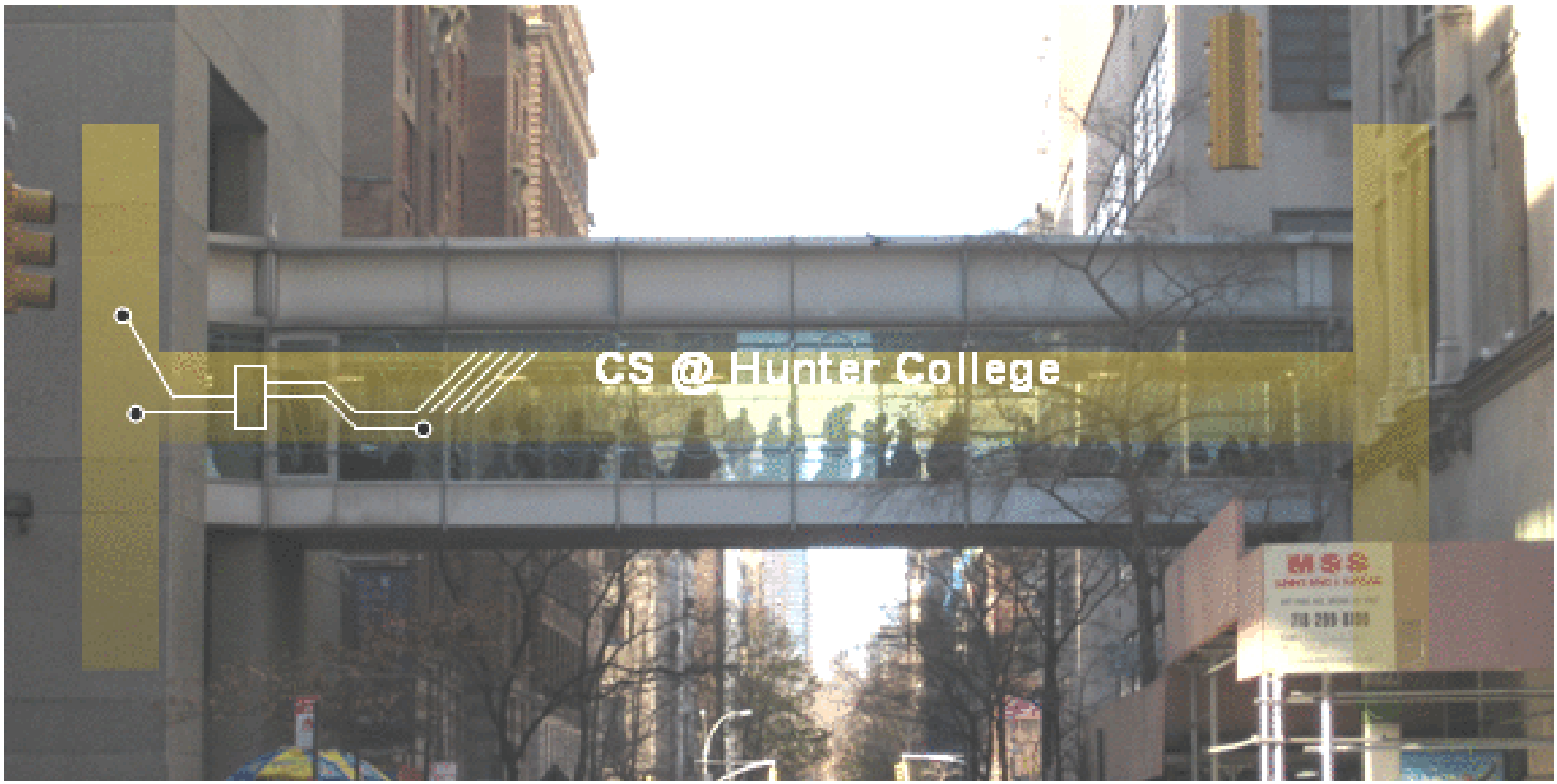
CSci 127: Introduction to Computer Science



hunter.cuny.edu/csci

Announcements

- Next Week: OpenData Showcase: 28 March, 4:30-6pm (rescheduled due to snow).
- Each lecture includes a survey of computing research and tech in NYC.

  Today: Mitsue Iwata
  NYC OpenData Initiative
  Mayor's Office

Frequently Asked Questions

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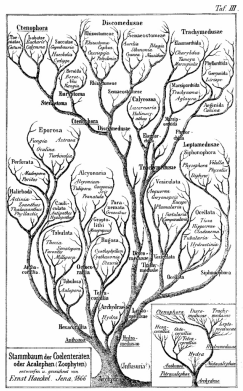
  - *Internships:* `https://jobs.lever.co/cunyinternships`

Today's Topics

- Recap: Tree-based Networks
- Introduction to Functions
- NYC Open Data

Recap: Tree-Based Networks



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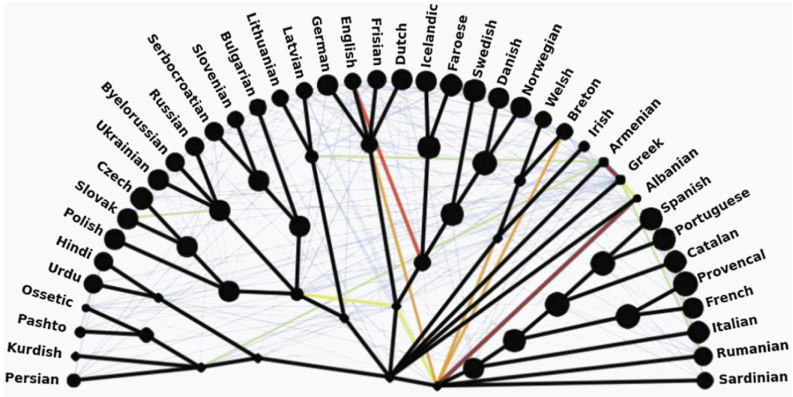

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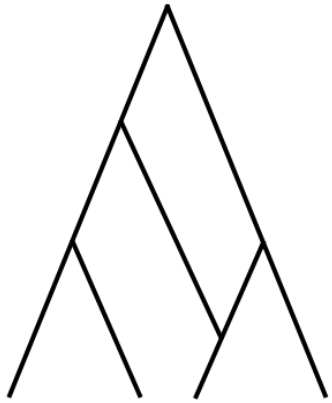
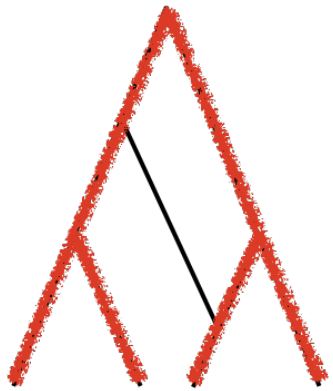


Network



Highlighted Tree

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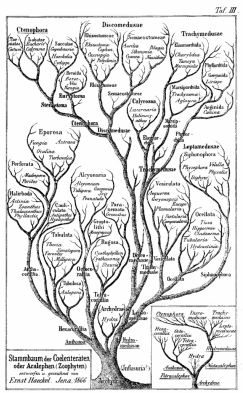

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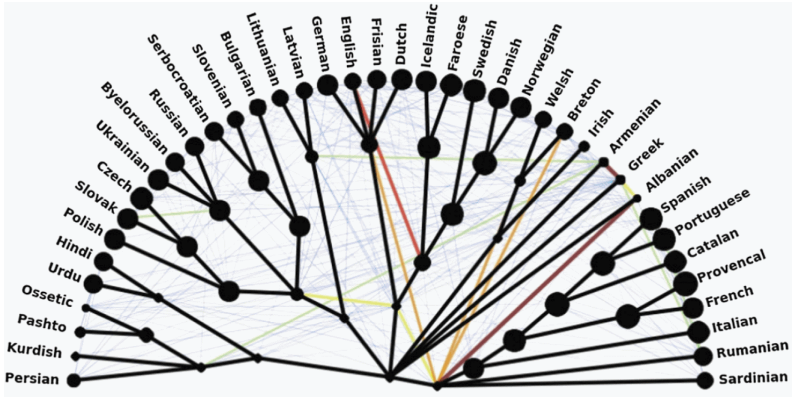

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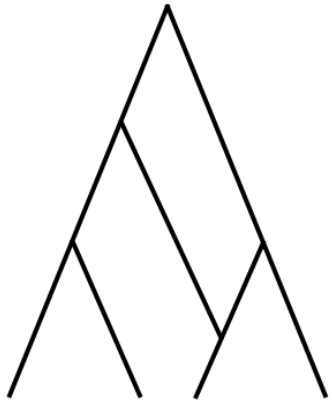

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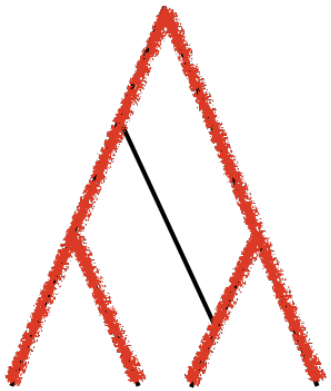

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- Evolutionary history can be represented by a tree.

