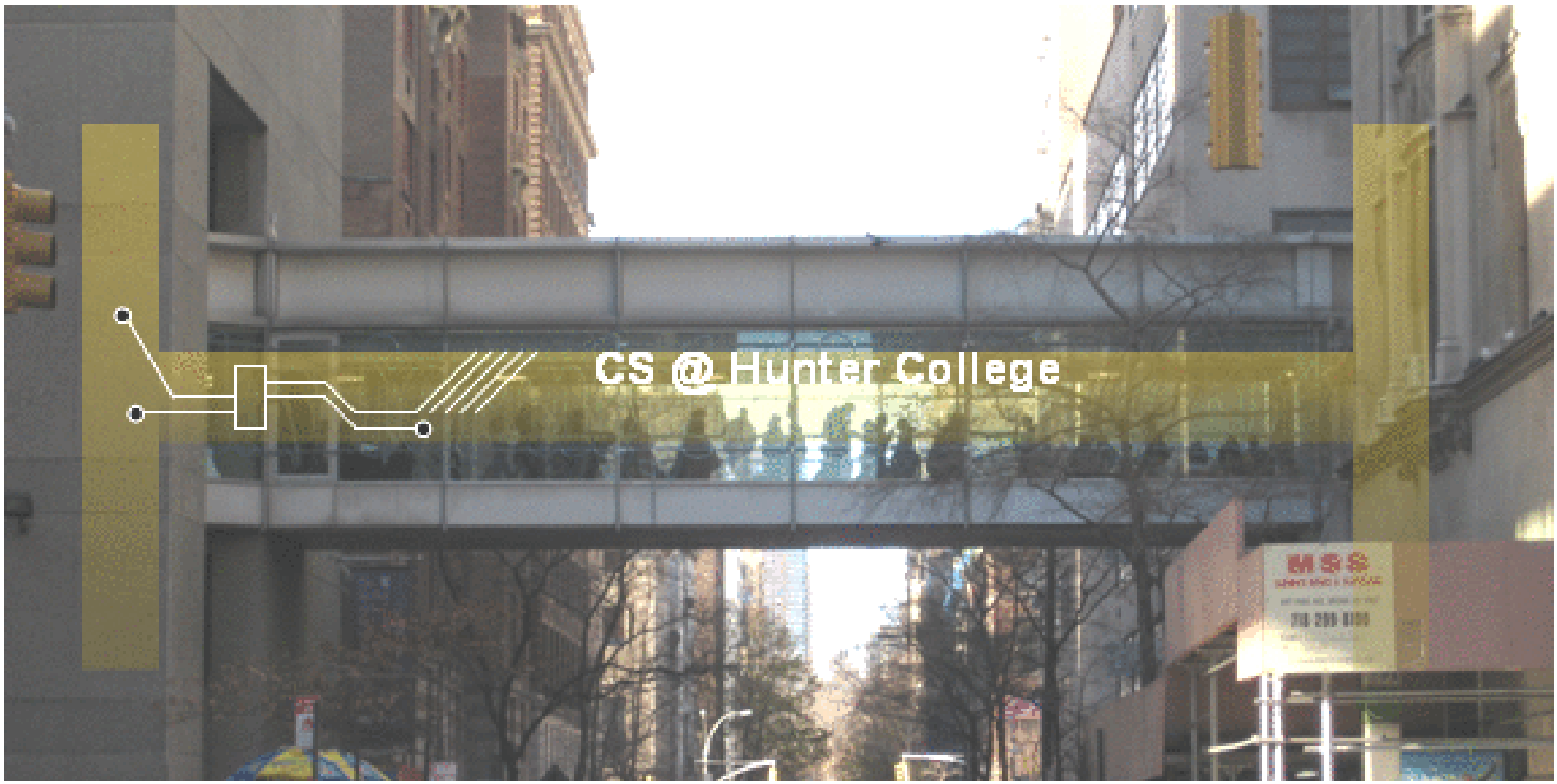
CSci 127: Introduction to Computer Science



hunter.cuny.edu/csci

Frequently Asked Questions

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- **Can we have more time for the Lab quiz?**
  Yes! After a few of you have mentioned feeling too rushed for the lab quiz, I have increased the time to 20 minutes.
  Keep in mind that the final exam will be in the same format and it is also timed. You will have 2 hours for the final exam.

Today's Topics

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

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Recap: Logical Operators

and

in1		in2	*returns:*
`False`	`and`	`False`	`False`
`False`	`and`	`True`	`False`
`True`	`and`	`False`	`False`
`True`	`and`	`True`	`True`

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`False`	`and`	`True`	`False`
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or

in1		in2	*returns:*
`False`	`or`	`False`	`False`
`False`	`or`	`True`	`True`
`True`	`or`	`False`	`True`
`True`	`or`	`True`	`True`

Recap: Logical Operators

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False	and	True	False
True	and	False	False
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or

in1		in2	*returns:*
False	or	False	False
False	or	True	True
True	or	False	True
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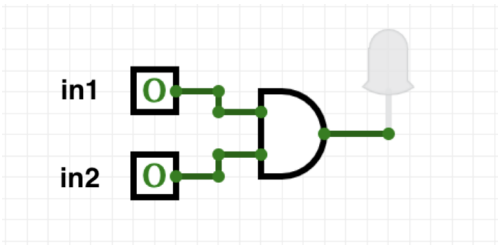
not

