehman	6,600	4,720	11,320
Medgar Evers	4,760	2,059	6,819
NYCCT	10,912	6,370	17,282
Queens	11,693	4,633	16,326
Staten Island	9,584	2,948	12,532
York	5,066	3,192	8,258

- Excel .xls files have much extra formatting.
- The text file version is called **CSV** for comma separated values.
- Each row is a line in the file.
- Columns are separated by commas on each line.

# CSV Files

Source: [https://en.wikipedia.org/wiki/Demographics\\_of\\_New\\_York\\_City](https://en.wikipedia.org/wiki/Demographics_of_New_York_City),,,,,,  
All population figures are consistent with present-day boundaries.,,,,,,  
First census after the consolidation of the five boroughs.,,,,,,

,,,,,

,,,,,

Year,Manhattan,Brooklyn,Queens,Bronx,Staten Island,Total

```
1698,4937,2017,,,727,7681
1771,21863,3623,,,2847,28423
1790,33131,4549,6159,1781,3827,49447
1800,60515,5740,6642,1755,4563,79215
1810,96373,8303,7444,2267,5347,119734
1820,123706,11187,8246,2782,6135,152056
1830,202589,20535,9049,3023,7082,242278
1840,312710,47613,14480,5346,10965,391114
1850,515547,138882,18593,8032,15061,696115
1860,813669,279122,32903,23593,25492,1174779
1870,942292,419921,45468,37393,33029,1478103
1880,1164673,599495,56559,51980,38991,1911698
1890,1441216,838547,87050,88908,51693,2507414
1900,1850093,1166582,152999,200507,67021,3437202
1910,2331542,1634351,284041,430980,85969,4766883
1920,2284103,2018356,469042,732016,116531,5620048
1930,1867312,2560401,1079129,1265258,158346,6930446
1940,1889924,2698285,1297634,1394711,174441,7454995
1950,1960101,2738175,1550849,1451277,191555,7891957
1960,1698281,2627319,1809578,1424815,221991,7781984
1970,1539233,2602012,1986473,1471701,295443,7894862
1980,1428285,2230936,1891325,1168972,352121,7071639
1990,1487536,2300664,1951598,1203789,378977,7322564
2000,1537195,2465326,2229379,1332650,443728,8008278
2010,1585873,2504700,2230722,1385108,468730,8175133
2015,1644518,2636735,2339150,1455444,474558,8550405
```

nycHistPop.csv



# Reading in CSV Files

Undergraduate			
College	Full-time	Part-time	Total
Baruch	11,288	3,922	15,210
Brooklyn	10,198	4,208	14,406
City	10,067	3,250	13,317
Hunter	12,223	4,500	16,723
John Jay	9,831	2,843	12,674
Lehman	6,600	4,720	11,320
Medgar Evers	4,760	2,059	6,819
NYCCT	10,912	6,370	17,282
Queens	11,693	4,633	16,326
Staten Island	9,584	2,948	12,532
York	5,066	3,192	8,258

- To read in a CSV file: `myVar = pd.read_csv("myFile.csv")`
- Pandas has its own type, **DataFrame**, that is perfect for holding a sheet of data.
- Often abbreviated: `df`.
- It also has **Series**, that is perfect for holding a row or column of data.

# Example: Reading in CSV Files

```
import matplotlib.pyplot as plt
import pandas as pd
```

```
pop = pd.read_csv('nycHistPop.csv', skiprows=5)
```

```
Source: https://en.wikipedia.org/wiki/Demographics\_of\_New\_York\_City,.....
All population figures are consistent with present-day boundaries.....
First census after the consolidation of the five boroughs.....
```

```
Year,Manhattan,Brooklyn,Queens,Bronx,Staten Island>Total
1698,4937,2017,,127,7881
1773,21883,3623,,2847,28423
1790,35131,4548,6159,1181,3827,49447
1800,40515,5740,6642,1755,4543,79215
1810,46373,6303,7444,2267,5347,119734
1820,123706,11187,8246,2782,6135,152056
1830,202589,20535,8048,3023,7082,242278
1840,312710,47613,34480,5344,10965,391114
1850,515547,138882,18593,8032,15061,696115
1860,813649,279122,32903,23593,25492,1174779
1870,942282,419801,45468,37393,33029,1478183
1880,1164673,599495,56559,51980,38991,1911698
1890,1441216,838547,87050,88908,51693,2507414
1900,1650093,1166582,152899,200507,67021,3437202
1910,2331542,1634351,284041,430989,85969,4766883
1920,2284183,2018356,448942,732018,116531,5420048
1930,1867312,2580451,1079129,1265258,150346,6505446
1940,1889924,2698285,1297634,1394711,174441,7454395
1950,1960101,2738275,1550849,1452177,191555,7893257
1960,1698281,2627319,1809578,1424815,221991,7781984
1970,1539233,2402012,1986473,1471701,295443,7094862
1980,1428285,2230936,1891325,1168972,352121,7071439
1990,1487536,2300644,1951598,1203789,378977,7322564
2000,1531795,2465326,2229379,1332450,443728,8008278
2010,1648473,2504760,2230722,1385108,448730,8175133
2015,1644518,2636738,2339150,1455444,474558,8550405
```