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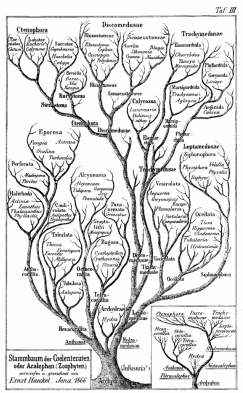

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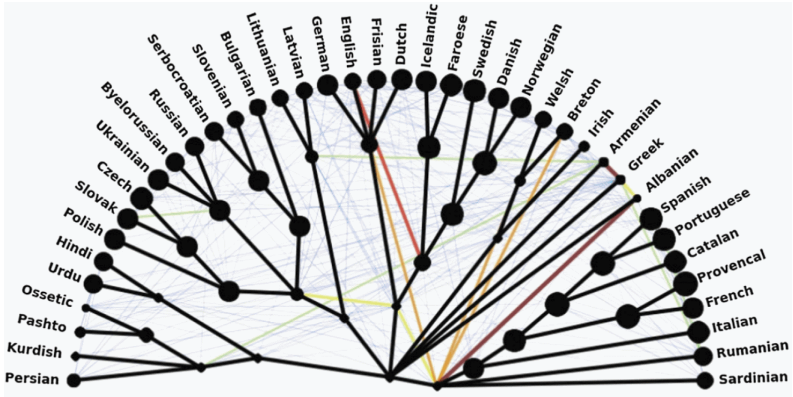

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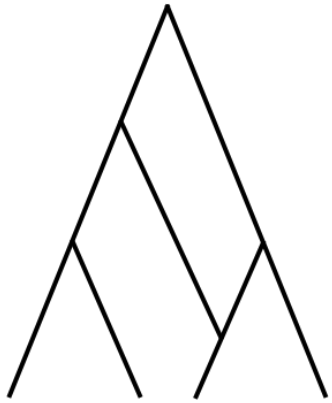

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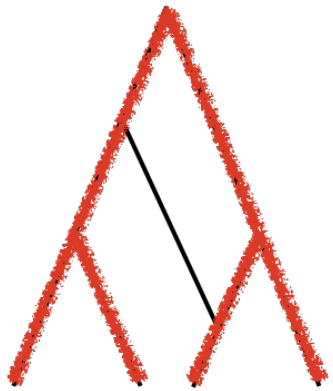

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- Evolutionary history can be represented by a tree.
- Events like hybridization can cause non-tree-like networks.

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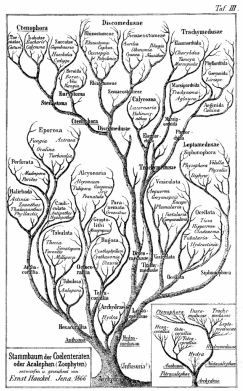

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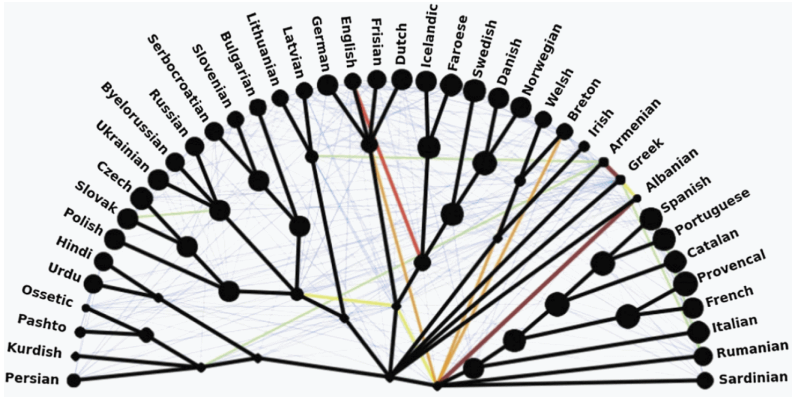

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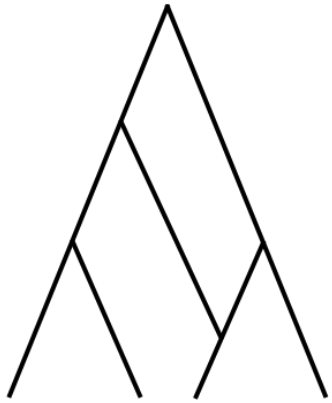

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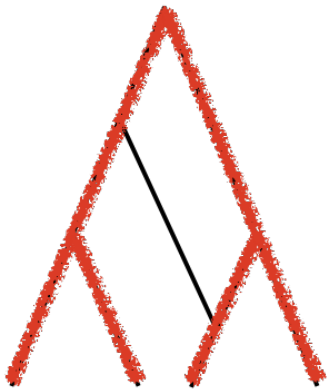

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- Evolutionary history can be represented by a tree.
- Events like hybridization can cause non-tree-like networks.
- Is there a tree on which the network is based?
  That is, can you start with a tree and only add lines between the original tree edges.

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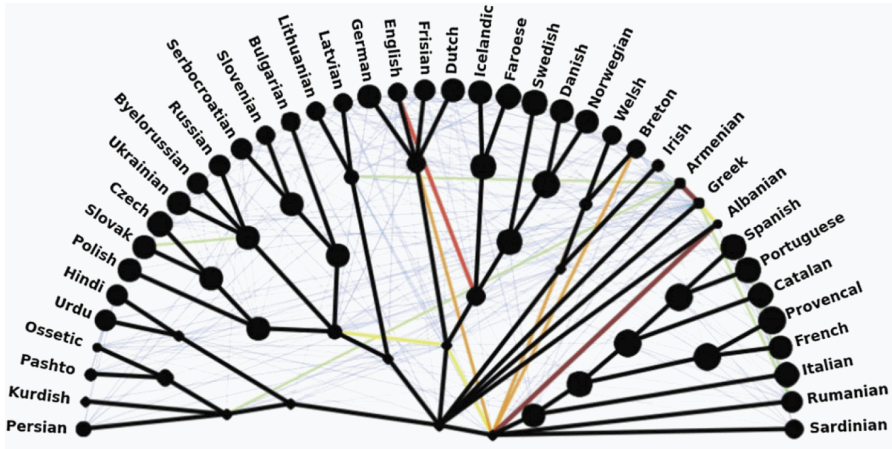

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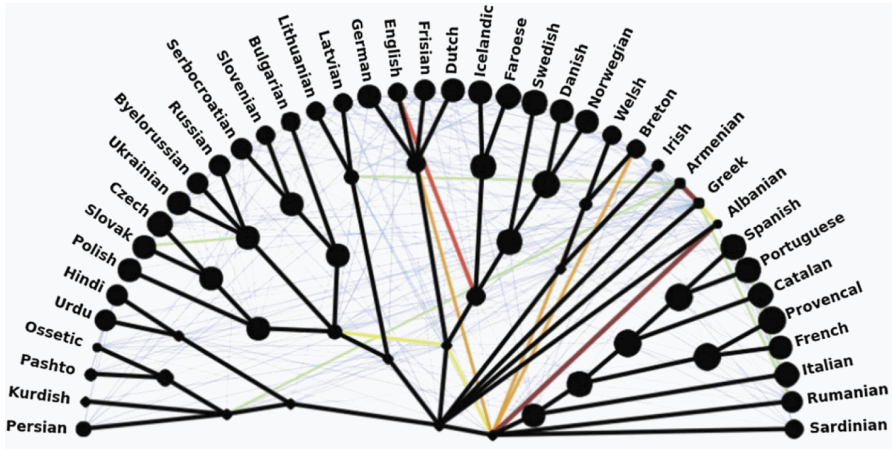

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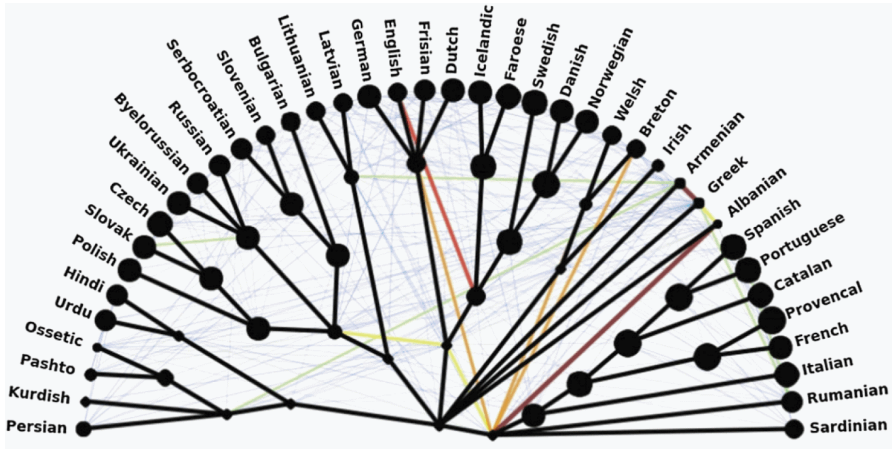

