CSci 127: Introduction to Computer Science
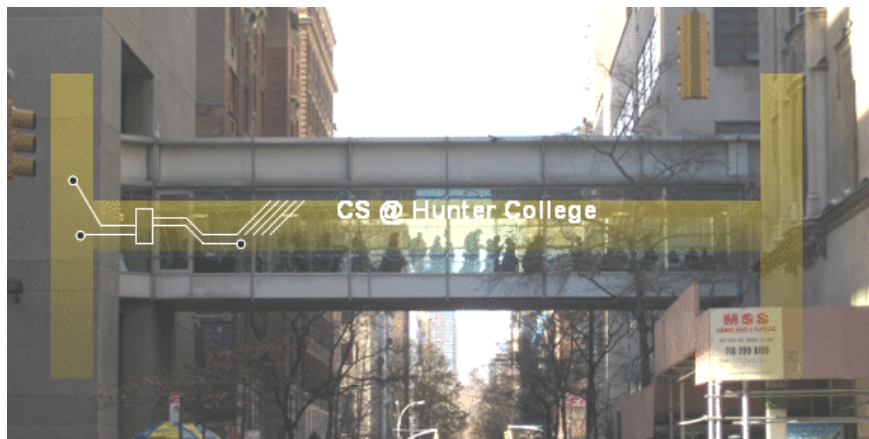
Frequently Asked Questions

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  Yes, we will, since
  1) it's fundamental, and
  2) the same ideas are used for accessing formatted data (today's topic).

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  Yes, we will, since
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  Yes, we will, since
  1) it's fundamental, and
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- **I still don't get what is meant by input?**
  Input is data provided to a program each time it runs, it may change at each run. In this course we wrote programs that get input from the user via the input() function or by reading a file.

Today's Topics

- Recap: Logical Expressions & Circuits
- Design: Cropping Images
- Accessing Formatted Data

Today's Topics

- **Recap: Logical Expressions & Circuits**
- Design: Cropping Images
- Accessing Formatted Data

Recap: Logical Operators

and

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

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

Recap: Logical Operators

and

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

not

	in1	returns:
not	False	True
not	True	False

or

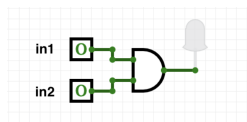| in1		in2	returns:
False	or	False	False
False	or	True	True
True	or	False	True
True	or	True	True

Logical Operators & Circuits

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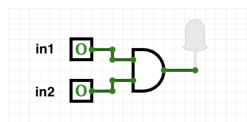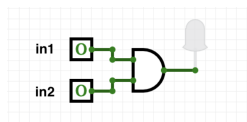
Logical Operators & Circuits

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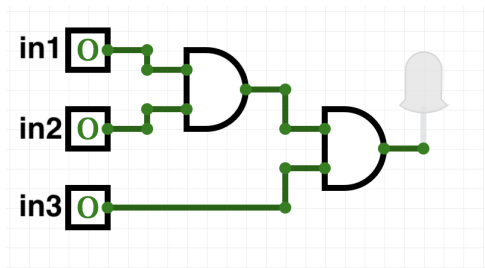 Example: in1 and in2

Logical Operators & Circuits

- Each logical operator (and, or, & not) can be used to join together expressions.
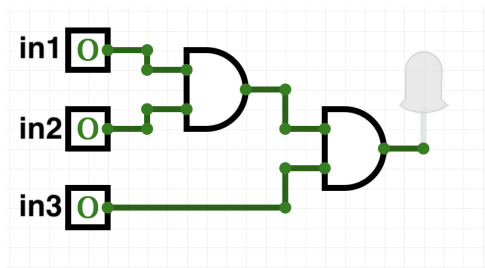
  Example: in1 and in2

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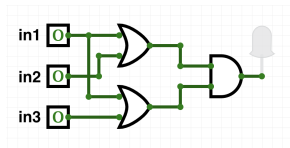
Examples: Logical Circuit

Examples: Logical Circuit

(in1 and in2) and in3

More Circuit Examples

Examples from last lecture:
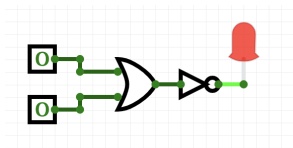
Draw a circuit that corresponds to each logical expression:

- not(in1 or in2)
- (in1 or in2) and (in1 or in3)
- (not(in1 and not in2)) or (in1 and (in2 and in3))

Challenge:

Predict what the code will do:

```python
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)
```

```python
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

```
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(Demo with pythonTutor)

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- Recap: Logical Expressions & Circuits
- **Design: Cropping Images**
- Accessing Formatted Data
- CS Survey: Astrophysics and astropy

Challenge: Design Question

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

Challenge: 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

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- Example:
  1. Import libraries.
  2. Ask user for an image name.
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  5. Make a new image that's half the height and half the width.

