CSci 127: Introduction to Computer Science

CS @ Hunter College

hunter.cuny.edu/csci

Frequently Asked Questions

From lecture slips & recitation sections.

- I didn't get the tree-based networks from last time!
  No worries– we'll talk about it first.

- Why do we have design questions (like the tree-based one)?
  The design questions cover two of the course's learning objectives: exposure to advanced computer science topics & problem solving.

- Please, more time on circuits/logical expressions/truth tables/decisions!
  We will do a bit today, but much more in the following weeks.

- Why is the schedule of classes and quizzes so crazy?
  - *Lots of holidays has "our week" now starting on Wednesday.*
  - *Spring Break is Friday, 30 March to Sunday, 8 April.*
  - *Since we'll miss 2 Fridays, 11 April will follow Friday schedule.*
  - *After spring break, "our week" will start on Thursdays.*

- I'd like to do more. Any suggestions?
  - *Hunter has an ACM Chapter & Women in CS clubs.*
  - *Tech Meetups: focused on just about everything tech (both via CUNY and city-wide).*
  - *Internships:* `https://jobs.lever.co/cunyinternships`

Today's Topics
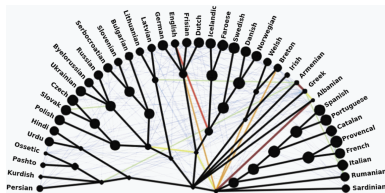

- Recap: Tree-based Networks
- Introduction to Functions
- NYC Open Data

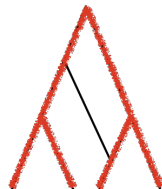# Recap: Tree-Based Networks
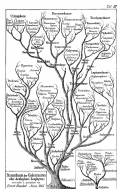
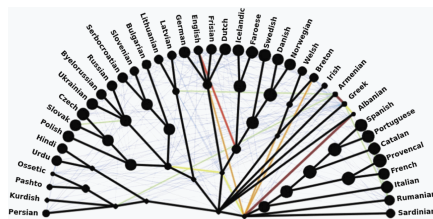Haekel   List *et al.*, 2013   Network   Highlighted Tree

- 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.

Tree-based Networks: Lecture Slip

List *et al.*, 2013

- When is the network just a tree with edges joining its branches?
- **Input:** A network.
- **Output:** True if the network is tree-based, and false otherwise.
- **Design:**
  - ▶ Need paths that connect the "root" to the leaves (with no cycles).
  - ▶ Start by highlighting all edges that must be part of the tree.
  - ▶ Then figure out which edges can't be there and mark those.
  - ▶ What's left: a bunch of choices on which edge to include in the tree
  - ▶ Becomes a logic puzzle: a logical expression that can be solved.

Example: Tree-Based Networks
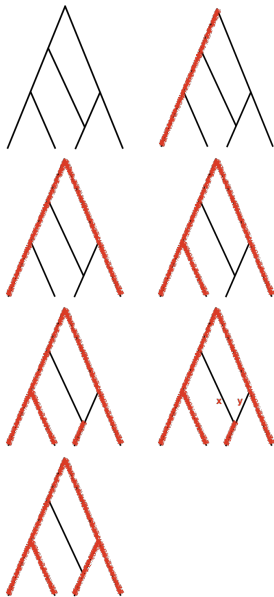
- First, highlight what must/must not be there.

- 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)

- 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.

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

- The opening function is often called `main()`

- 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

```python
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#Date:   October 2017
#This program, uses functions,
#        says hello to the world!

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if __name__ == "__main__":
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```

Python Tutor

```python
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#This program, uses functions,
#     says hello to the world!

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

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

(Demo with `pythonTutor`)

In Pairs or Triples:

1. Predict what the code will do:

```python
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:

```python
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

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

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dTotal = totalWithTax(dinner, dTip)
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```

(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      ###
    ### 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)
```

(Demo with IDLE)

In Pairs or Triples:

Predict what the code will do:

```python
#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)
```

```python
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

```
#CSci 127 Teaching Staff
#Triangles two ways...
import turtle

def setUp(t, dist, col):
    t.penup()
    t.forward(dist)
    t.pendown()
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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)
```

(Demo with `IDLE`)

Recap: Functions

```
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```

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

- 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.

In Pairs or Triples:

Predict what the code will do:

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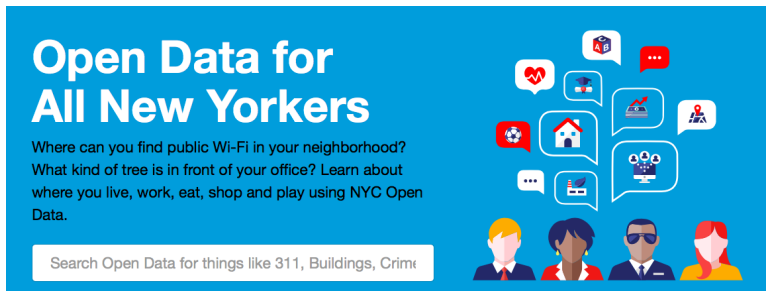
```python
import matplotlib.pyplot as plt
import numpy as np
img = plt.imread('csBridge.png')
plt.imshow(img)
plt.show()
height = img.shape[0]
width = img.shape[1]
img2 = img[:height/2, :width/2]
plt.imshow(img2)
plt.show()
```

Python Tutor