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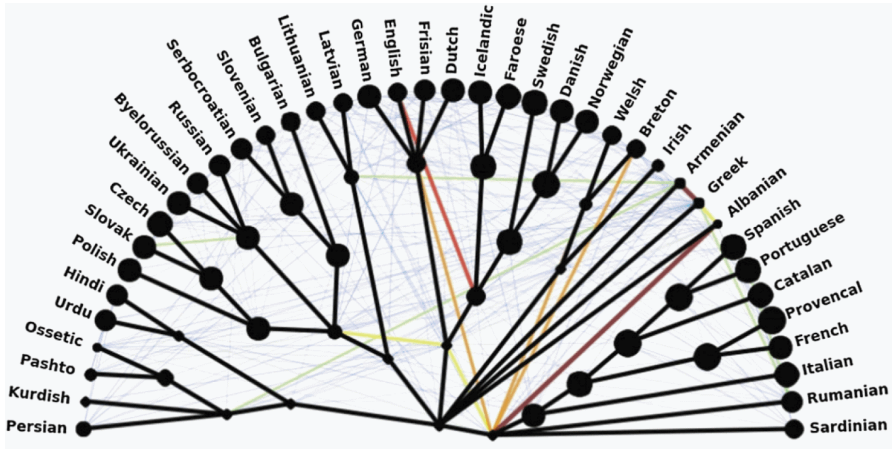

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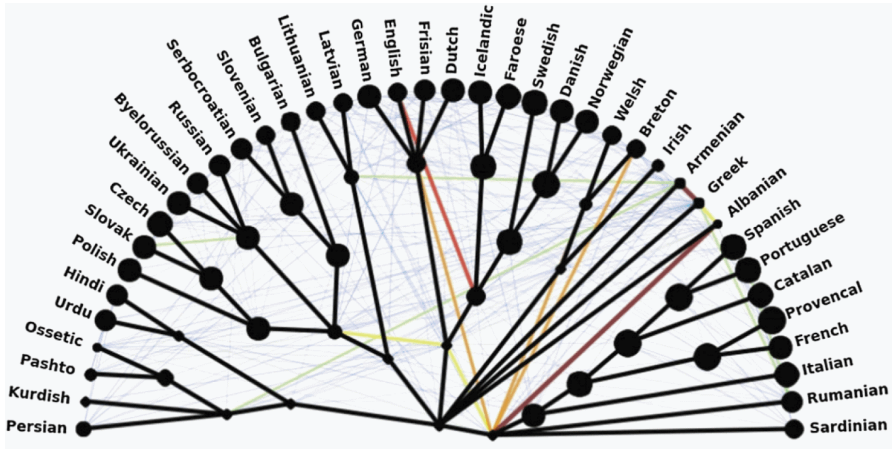

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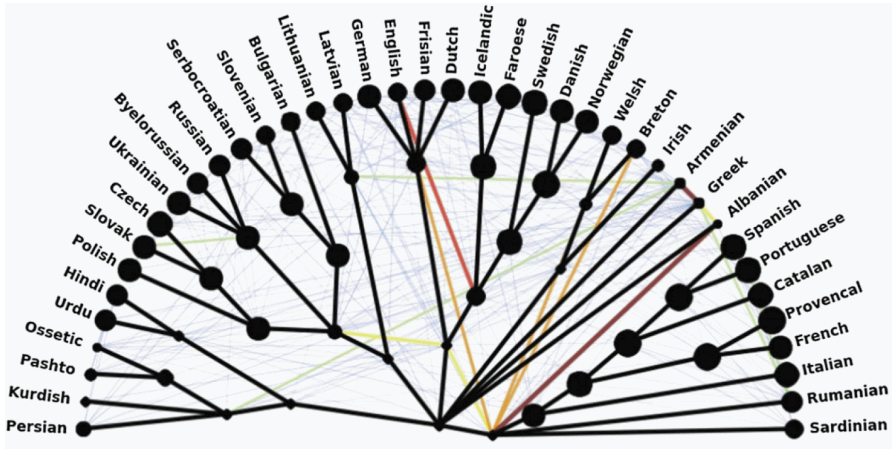

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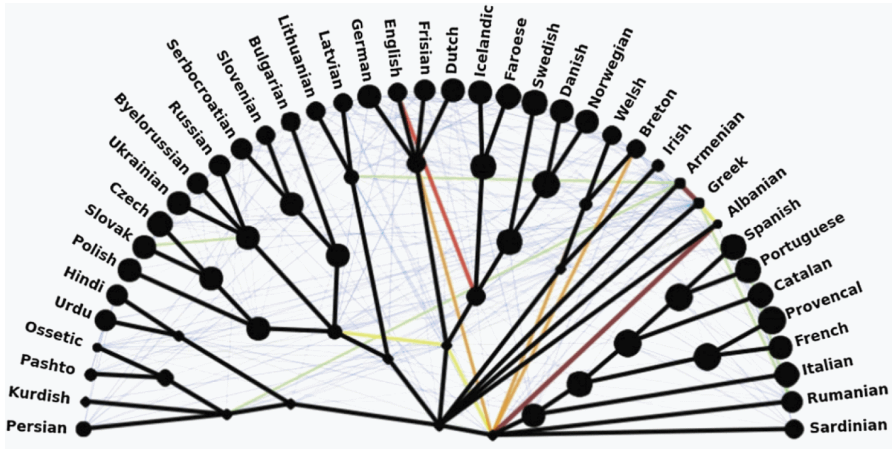

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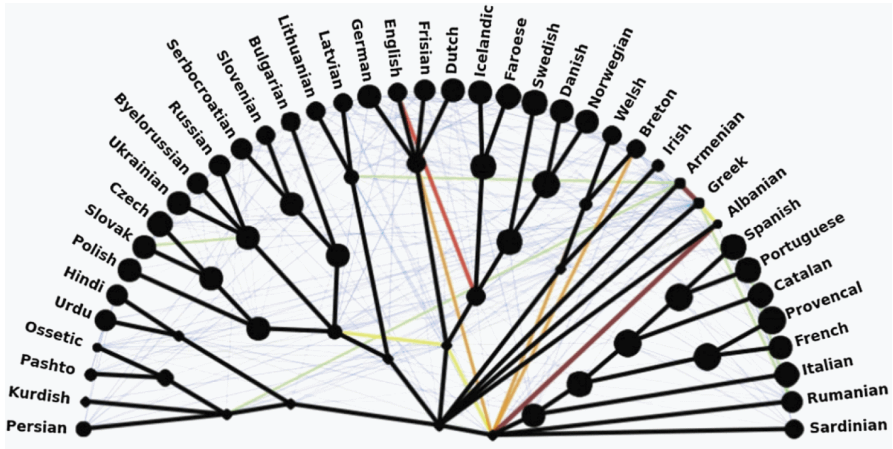

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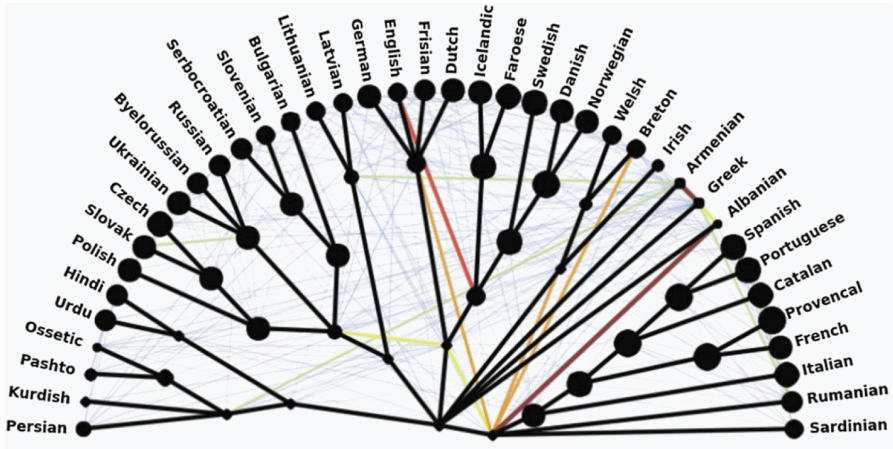

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  - Becomes a logic puzzle: a logical expression that can be solved.