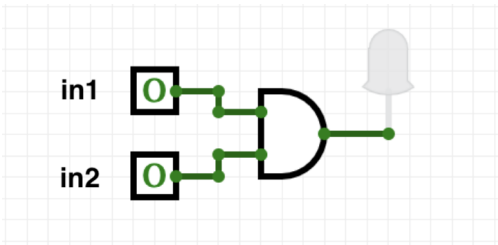
	in1	*returns:*
not	False	True
not	True	False

Logical Operators & Circuits



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

Logical Operators & Circuits



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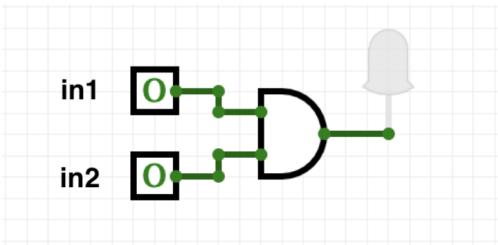
  Example: `in1 and in2`

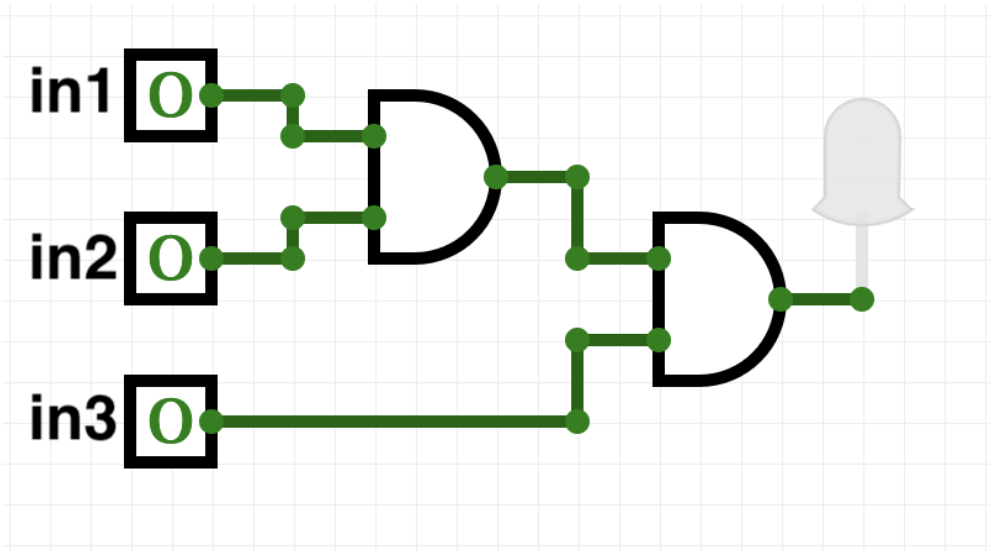
Logical Operators & Circuits



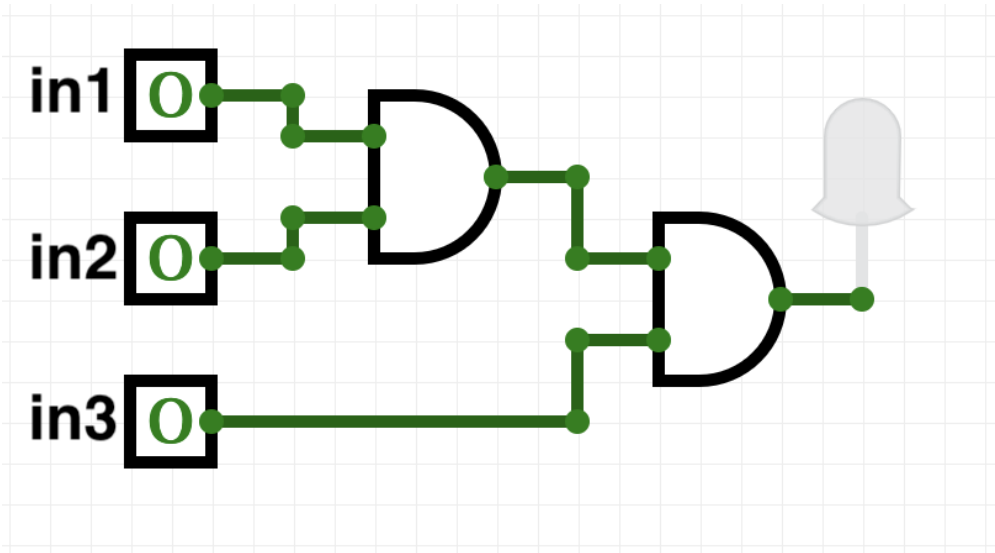
- Each logical operator (`and`, `or`, & `not`) can be used to join together expressions.

