# Compsci 101
# Accumulator Pattern, Loop Tracing, Files

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```
lst = ["ant", "bat", "cat", "dog"]
for i in range(len(lst))
    print(i, lst[i])
```

# `I` is for …

- **Identity**
  - Who are you? Computer Science Student
- **Invariant**
  - Reasoning formally and informally about loops
- **Internet**
  - Network of networks
  - Far more than that!

# Lynn Conway

**See Wikipedia and lynnconway.com**

- **Helped invent dynamic scheduling early '60s IBM**
- **Transgender, fired in ‘68**
- **IBM apologized in 2020 (52 years later)**

- **Joined Xerox Parc in 1979**
- **Revolutionized VLSI design with Carver Mead**

- **Joined U. Michigan 1985**
- **NAE '89, IEEE Pioneer ‘09**
- **Professor and Dean, retired '98**

“If you want to change the future, start living as if you are already there.”

# Announcements

- **Assignment 2 Turtles due Thurs!**
- **Lab 5 Friday – Prelab coming out Wed or Thur**
- **Coming, APT-3 out Thursday**
- **Coming, APT-1 QUIZ (Feb 23-27)**
  - Timed APTs, take when you want during these dates
  - Your own work!
- **DO NOT discuss Exam 1 until it is handed back**
  - Will be handed back on Gradescope

# Plan for the Day

- **Accumulator Pattern**
- **Range**
- **Loop Index**
- **Loop Tracing**
- **Files**

# The Accumulator Pattern

- **Pattern you will see with a lot of loops**
- **Here is the pattern:**

  - Initialize a variable
  - loop over a sequence (list or string)
    - Accumulate (add a little more to variable)
  - Do something with variable (result)

# Example of Accumulator Pattern

```
def sumlist(lst):
    total = 0
    for num in lst:
        total += num
    return total
```

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```
def sumlist(lst):
    total = 0
    for num in lst:
        total += num
    return total
```

```
lsta = [3, 7, 8, 2, 6]
print(sumlist(lsta))
```

Output:

# Example 2: Accumulator Pattern

```
def numLetters(word):
    total = 0
    for letter in word:
        total += 1
    return total
```

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```
def numLetters(word):
    total = 0
    for letter in word:
        total += 1
    return total
```

```
word = "card"
print(numLetters(word))
```

Output:

# REVIEW: Looping over Sequences

- **Let's explore this:**
  - Given a sentence:
    - "Duke Computer Science is so much fun!"
  - How do we create this sentence?
    - "Dk Cmptr Scnc s s mch fn!"
  - Input is sentence. Output has vowels removed

# Accumulator Pattern: NoVowels

- **"For each character, if it's not a vowel add it to the output string"**
- **Accumulator pattern: change a variable in a loop**
  - Accumulate a value while iterating through loop

```
20  def noVowels(phrase):
21      ret = ""
22      for ch in phrase:
23          if not isVowel1(ch):
24              ret = ret + ch
25      return ret
```

# range() Sequence

- **`Range generates a sequence of values`**
- **`range(y)` – starts at 0 and goes up to but doesn't include y: 0 … (y-1)**
  - **y** is an integer
- **`range(x,y)`: x … (y-1)**
  - **x** and **y** are integers
- **Sequence that provides access to int values**
- **"up to but not including" sounds familiar? Slicing!**

# Example

```
range(5)
list(range(5))
range(5)[0]
range(5)[4]
range(5)[5]
range(5,10)
list(range(5,10))
range(5,10)[3]
for x in range(3):
    print(x)
```

# Range Examples

- **Access all the values in a list to print them**
  - Use the "for each in sequence" pattern

```
lst = ["ant", "bat", "cat", "dog"]
for s in lst:
    print(s)
```

# Range Examples

- **Access all the values in a list to print them**
  - Use an index to access $i^{th}$ element

```
lst = ["ant", "bat", "cat", "dog"]
for i in range(len(lst))
    print(i, lst[i])
```

# Repetition with Range

- **Sometimes rather than looping over a sequence of values you want to repeat # times**
  - Do this 4 times
  - Do that 250 times

- **Can do this with the Python range function!**
  - If don't care about the value in the range (e.g. "Do this four times"), can do:

```
for _ in range(4):
    CODE
```

# WOTO-1 – Accumulator, Range
# http://bit.ly/101s23-0214-1

# Code-Tracing a Loop

1. **Find the changing variables/expressions**
2. **Create table, columns are variables/expressions**
    1. First column is loop variable
    2. Add columns to help track everything else
3. **Each row is an iteration of the loop**
    1. *Before* execute code block, copy down each variable's value
    2. Execute code block, update a value in the row as it changes

# Code-Tracing a Loop

1. **Find the changing variables/expressions**
2. **Create table, columns are variables/expressions**
    1. First column is loop variable
    2. Add columns to help track everything else

```
def mystery(lst):
    idxMax = 0
    for i in range(len(lst)):
        if lst[idxMax] < lst[i]:
            idxMax = i

    return idxMax
```

What should be the table's columns?

# Fill in table

1. **Before execute code block, copy down each variable's value**
2. **Execute code block, update a value in the row as it changes**

```
def mystery(lst):
    idxMax = 0
    for i in range(len(lst)):
        if lst[idxMax] < lst[i]:
            idxMax = i

    return idxMax

mystery([2, 12, 4, 15, 15])
```

| i | idxMax | lst[idxMax] | lst[i] | lst[idxMax] < lst[i] |
|---|---|---|---|---|
| | | | | |
| | | | | |

1. **Before execute code block, copy down each variable's value**
2. **Execute code block, update a value in the row as it changes**

```
def mystery(lst):
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```

```
mystery([2, 12, 4, 15, 15])
```

| i | idxMax | lst[idxMax] | lst[i] | lst[idxMax] < lst[i] |
|---|---|---|---|---|
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

# WOTO-2 Loop Tracing
# http://bit.ly/101s23-0214-2

- **Remember the steps**
- **(1) Find the changing variable/expressions,**
- **(2) Create the table with these as the column**
- **(3) Each row is an iteration of the loop**