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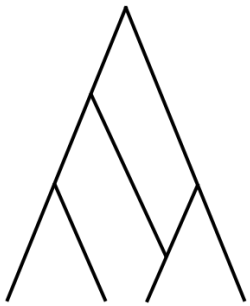

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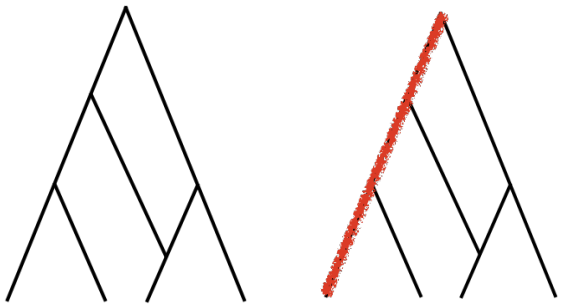

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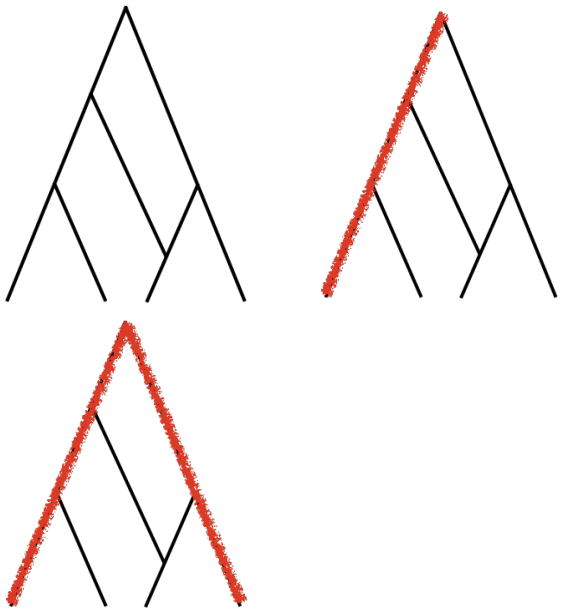

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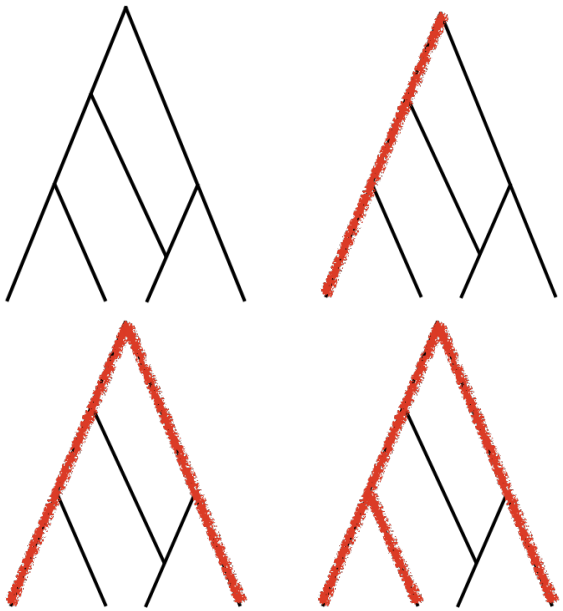

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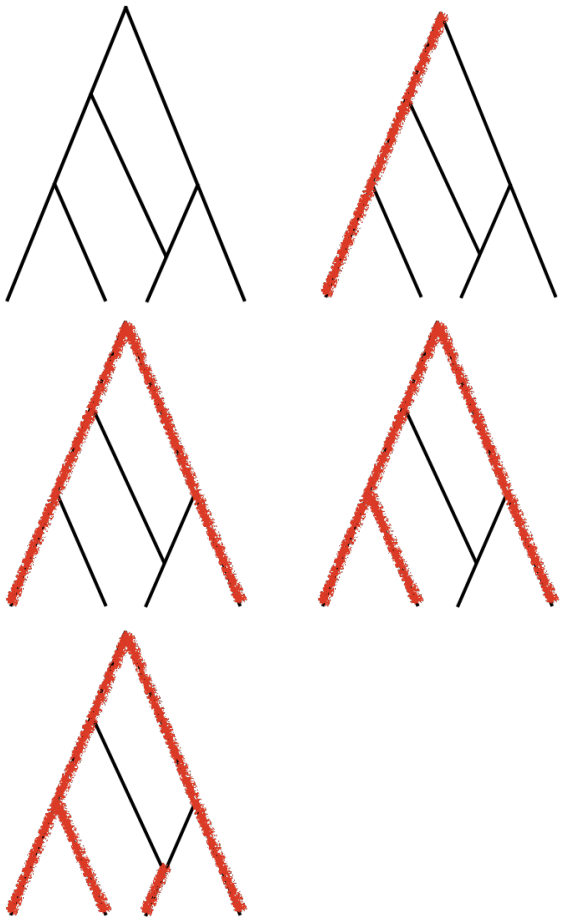

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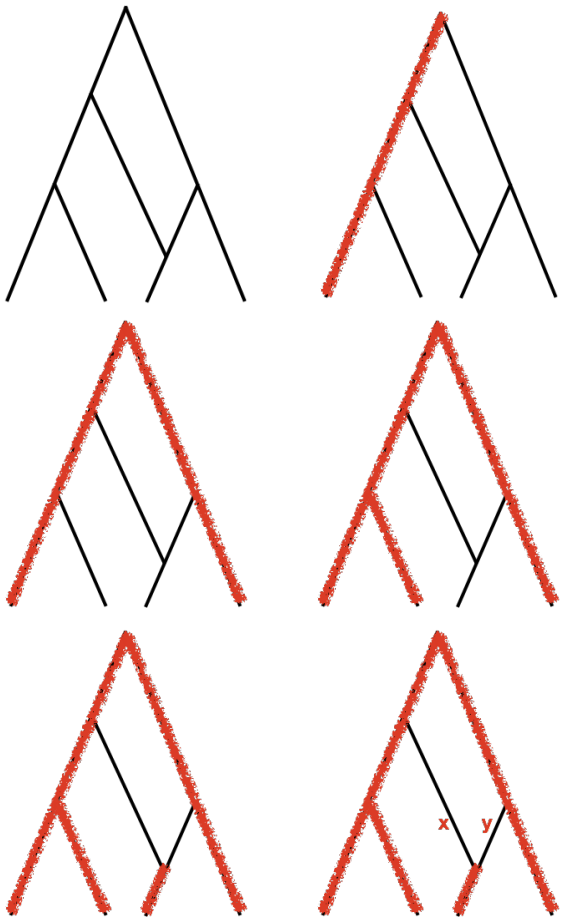

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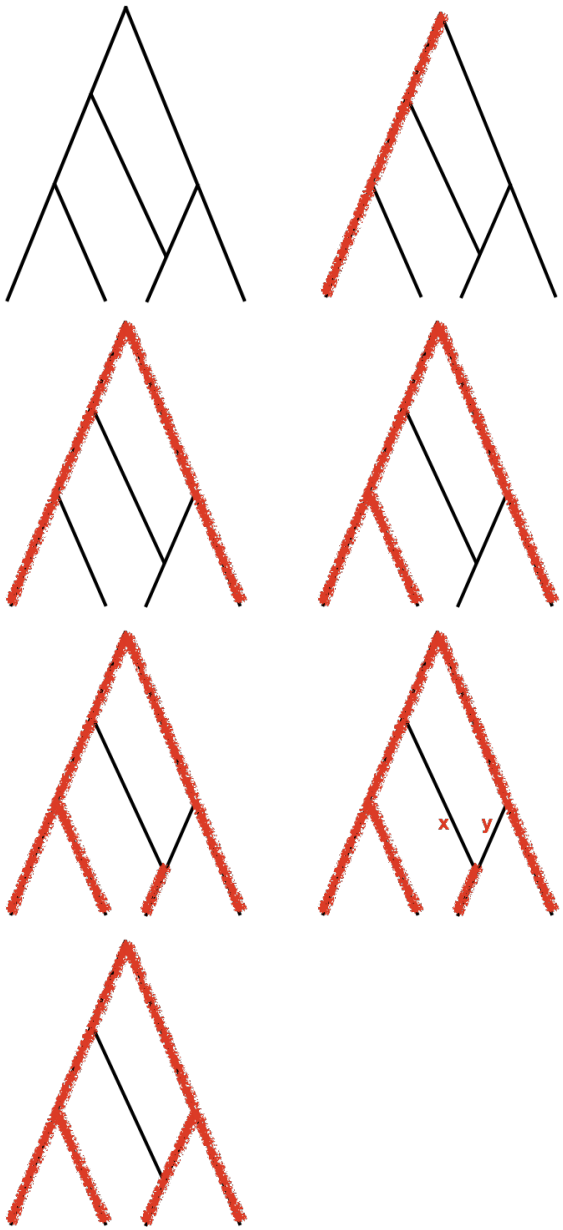