nycHistPop.csv

In Lab 6

# Example: Reading in CSV Files

```
import matplotlib.pyplot as plt
import pandas as pd
```

```
pop = pd.read_csv('nycHistPop.csv', skiprows=5)
```

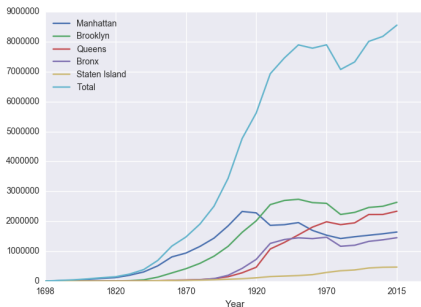
```
Source: https://en.wikipedia.org/wiki/Demographics\_of\_New\_York\_City,.....
All population figures are consistent with present-day boundaries.....
First census after the consolidation of the five boroughs.....
```

```
Year,Manhattan,Brooklyn,Queens,Bronx,Staten Island,Total
1698,4937,2017,,727,7881
1773,21883,3623,,2847,28423
1790,35131,4548,6159,1181,3827,49447
1800,40515,5740,6442,1755,4543,79215
1810,46373,6303,7444,2267,5347,119734
1820,123706,11187,8246,2782,6135,152056
1830,202589,20535,8048,3023,7082,242278
1840,312710,47613,14480,5344,10965,393114
1850,515547,138882,18593,8032,15561,696115
1860,813649,279122,32903,23593,25492,1174779
1870,942282,419901,45468,37393,33529,1478183
1880,1164673,599495,56559,51980,38991,1911698
1890,1441216,838547,87050,88908,51493,2507414
1900,1650093,1146582,152899,20507,67021,2437202
1910,2331542,1634351,284041,430989,85949,4766883
1920,2284193,2018356,449042,732018,116531,5420348
1930,1867312,2560451,1079129,1265258,159346,6950446
1940,1889924,2698285,1297634,1394711,174441,7454995
1950,1960101,2738275,1550849,1452277,191559,7893297
1960,1698281,2627319,1809578,1424815,221991,7781986
1970,1539233,2402012,1996473,1471701,295443,7094862
1980,1428285,2230936,1891325,1148972,352121,7077439
1990,1487536,2300644,1951598,1203789,378977,7322564
2000,1537195,2465326,2229379,1332450,443728,8008278
2010,1648473,2504760,2230722,1385108,448730,8175133
2015,1644518,2636733,2339155,1455444,474558,8550405
```

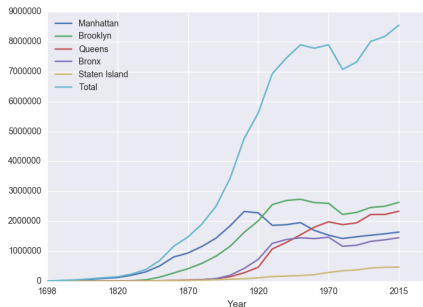
nycHistPop.csv

In Lab 6

```
pop.plot(x="Year")
plt.show()
```



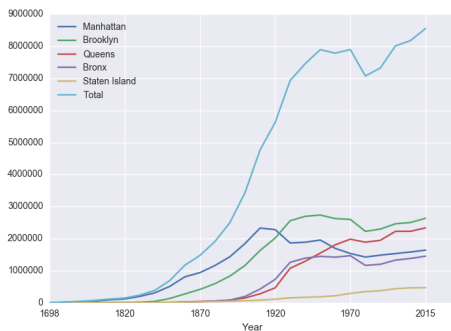
# Series in Pandas



- Series can store a column or row of a DataFrame.
- Example: `pop["Manhattan"]` is the Series corresponding to the column of Manhattan data.
- Example:  

```
print("The largest number living in the Bronx is",  
pop["Bronx"].max())
```