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  6. Display the new image.

In Pairs or Triples: Design Question

The City University of New York

1. Import libraries.

In Pairs or Triples: Design Question

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   ```
   import matplotlib.pyplot as plt
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   img2 = img[height//2:, :width//2] #Crop to lower left corner
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   img2 = img[height//2:, :width//2] #Crop to lower left corner
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6. Display the new image.

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

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- **Accessing Formatted Data**
- CS Survey: Astrophysics and astropy

Structured Data

College	Undergraduate		
	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
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- Subsequent lines have a college and attributes about the college.

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- In the example above, we have the first line that says "Undergraduate".
- Next line has the titles for the columns.
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- Python has several ways to read in such data.

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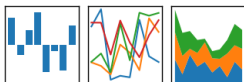- Python has several ways to read in such data.
- We will use the popular Python Data Analysis Library (**Pandas**).

Structured Data

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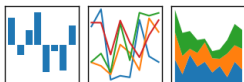
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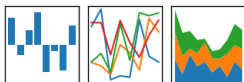

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Structured Data

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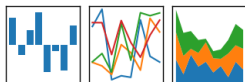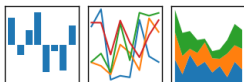$$y_{it} = \beta' x_{it} + \mu_i + \epsilon_{it}$$

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  https://repl.it/
- To use, add to the top of your program:

  ```
  import pandas as pd
  ```

CSV Files

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- Excel .xls files have much extra formatting.

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- Columns are separated by commas on each line.

CSV Files

```
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,,,727,7681
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

College	Undergraduate		
	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")`

Reading in CSV Files

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- Pandas has its own type, **DataFrame**, that is perfect for holding a sheet of data.

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

Example: Reading in CSV Files

```
Source: https://en.wikipedia.org/wiki/Demographics_of_New_York_City,,,,,,
All population figures are consistent with present-day boundaries.,,,,,,
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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
1820,123704,11187,8246,2782,6135,152056
1830,202589,20535,9049,3023,7082,242278
1840,312710,47613,14480,5346,10965,391114
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2010,1585873,2504700,2230722,1385108,468730,8175133
2015,1644518,2636735,2339150,1455444,474558,8550405
```

nycHistPop.csv

In Lab 6

Example: Reading in CSV Files

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

```
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,,,,,
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Year,Manhattan,Brooklyn,Queens,Bronx,Staten Island,Total
1698,4937,2017,,,727,7681
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1830,202589,20535,9049,3023,7082,242278
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1910,2331542,1634351,284041,430980,85969,4766883
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1940,1889924,2698285,1297634,1394711,174441,7454995
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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

In Lab 6

Example: Reading in CSV Files

```python
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,,727,7681
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1810,96373,8303,7444,2267,5347,119734
1820,123706,11187,8246,2782,6135,152056
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2015,1644518,2636735,2339150,1455444,474558,8550405
```

nycHistPop.csv

In Lab 6

Example: Reading in CSV Files

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

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


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

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,,,727,7681
1771,21863,3623,,,2847,28423
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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
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1910,2331542,1634351,284041,430980,85969,4766883
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1990,1487536,2300664,1951598,1203789,378977,7322564
2000,1537195,2465526,2229379,1332650,443728,8008278
2010,1585873,2504700,2230722,1385108,468730,8175133
2015,1644518,2636735,2339150,1455444,474558,8550405