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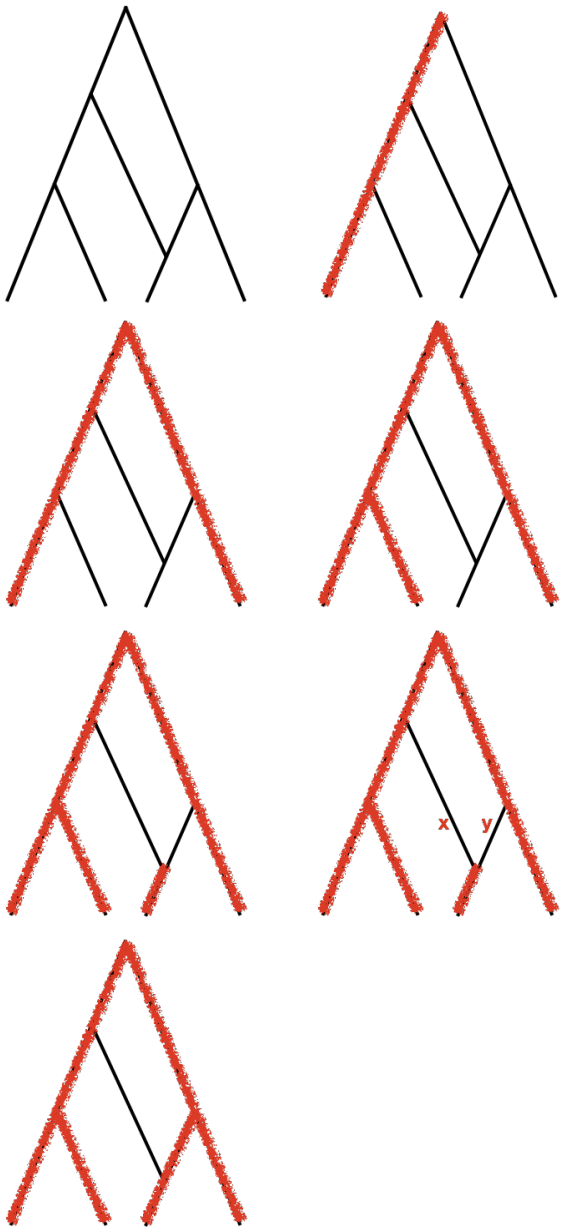

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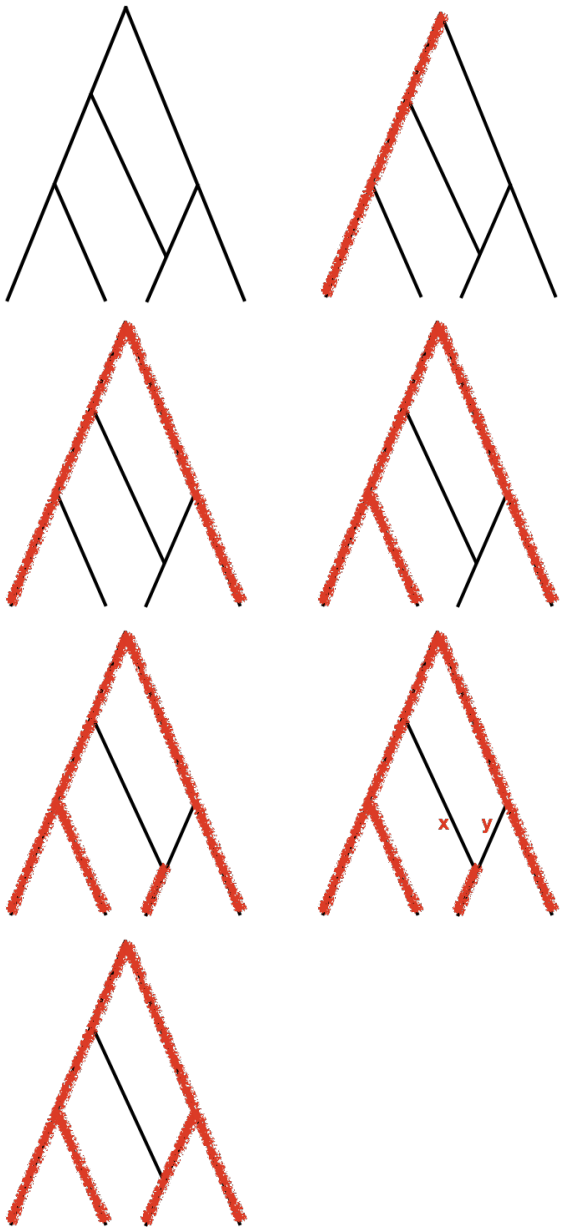
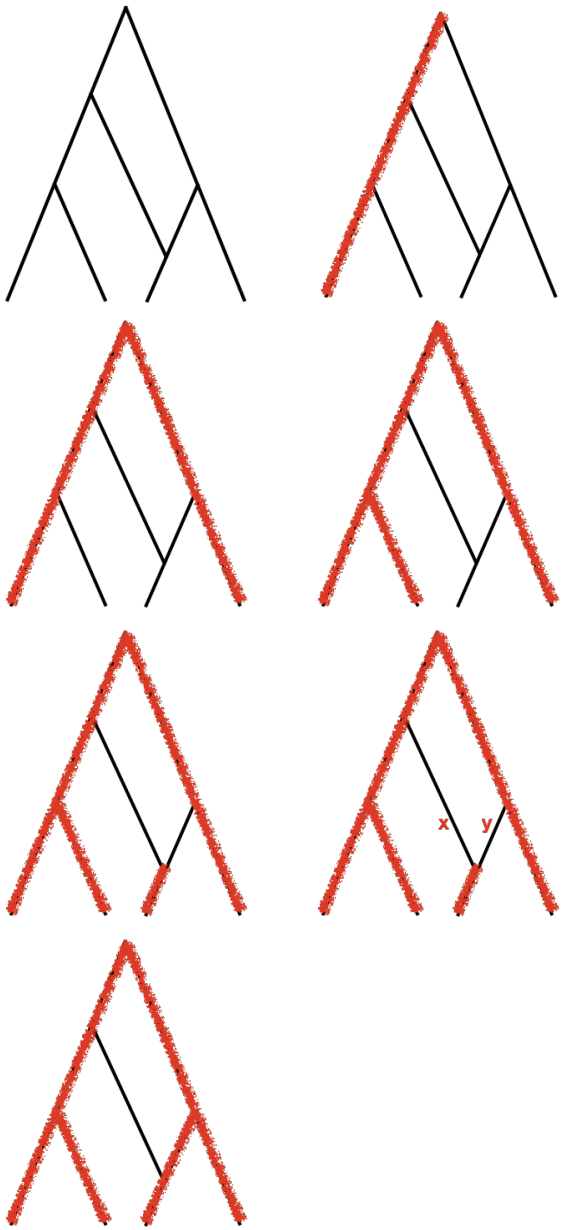


- First, highlight what must/must not be there.
- Then, what's left: can have edge **x** if edge **y** isn't there (and vice versa):

Example: Tree-Based Networks



- First, highlight what must/must not be there.
- Then, what's left: can have edge **x** if edge **y** isn't there (and vice versa):

```
(x and not y) or (not x and y)
```

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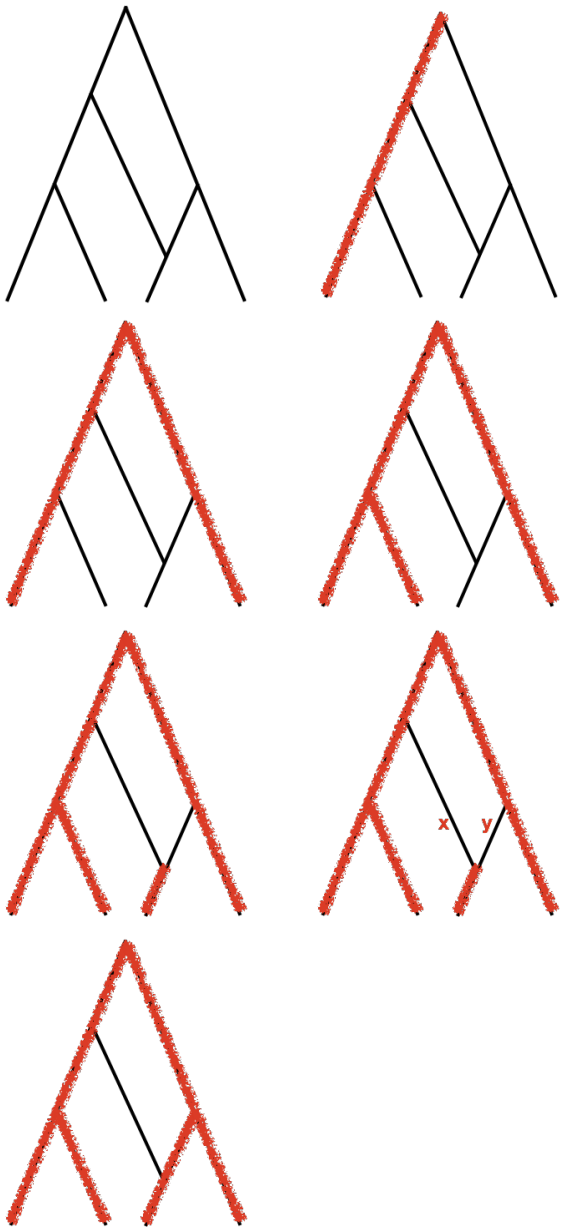

- First, highlight what must/must not be there.
- Then, what's left: can have edge **x** if edge **y** isn't there (and vice versa):

  `(x and not y) or (not x and y)`

- Solve the resulting logical puzzle.