# Examples of Processing Data

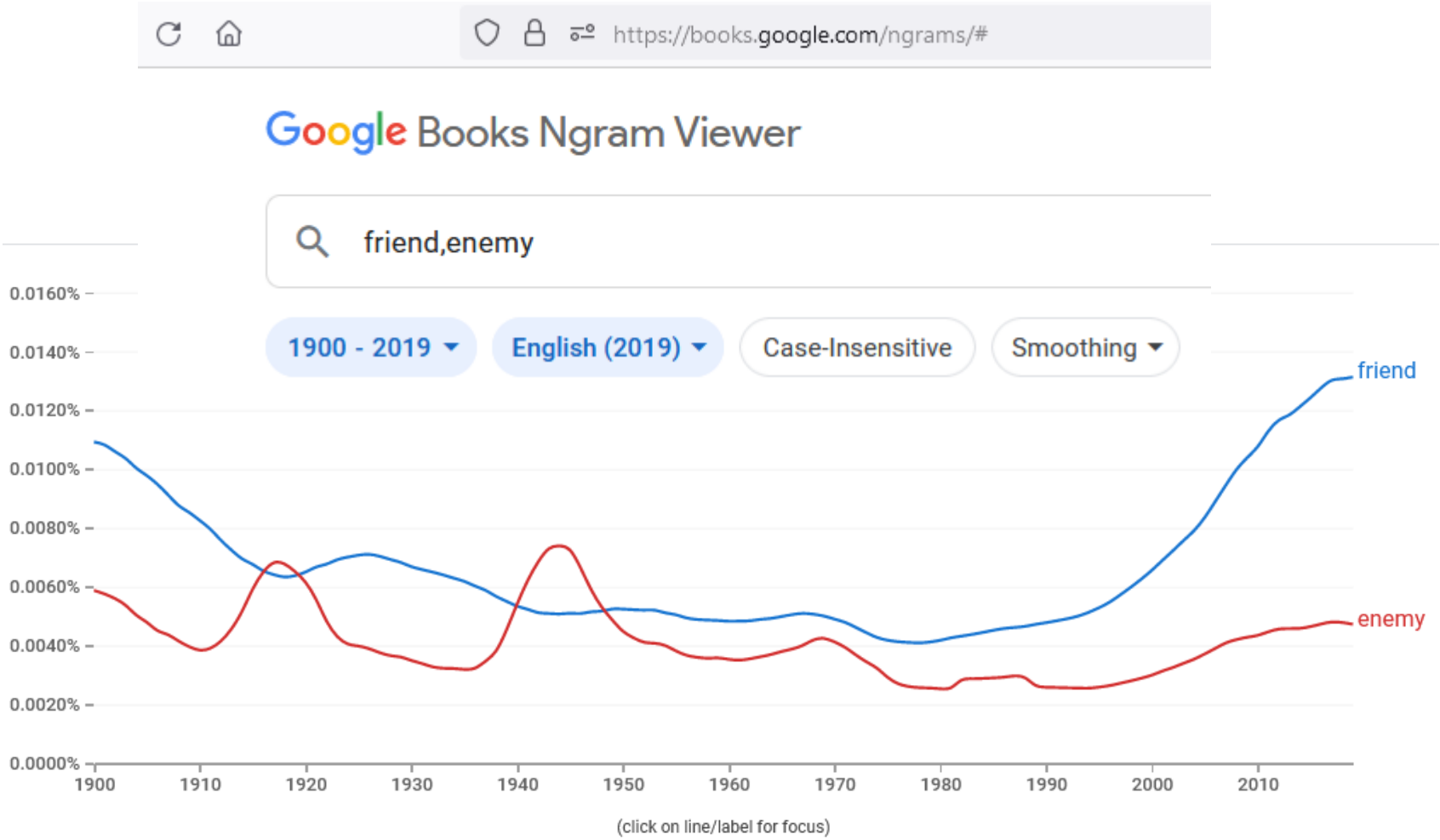
- **Lecture 1: count letters in Bible**

- **Another example: Google Ngram viewer**
  - Ngram informs how words evolve
  - Shows number of times phrases occur in books over the years
  - https://books.google.com/ngrams

- **Funny video on irregular words**
- **https://www.youtube.com/watch?v=tFW7orQsBuo**

# Studying Language Evolution

- **friend vs enemy**



# Processing Data

- **How do we find the longest word in .. Any text?**
- **How do we find the word that occurs the most?**
- **How is this related to how Google Search works?**

- **Text files can be viewed as sequences**
  - Sequences of lines
  - Each line is a string
  - Some clean-up because of ‘\n’

# File Pattern: One line at a time

- **Simplest and reasonably efficient Python pattern**
  - Open, loop, close, return/process
  - LineCounter.py

- **File as sequence**
  - One line at-a-time

```
7   def lineCount(fname):
8       """
9       return # lines in file fname
10      """
11      f = open(fname)
12      lc = 0
13      for line in f:
14          lc = lc + 1
15
16      f.close()
17      return lc
```

# lineCount function

```
7   def lineCount(fname):
8       """
9       return # lines in file fname
10      """
11      f = open(fname)
12      lc = 0
13      for line in f:
14          lc = lc + 1
15
16      f.close()
17      return lc
```

# altCount function

```
19  def altCount(fname):
20      """
21      return # lines in file fname
22      """
23      f = open(fname)
24      lc = len(f.readlines())
25      f.close()
26      return lc
```

# main

```
28  if __name__ == "__main__":
29      name = "data/poe.txt"
30      pc = lineCount(name)
31      print("# lines:",pc)
32      pc2 = altCount(name)
33      print("# lines:",pc2)
```

# File Objects

- **A file is an object, like a string**
  - Functions applied to object: **`len("word")`**
  - To get file object use **`open("data.txt")`**
  - What is returned? Integer value, file object

- **Often methods (aka function) applied to object**
  - **`f.readlines(), f.read(), f.close()`**
  - Just like: **`st.lower(), st.count("e")`**

# WOTO-3 Files
# http://bit.ly/101s23-0214-3