nycHistPop.csv

In Lab 6

Example: Reading in CSV Files
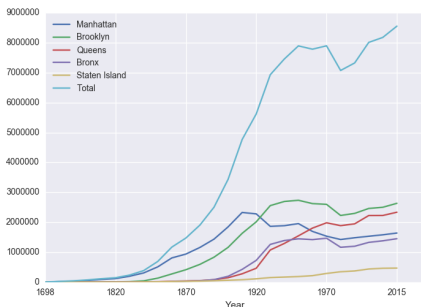
```python
import matplotlib.pyplot as plt
import pandas as pd

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

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

Source: https://en.wikipedia.org/wiki/Demographics_of_New_York_City,,,,,,
All population figures are consistent with present-day boundaries.,,,,,,
,,,,,,
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
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1900,1850093,1166582,152999,200507,67021,3437202
1910,2331542,1634351,284041,430980,85969,4766883
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nycHistPop.csv

In Lab 6

Series in Pandas
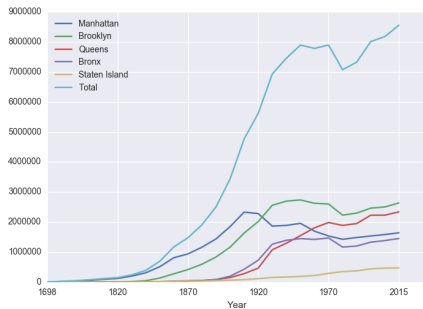
- Series can store a column or row of a DataFrame.

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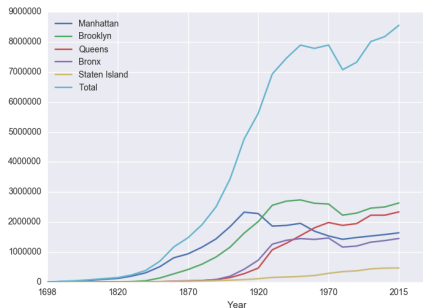
- Series can store a column or row of a DataFrame.
- Example: `pop["Manhattan"]` is the Series corresponding to the column of Manhattan data.
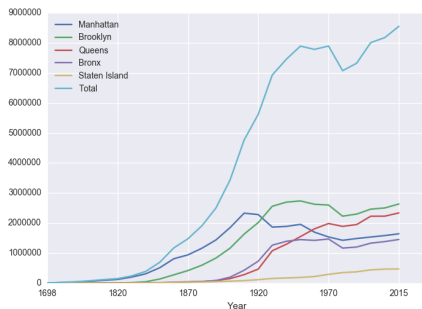
Series in Pandas

- 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())
  ```

Challenge:
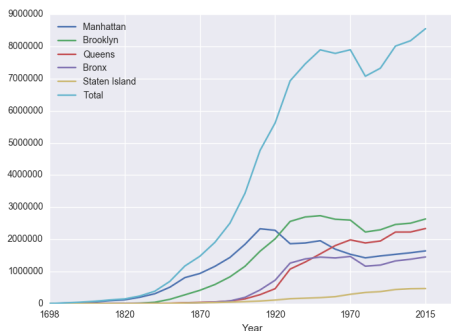
Predict what the following will do:

- `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())
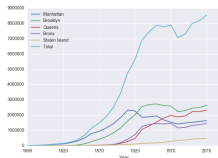
Solutions

Predict what the following will do:
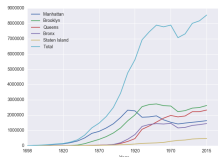
- print("Queens:", pop["Queens"].min())
  Minimum value in the column with label "Queens".

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())

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".

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())
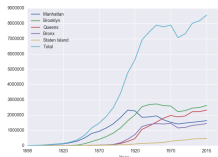 *Average of values in the column "Staten Island".*

- print("S I :", pop["Staten Island"].std())

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".

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")`

Solutions

Predict what the following will do:
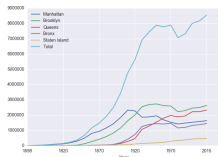
- `print("Queens:", pop["Queens"].min())`
  Minimum value in the column with label "Queens".

- `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".

Solutions

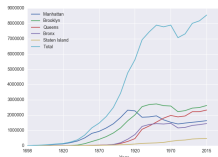Predict what the following will do:

- `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")`

Solutions

Predict what the following will do:

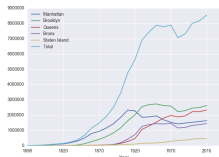- `print("Queens:", pop["Queens"].min())`
  Minimum value in the column "Queens".

- `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.

Solutions

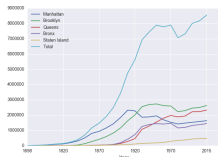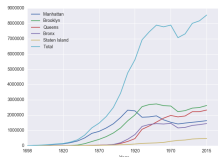Predict what the following will do:

- `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"]`

Solutions

Predict what the following will do:
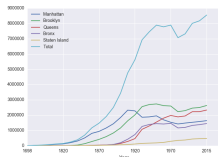
- print("Queens:", pop["Queens"].min())
  Minimum value in the column "Queens".