Functions

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

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

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

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

Functions

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- Many languages require that all code must be organized with functions.

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Functions

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- You **call** or **invoke** a function by typing its name, followed by any inputs, surrounded by parenthesis: Example: `print("Hello", "World")`
- Can write, or **define** your own functions, which are stored, until invoked or called.

"Hello, World!" with Functions

```
#Name:  your name here
#Date:  October 2017
#This program, uses functions,
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def main():
    print("Hello, World!")

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

Python Tutor

```
#Name:  your name here
#Date:  October 2017
#This program, uses functions,
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def main():
     print("Hello, World!")

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

(Demo with pythonTutor)

In Pairs or Triples:

1. *Predict what the code will do:*

```
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: '))
dTip = float(input('Enter dinner tip:' ))
dTotal = totalWithTax(dinner, dTip)
print('Dinner total is', dTotal)
```

2. *Fill in the missing code:*

```
def monthString(monthNum):
    """
    Takes as input a number, monthNum, and
    returns the corresponding month name as a string.
    Example: monthString(1) returns "January".
    Assumes that input is an integer ranging from 1 to
    """

    monthString = ""

    ###################################
    ### FILL IN YOUR CODE HERE      ###
    ### Other than your name above, ###
    ### this is the only section    ###
    ### you change in this program. ###
    ###################################

    return(monthString)

def main():
    n = int(input('Enter the number of the month: '))
    mString = monthString(n)
    print('The month is', mString)
```

Python Tutor

```
def totalWithTax(food,tip):
    total = 0
    tax = 0.0875
    total = food + food * tax
    total = total + tip
    return(total)

lunch = float(input('Enter lunch total: '))
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dTotal = totalWithTax(dinner, dTip)
print('Dinner total is', dTotal)
```

(Demo with `pythonTutor`)

IDLE

```
def monthString(monthNum):
    """
    Takes as input a number, monthNum, and
    returns the corresponding month name as a string.
    Example: monthString(1) returns "January".
    Assumes that input is an integer ranging from 1 to 12
    """

    monthString = ""

    ###################################
    ### FILL IN YOUR CODE HERE      ###
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    ###################################

    return(monthString)

def main():
    n = int(input('Enter the number of the month: '))
    mString = monthString(n)
    print('The month is', mString)
```

(Demo with IDLE)

In Pairs or Triples:

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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#Triangles two ways...
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```

(Demo with IDLE)

Recap: Functions

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In Pairs or Triples:

Predict what the code will do:

```
motto = "Mihi Cura Futuri"
l = len(motto)
for i in range(l):
    print(motto[i])
for j in range(l-1,-1,-1):
    print(motto[j])
```

```
import matplotlib.pyplot as plt
import numpy as np
img = plt.imread('csBridge.png')
plt.imshow(img)
plt.show()
height = img.shape[0]
width = img.shape[1]
img2 = img[:height/2, :width/2]
plt.imshow(img2)
plt.show()
```

Python Tutor

```
motto = "Mihi Cura Futuri"
l = len(motto)
for i in range(l):
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```

(Demo with `pythonTutor`)

Accessing Structured Data: NYC Open Data

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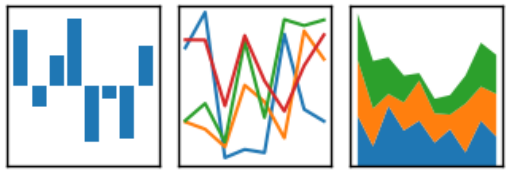
- Lab 7 covers accessing and downloading NYC OpenData datasets.

Structured Data

pandas

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



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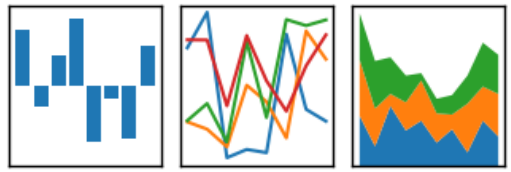

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- The text file version is called **CSV** for comma separated values.

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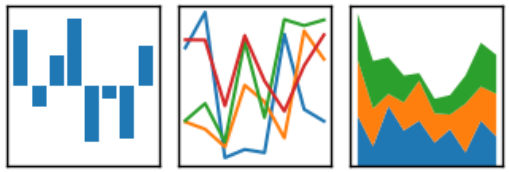

- Common to have data structured in a spread sheet.
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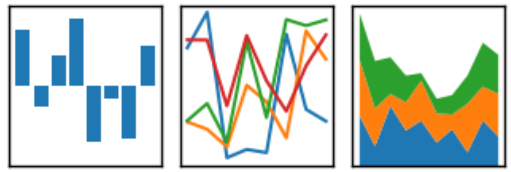

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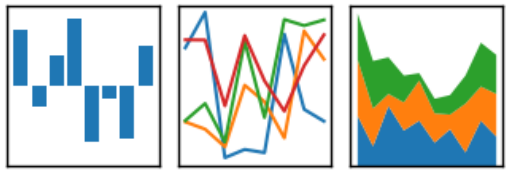

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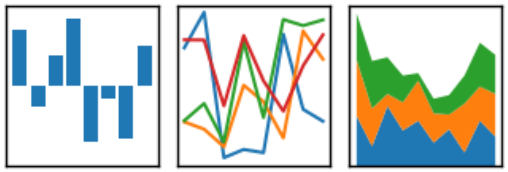

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```

- To read in a CSV file:

```
myVar = pd.read_csv("myFile.csv")
```

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.,,,,,,
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
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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
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1970,1539233,2602012,1986473,1471701,295443,7894862
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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

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

```
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```

`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)
```

```
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```

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()
```

```
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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`

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()
```

```
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
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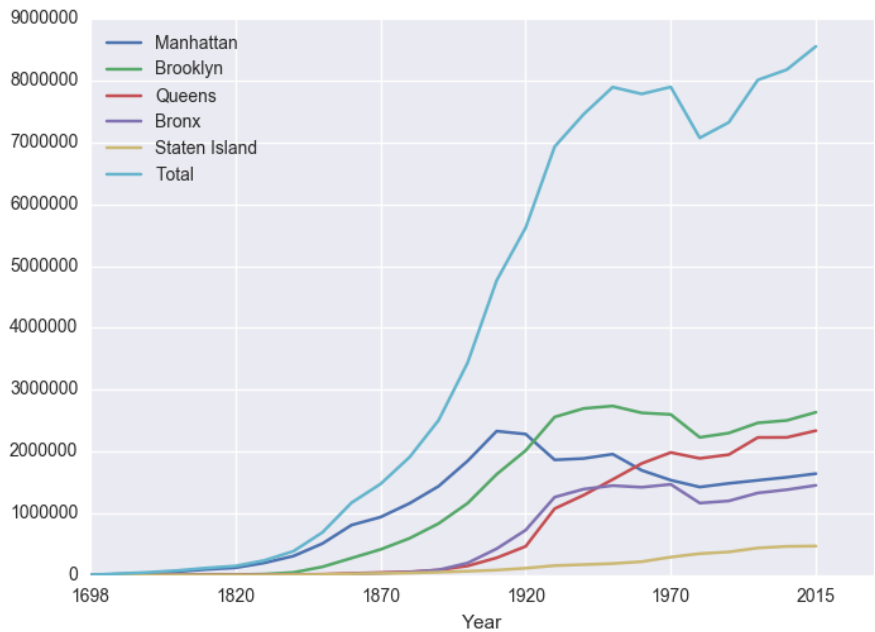
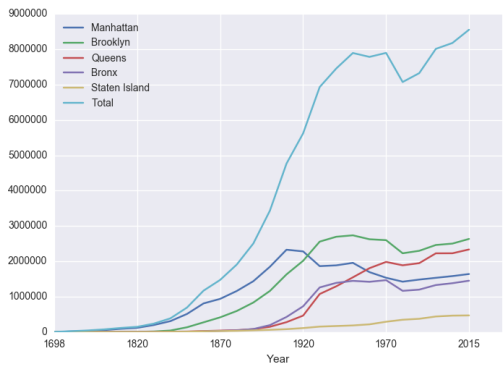
nycHistPop.csv