# In Pairs or Triples



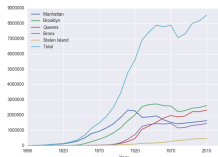
Predict what the following will do:

- `print("Queens:", pop["Queens"].min())`
- `print("S I:", pop["Staten Island"].mean())`
- `print("S I:", pop["Staten Island"].std())`
- `pop.plot.bar(x="Year")`
- `pop.plot.scatter(x="Brooklyn", y= "Total")`
- `pop["Fraction"] = pop["Bronx"]/pop["Total"]`

# Solutions

Predict what the following will do:

- `print("Queens:", pop["Queens"].min())`  
*Minimum value in the column with label "Queens".*
- `print("S I:", pop["Staten Island"].mean())`  
*Average of values in the column "Staten Island".*
- `print("S I :", pop["Staten Island"].std())`  
*Standard deviation of values in the column "Staten Island".*
- `pop.plot.bar(x="Year")`  
*Bar chart with x-axis "Year".*
- `pop.plot.scatter(x="Brooklyn", y="Total")`  
*Scatter plot of Brooklyn versus Total values.*
- `pop["Fraction"] = pop["Bronx"]/pop["Total"]`  
*New column with the fraction of population that lives in the Bronx.*



# In Pairs or Triples

Write a complete Python program that reads in the file, `cunyF2016.csv`, and produces a scatter plot of full-time versus part-time enrollment.

Undergraduate			
College	Full-time	Part-time	Total
Baruch	11,288	3,922	15,210
Brooklyn	10,198	4,208	14,406
City	10,087	3,250	13,317
Hunter	12,223	4,500	16,723
John Jay	9,831	2,843	12,674
Lehman	6,800	4,720	11,320
Medgar Evers	4,780	2,059	6,819
NYCCT	10,912	6,370	17,282
Queens	11,693	4,633	16,326
Staten Island	9,584	2,948	12,532
York	5,066	3,192	8,258

`cunyF2016.csv`

# In Pairs or Triples

Undergraduate			
College	Full-time	Part-time	Total
Baruch	11,288	3,922	15,210
Brooklyn	10,198	4,208	14,406
City	10,087	3,250	13,317
Hunter	12,223	4,500	16,723
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Queens	11,693	4,633	16,326
Staten Island	9,584	2,948	12,532
York	5,066	3,192	8,258

cunyF2016.csv

Write a complete Python program that reads in the file, `cunyF2016.csv`, and produces a scatter plot of full-time versus part-time enrollment.

*Solution:*

- 1 *Include pandas & pyplot libraries.*
- 2 *Read in the CSV file.*
- 3 *Set up a scatter plot.*
- 4 *Display plot.*



# In Pairs or Triples

Write a complete Python program that reads in the file, `cunyF2016.csv`, and produces a scatter plot of full-time versus part-time enrollment.

College	Undergraduates		
	Full-time	Part-time	Total
Baruch	11,288	3,922	15,210
Brooklyn	10,198	4,208	14,406
City	10,087	3,250	13,317
Hunter	12,223	4,500	16,723
John Jay	9,831	2,843	12,674
Lehman	6,800	4,720	11,320
Medgar Evers	4,760	2,059	6,819
NYCCT	10,912	6,370	17,282
Queens	11,693	4,633	16,326
Staten Island	9,584	2,948	12,532
York	5,066	3,192	8,258

`cunyF2016.csv`

*Solution:*

- 1 *Include pandas & pyplot libraries.*  
`import matplotlib.pyplot as plt`  
`import pandas as pd`
- 2 *Read in the CSV file.*  
`pop=pd.read_csv('cunyF2016.csv',skiprows=1)`
- 3 *Set up a scatter plot.*  
`pop.plot(x="Full-time",y="Part-time")`
- 4 *Display plot.*  
`plt.show()`

# Recap

- On lecture slip, write down a topic you wish we had spent more time (and why).
- Recap: Logical Expressions & Circuits
- Accessing Formatted Data:
  - ▶ Pandas library has elegant solutions for accessing & analyzing structured data.
  - ▶ Can manipulate individual columns or rows ('Series').
  - ▶ Has useful functions for the entire sheet ('DataFrame') such as plotting.