- 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.

Challenge:

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	10,067	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

cunyF2016.csv

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Challenge:

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.*

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Solution:

1. *Include pandas & pyplot libraries.*

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cunyF2016.csv

Solution:

1. *Include pandas & pyplot libraries.*

2. *Read in the CSV file.*

3. *Set up a scatter plot.*

4. *Display plot.*

Challenge:

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   ```

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2. *Read in the CSV file.*
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   ```

3. *Set up a scatter plot.*
   ```
   pop.plot.scatter(x="Full-time",y="Part-time")
   ```

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4. *Display plot.*

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   ```
3. *Set up a scatter plot.*
   ```
   pop.plot.scatter(x="Full-time",y="Part-time")
   ```
4. *Display plot.*
   ```
   plt.show()
   ```

groupby()

Sometimes you have **recurring values in a column** and you want to examine the data for a particular value.

Date	Location	MinTemp	MaxTemp	Rainfall
12/1/08	Albury	13.4	22.9	0.6
5/22/15	BadgerysCree	11	15.6	1.6
3/17/11	BadgerysCree	18.1	25.8	16.6
7/27/10	Cobar	5.3	17.2	0
9/5/10	Moree	12.1	19.8	23.4
1/23/12	CoffsHarbour	20	24.4	28
7/15/11	Moree	2.8	19	0
1/28/10	Newcastle	22.2	28	0
12/2/15	Moree	20.1	32	4.8
	...			

Rain in Australia

`AustraliaRain.csv`

groupby()

Sometimes you have **recurring values in a column** and you want to examine the data for a particular value.

For example, to **find the average rainfall at each location***:*

Rain in Australia				
Date	Location	MinTemp	MaxTemp	Rainfall
12/1/08	Albury	13.4	22.9	0.6
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7/15/11	Moree	2.8	19	0
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1. *Import libraries.*
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*For example, to **find the average rainfall at each location**:*

1. *Import libraries.*
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2. *Read in the CSV file.*
   rain =
   pd.read_csv('AustraliaRain.csv',skiprows=1)

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AustraliaRain.csv

1. *Import libraries.*
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2. *Read in the CSV file.*
   rain =
   pd.read_csv('AustraliaRain.csv',skiprows=1)

3. *Group the data by location.*
   groupAvg = rain.**groupby('Location')**

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4. *Print the average rainfall at each location.*
   print(groupAvg['Rainfall'].mean())

groupby()

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	...			

AustraliaRain.csv

Adelaide	1.572185
Albany	2.255073
Albury	1.925710
AliceSprings	0.869355
BadgerysCreek	2.207925
Ballarat	1.688830
Bendigo	1.621452
Brisbane	3.160536
Cairns	5.765317
Canberra	1.735038
Cobar	1.129262
CoffsHarbour	5.054592
Dartmoor	2.148554

Sometimes you have **recurring values in a column** and you want to examine the data for a particular value.

For example, to **find the average rainfall at each location***:*

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Sometimes you have **recurring values in a column** and you want to examine the data for a particular value.

For example, to **find the average rainfall at one location, e.g. Albury***:*

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7/27/10	Cobar	5.3	17.2	0
9/5/10	Moree	12.1	19.8	23.4
1/23/12	CoffsHarbour	20	24.4	26
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`AustraliaRain.csv`

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   ```
   rain =
   pd.read_csv('AustraliaRain.csv',skiprows=1)
   ```

3. **Group the data by location get data for group Albury.**
   ```
   AlburyAvg =
   rain.groupby('Location').get_group('Albury')
   ```

groupby()

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   AlburyAvg =
   rain.groupby('Location').get_group('Albury')
   ```

4. *Print the average rainfall in Albury.*
   ```
   print(AlburyAvg['Rainfall'].mean())
   ```

groupby()

Sometimes you have **recurring values in a column** and you want to examine the data for a particular value.