In Lab 6

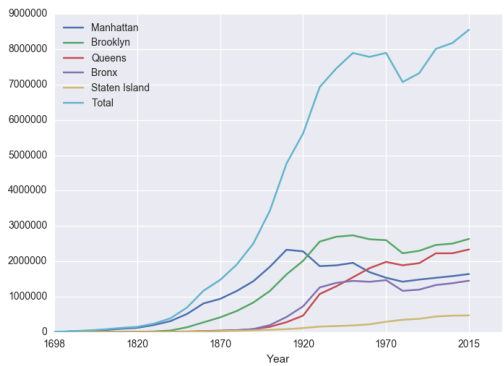


Series in Pandas



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

Series in Pandas



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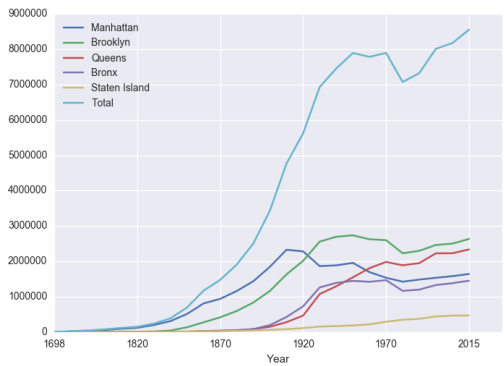

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- Example:

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

CS Survey: Mitsue Iwata, Data Analytics

- Project Manager, NYC Mayor's Office of Data Analytics

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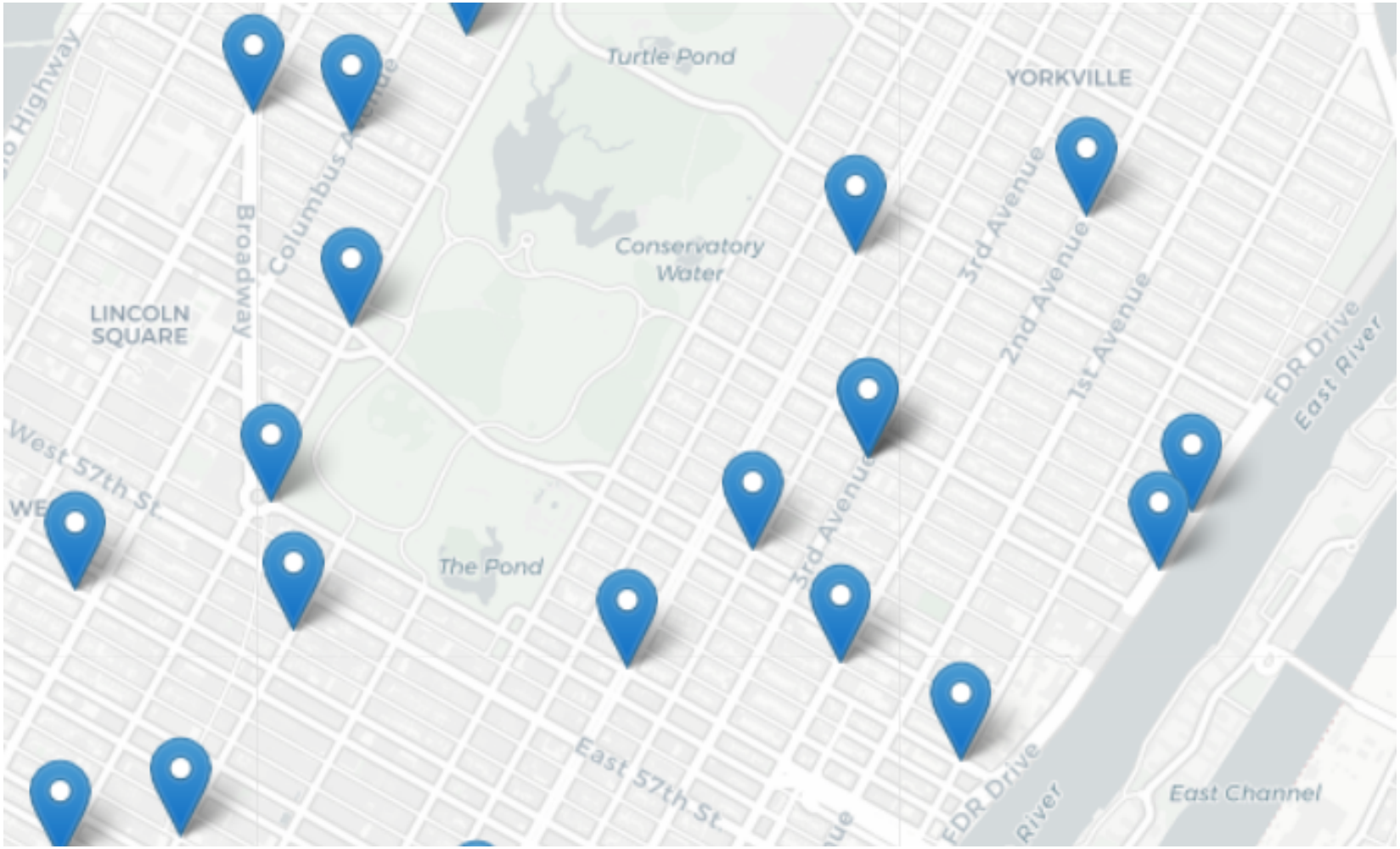
Design Question



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

(Design only the pseudocode.)

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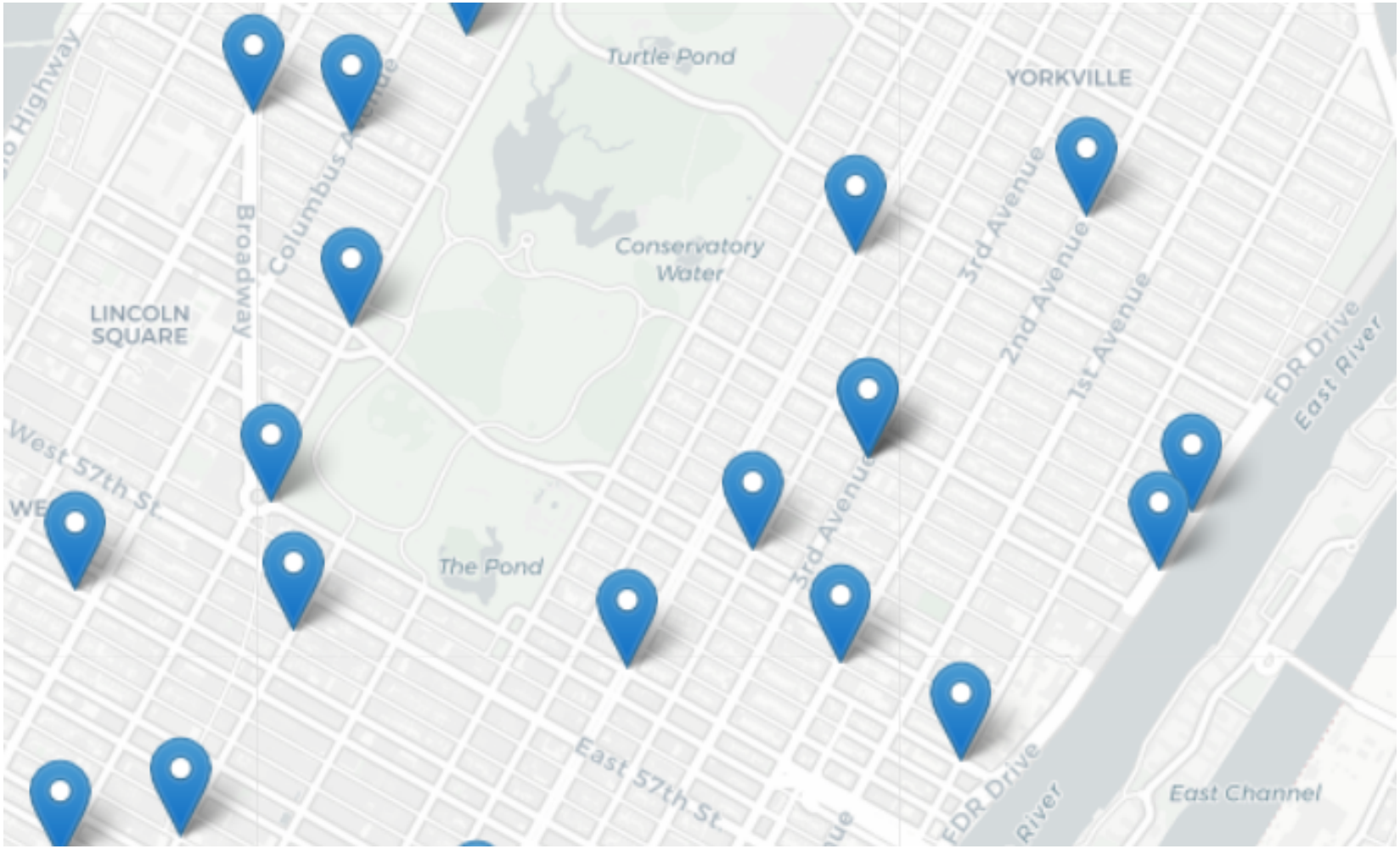