```python
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])
```

(Demo with pythonTutor)

Accessing Structured Data: NYC Open Data

- Freely available source of data.
- Maintained by the NYC data analytics team.
- We will use several different ones for this class.
- Will use pandas, pyplot & folium libraries to analyze, visualize and map the data.
- Lab 7 covers accessing and downloading NYC OpenData datasets.

Structured Data

pandas
$$y_{it} = \beta' x_{it} + \mu_i + \epsilon_{it}$$
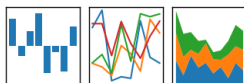
- Common to have data structured in a spread sheet.
- The text file version is called **CSV** for comma separated values.
- Each row is a line; columns are separated by commas.
- We will use the popular Python Data Analysis Library (**Pandas**).
- To use, add to the top of your file:

  ```
  import pandas as pd
  ```
- To read in a CSV file:
  ```
  myVar = pd.read_csv("myFile.csv")
  ```

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
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
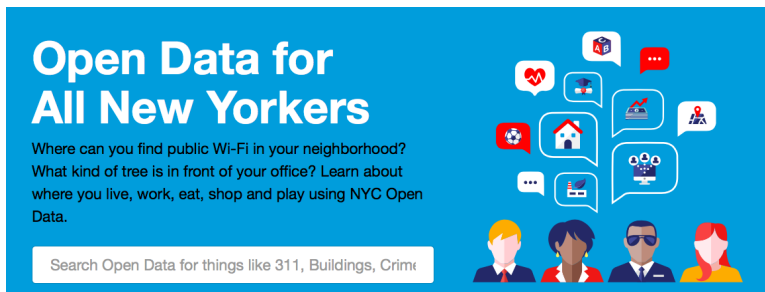
nycHistPop.csv

In Lab 6
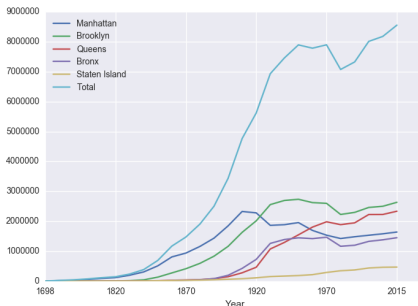
Series in Pandas
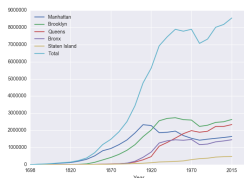
- Series can store a column or row of a DataFrame.

- 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())`
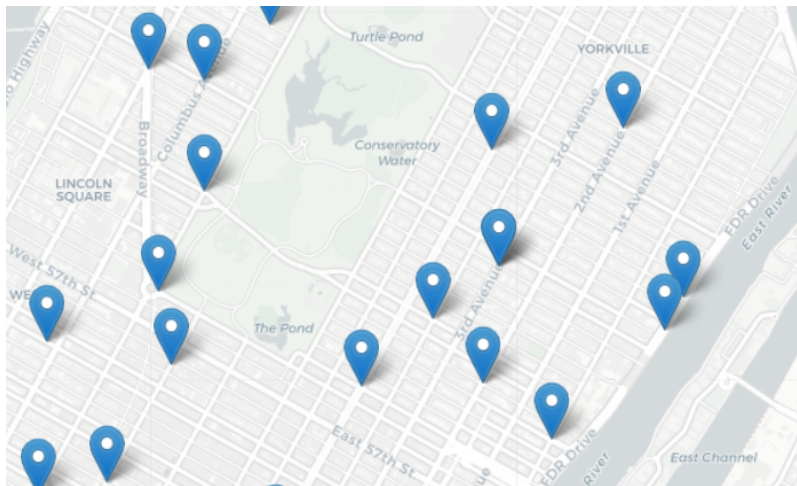
CS Survey: Mitsue Iwata, Data Analytics

- Project Manager, NYC Mayor's Office of Data Analytics
- Hunter College, Class of 2014.
- MS, Computational Analysis & Public Policy,
  University of Chicago, 2016.

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.)

Design Question

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

How to approach this:

- Create a "To Do" list of what your program has to accomplish.
- Read through the problem, and break it into "To Do" items.
- Don't worry if you don't know how to do all the items you write down.
- Example:
  1. Find data set (great place to look: NYC OpenData).
  2. Ask user for current location.
  3. Open up the CSV file.
  4. Check distance to each to user's location.
  5. Save the location with the smallest distance.

Recap

- On lecture slip, write down a topic you wish we had spent more time (and why).

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

- 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.

- Accessing Formatted Data: NYC OpenData