  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



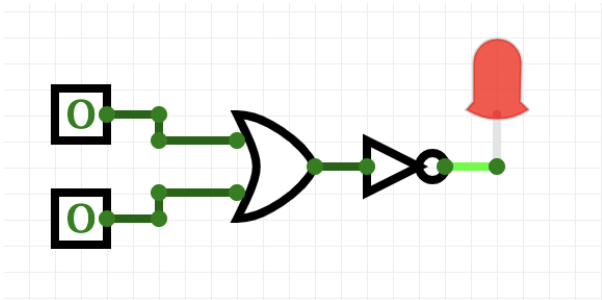
Examples: Logical Circuit

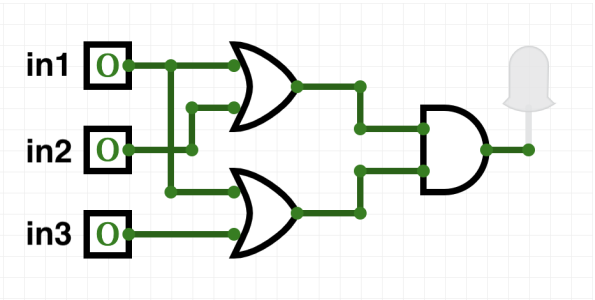


`(in1 and in2) and in3`

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:

-
```
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

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(Demo with pythonTutor)

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- **Design: Cropping Images**
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- CS Survey: Astrophysics and astropy

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.

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

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   ```
   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)
   ```

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Design: Cropping Images

Accessing Formatted Data

CS Survey: Astrophysics and astropy

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To use, add to the top of your program:

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import pandas as pd
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nycHistPop.csv

Reading in CSV Files

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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

nycHistPop.csv

In Lab 6

Example: Reading in CSV Files

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

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)
```

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)

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

nycHistPop.csv

In Lab 6

Example: Reading in CSV Files

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import pandas as pd

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nycHistPop.csv

In Lab 6

Series in Pandas

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Example: pop["Manhattan"] is the Series corresponding to the column of Manhattan data.

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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())
```

Challenge:

Predict what the following will do:

```
print("Queens:", pop["Queens"].min())
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Predict what the following will do:

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print("S I:", pop["Staten Island"].mean())
print("S I:", pop["Staten Island"].std())
pop.plot.bar(x="Year")
```

Challenge:

Predict what the following will do:

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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")
```

Challenge:

Predict what the following will do:

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print("Queens:", pop["Queens"].min())
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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:

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print("Queens:",  pop["Queens"].min())
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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())
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Minimum value in the column with label \Queens".

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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())
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Minimum value in the column with label \Queens".

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print("S I:", pop["Staten Island"].mean())
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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 with label \Queens".

print("S I:", pop["Staten Island"].mean())
Average of values in the column \Staten Island".

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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())
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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 with label \Queens".

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

cunyF2016.csv

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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:

cunyF2016.csv

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.

cunyF2016.csv

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.
2. Read in the CSV file.

cunyF2016.csv

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.
2. Read in the CSV file.
3. Set up a scatter plot.

cunyF2016.csv

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.
2. Read in the CSV file.
3. Set up a scatter plot.
4. Display plot.

cunyF2016.csv

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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:

cunyF2016.csv

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Solution:

1. Include pandas & pyplot libraries.
   ```
   import matplotlib.pyplot as plt
   import pandas as pd
   ```

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cunyF2016.csv

Challenge:

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Solution:

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   ```
   import matplotlib.pyplot as plt
   import pandas as pd
   ```
2. Read in the CSV file.
   ```
   pop=pd.read_csv('cunyF2016.csv',skiprows=1)
   ```

Challenge:

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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")
   ```

Challenge:

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

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   ```
3. Set up a scatter plot.
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   ```
4. Display plot.

Challenge:

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   ```
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   ```
2. Read in the CSV file.
   ```
   pop=pd.read_csv('cunyF2016.csv',skiprows=1)
   ```
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.

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 :

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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 :

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

AustraliaRain.csv

groupby()

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

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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.
   ```
   groupAvg = rain.groupby('Location')
   ```

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   ```
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   ```
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   ```
3. Group the data by location.
   ```
   groupAvg = rain.groupby('Location')
   ```
4. Print the average rainfall at each location.
   ```
   print(groupAvg['Rainfall'].mean())
   ```

groupby()

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

AustraliaRain.csv

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AustraliaRain.csv

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')
   ```

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 :

AustraliaRain.csv

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())
   ```

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 :

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   AlburyAvg = rain.groupby('Location').get_group('Albury')
   ```
4. Print the average rainfall in Albury.
   ```
   print(AlburyAvg['Rainfall'].mean())
   ```

Design Challenge

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

Libraries: pandas

Design Challenge - Solution

Libraries: pandas

Process:

- Print max of 'Luminosity' column

Design Challenge - Solution

Libraries: pandas

Process:

- Print max of 'Luminosity' column
- Print min of 'Temperature' column

Design Challenge - Solution

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

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

Libraries: pandas

```
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')          n
  .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') n
  .get_group('Hypergiant').mean()['Radius(R/Ro)'])
  ```

Recap

Recap: Logical Expressions & Circuits

Recap

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Accessing Formatted Data:

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

Recap

- 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 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.