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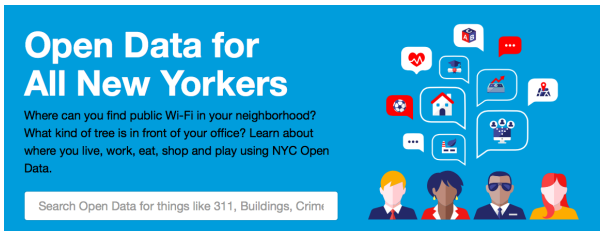
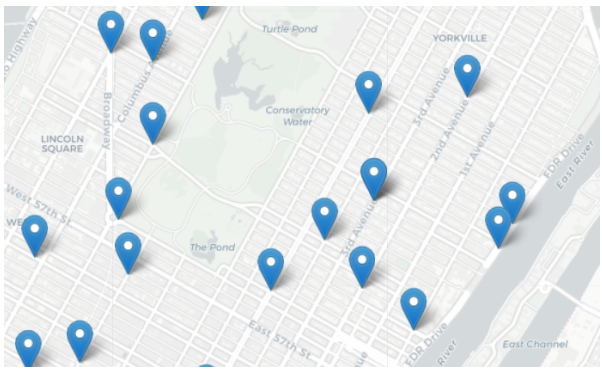
  4. Check distance to each to user's location.
  5. Save the location with the smallest distance.

Recap





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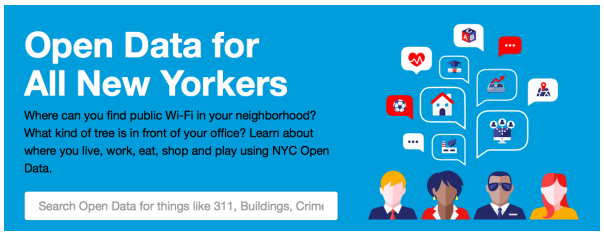

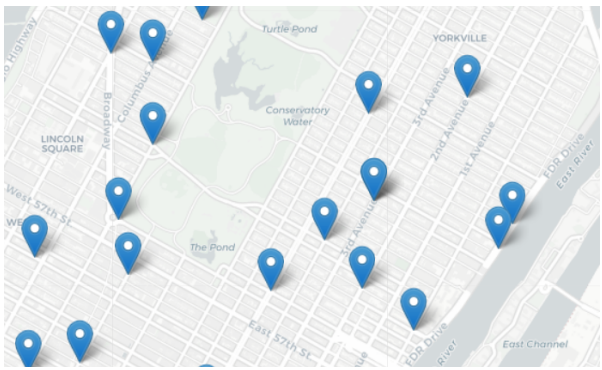

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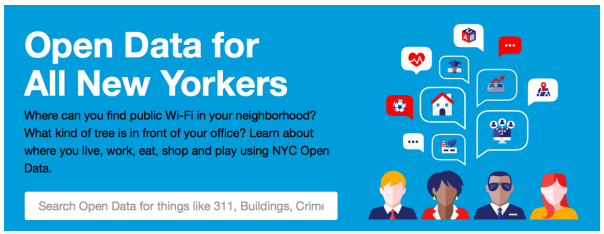

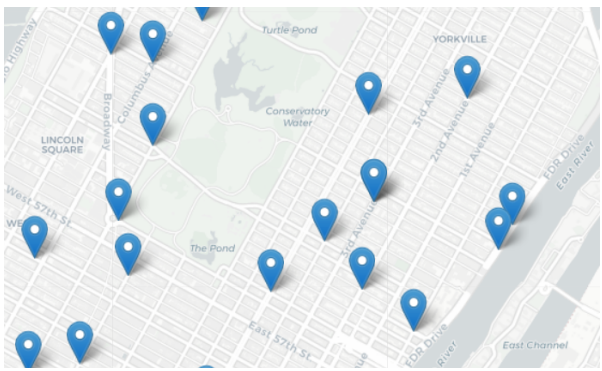

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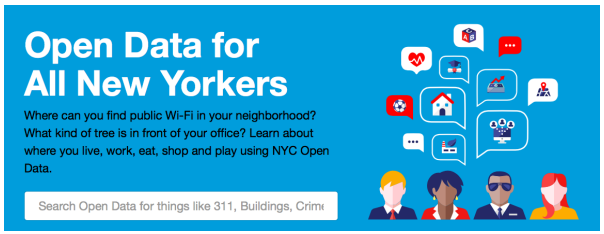

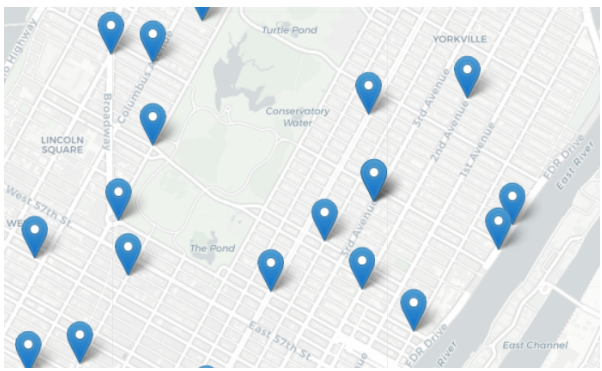

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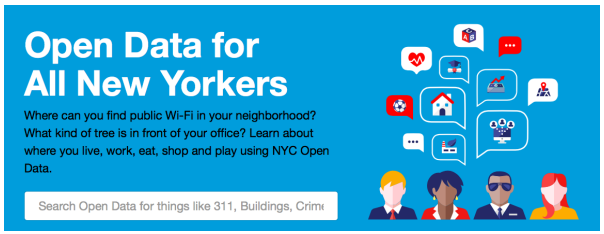

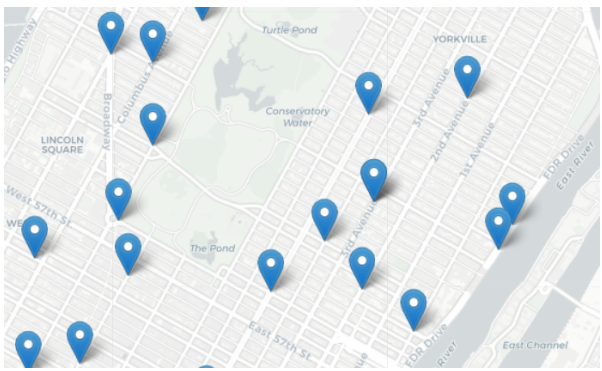

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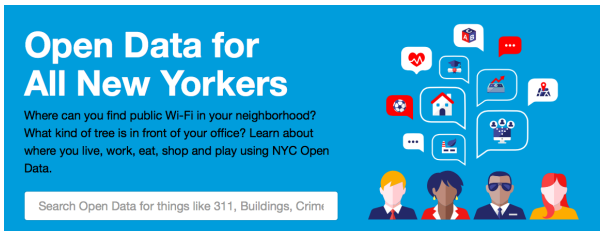

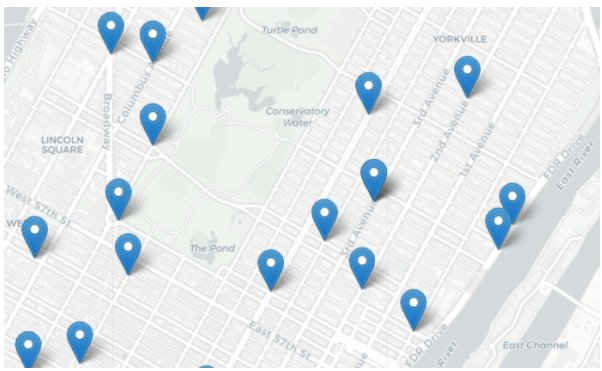

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- Accessing Formatted Data: NYC OpenData