For example, to **find the average rainfall at one location, e.g. Albury**:

1. *Import libraries.*
   `import pandas as pd`

2. *Read in the CSV file.*
   `rain =`
   `pd.read_csv('AustraliaRain.csv',skiprows=1)`

3. **Group the data by location get data for group Albury.**
   `AlburyAvg =`
   `rain.groupby('Location').get_group('Albury')`

4. *Print the average rainfall in Albury.*
   `print(AlburyAvg['Rainfall'].mean())`

AustraliaRain.csv

1.9257104647275156

Design Challenge

Stars						
Temperature (K)	Luminosity(L/Lo)	Radius(R/Ro)	Absolute magnitude(Mv)	Star type	Star color	Spectral Class
3068	0.0024	0.17	16.12	Brown Dwarf	Red	M
25000	0.056	0.0084	10.58	White Dwarf	Blue White	B
2650	0.00069	0.11	17.45	Brown Dwarf	Red	M
11790	0.00015	0.011	12.59	White Dwarf	Yellowish White	F
15276	1136	7.2	-1.97	Main Sequence	Blue-white	B
5800	0.81	0.9	5.05	Main Sequence	yellow-white	F
16500	0.013	0.014	11.89	White Dwarf	Blue White	B
3192	0.00362	0.1967	13.53	Red Dwarf	Red	M
6380	1.35	0.98	2.93	Main Sequence	yellow-white	F
3834	272000	1183	-9.2	Hypergiant	Red	M

- Design an algorithm that:
  - Prints the luminosity of the brightest star.
  - Prints the temperature of the coldest star.
  - Prints the average radius of a Hypergiant.

Design Challenge - Solution

Stars						
Temperature (K)	Luminosity(L/Lo)	Radius(R/Ro)	Absolute magnitude(Mv)	Star type	Star color	Spectral Class
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- **Libraries:** pandas

Design Challenge - Solution

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Temperature (K)	Luminosity(L/Lo)	Radius(R/Ro)	Absolute magnitude(Mv)	Star type	Star color	Spectral Class
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- **Libraries:** pandas
- **Process:**
  - Print **max** of **'Luminosity'** column

Design Challenge - Solution

Temperature (K)	Luminosity(L/Lo)	Radius(R/Ro)	Absolute magnitude(Mv)	Star type	Star color	Spectral Class
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- **Libraries:** pandas
- **Process:**
  - Print **max** of **'Luminosity'** column
  - Print **min** of **'Temperature'** column

Design Challenge - Solution

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Temperature (K)	Luminosity(L/Lo)	Radius(R/Ro)	Absolute magnitude(Mv)	Star type	Star color	Spectral Class
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- **Libraries:** pandas
- **Process:**
  - Print **max** of **'Luminosity'** column
  - Print **min** of **'Temperature'** column
  - **groupby 'Star Type'** and take **averages**, then print **max of 'Radius'** column

Design Challenge - Solution

Stars						
Temperature (K)	Luminosity(L/Lo)	Radius(R/Ro)	Absolute magnitude(Mv)	Star type	Star color	Spectral Class
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- **Libraries:** pandas
- **Process:**
  - ► Print **max** of **'Luminosity'** column
  - ► Print **min** of **'Temperature'** column
  - ► **groupby 'Star Type'** and take **averages**, then print **max of 'Radius'** column
  - ► OR **groupby 'Star Type'** and **get group 'Hypergiant'** to print **average 'Radius'**

Design Challenge - Code

- **Libraries:** pandas
  ```
  import pandas as pd
  stars = pd.read_csv('Stars.csv')
  ```

Design Challenge - Code

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  ```
  import pandas as pd
  stars = pd.read_csv('Stars.csv')
  ```
- **Process:**
  - Print **max** of **'Luminosity'** column
    ```
    print(stars['Luminosity(L/Lo)'].max())
    ```

Design Challenge - Code

- **Libraries:** pandas
  ```
  import pandas as pd
  stars = pd.read_csv('Stars.csv')
  ```
- **Process:**
  - Print **max** of **'Luminosity'** column
    ```
    print(stars['Luminosity(L/Lo)'].max())
    ```
  - Prints **min** of **'Temperature'** column and store it in temp variable
    ```
    print( stars['Temperature (K)'].min())
    ```

Design Challenge - Code

- **Libraries:** pandas
  ```
  import pandas as pd
  stars = pd.read_csv('Stars.csv')
  ```
- **Process:**
  - ▶ Print **max** of **'Luminosity'** column
    ```
    print(stars['Luminosity(L/Lo)'].max())
    ```
  - ▶ Prints **min** of **'Temperature'** column and store it in temp variable
    ```
    print( stars['Temperature (K)'].min())
    ```
  - ▶ **groupby 'Star Type'** and take **averages**, then print **max of 'Radius'** column
    ```
    print(stars.groupby('Star type')\
    .mean()['Radius(R/Ro)'].max())
    ```

Design Challenge - Code

- **Libraries:** pandas
  ```
  import pandas as pd
  stars = pd.read_csv('Stars.csv')
  ```
- **Process:**
  - ▶ Print **max** of **'Luminosity'** column
    ```
    print(stars['Luminosity(L/Lo)'].max())
    ```
  - ▶ Prints **min** of **'Temperature'** column and store it in temp variable
    ```
    print( stars['Temperature (K)'].min())
    ```
  - ▶ OR **groupby 'Star Type'** and **get group 'Hypergiant'** to print **average 'Radius'**
    ```
    print(stars.groupby('Star type')\
    .get_group('Hypergiant').mean()['Radius(R/Ro)'])
    ```

Recap

- Recap: Logical Expressions & Circuits

pandas

Recap

- Recap: Logical Expressions & Circuits

- Accessing Formatted Data:

  - Pandas library has elegant solutions for accessing & analyzing structured data.

pandas

Recap

pandas

- Recap: Logical Expressions & Circuits

- Accessing Formatted Data:

  - ▶ Pandas library has elegant solutions for accessing & analyzing structured data.
  - ▶ Can manipulate individual columns or rows ('Series').

Recap

- Recap: Logical Expressions & Circuits

- Accessing Formatted Data:

  pandas

  - ▶ 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.

Practice Quiz & Final Questions
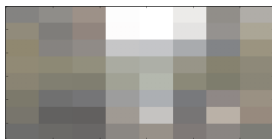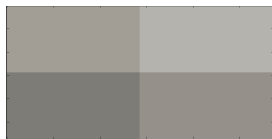
- Since you must pass the final exam to pass the course, we end every lecture with final exam review.
- Pull out something to write on (not to be turned in).
- Lightning rounds:
  - ▶ write as much you can for 60 seconds;
  - ▶ followed by answer; and
  - ▶ repeat.
- Past exams are on the webpage (under Final Exam Information).
- We're starting with Fall 2019, Version 2.

Weekly Reminders!
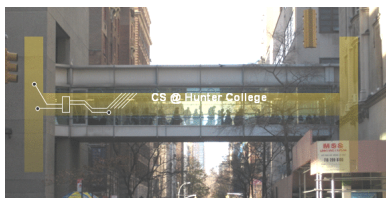

Before next lecture, don't forget to:
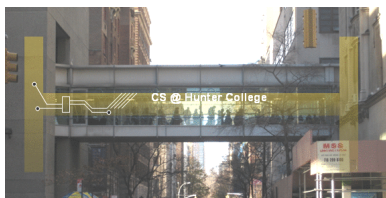
- Work on this week's Online Lab

Weekly Reminders!

Before next lecture, don't forget to:

- Work on this week's Online Lab
- Schedule an appointment to take the Quiz in lab 1001E Hunter North
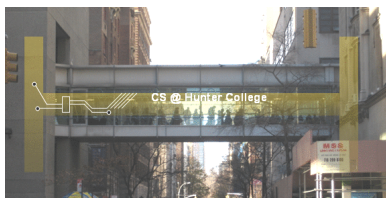
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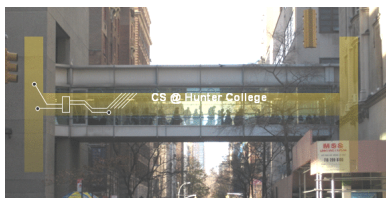- Submit this week's 5 programming assignments **(programs 26-30)**

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Before next lecture, don't forget to:

- Work on this week's Online Lab
- Schedule an appointment to take the Quiz in lab 1001E Hunter North
- If you haven't already, schedule an appointment to take the Code Review (**one every two weeks**) in lab 1001E Hunter North
- Submit this week's 5 programming assignments **(programs 26-30)**
- If you need help, schedule an appointment for Tutoring in lab 1001E 11am-5pm

Weekly Reminders!

Before next lecture, don't forget to:

- Work on this week's Online Lab
- Schedule an appointment to take the Quiz in lab 1001E Hunter North
- If you haven't already, schedule an appointment to take the Code Review (**one every two weeks**) in lab 1001E Hunter North
- Submit this week's 5 programming assignments **(programs 26-30)**
- If you need help, schedule an appointment for Tutoring in lab 1001E 11am-5pm
- Take the Lecture Preview on Blackboard on Monday (or no later than 10am on Tuesday)

Lecture Slips & Writing Boards

- Hand your lecture slip to a UTA.
- Return writing boards as you leave.