Textual Analysis & Introduction to Python

Feb 18 2016

Tuesday's Class Wrap-up

- Tuesday's Class
  - Using Matrix Multiplication (MMULT)
  - What if we use counting?
    - So much difficult to build 2-D different and sum map

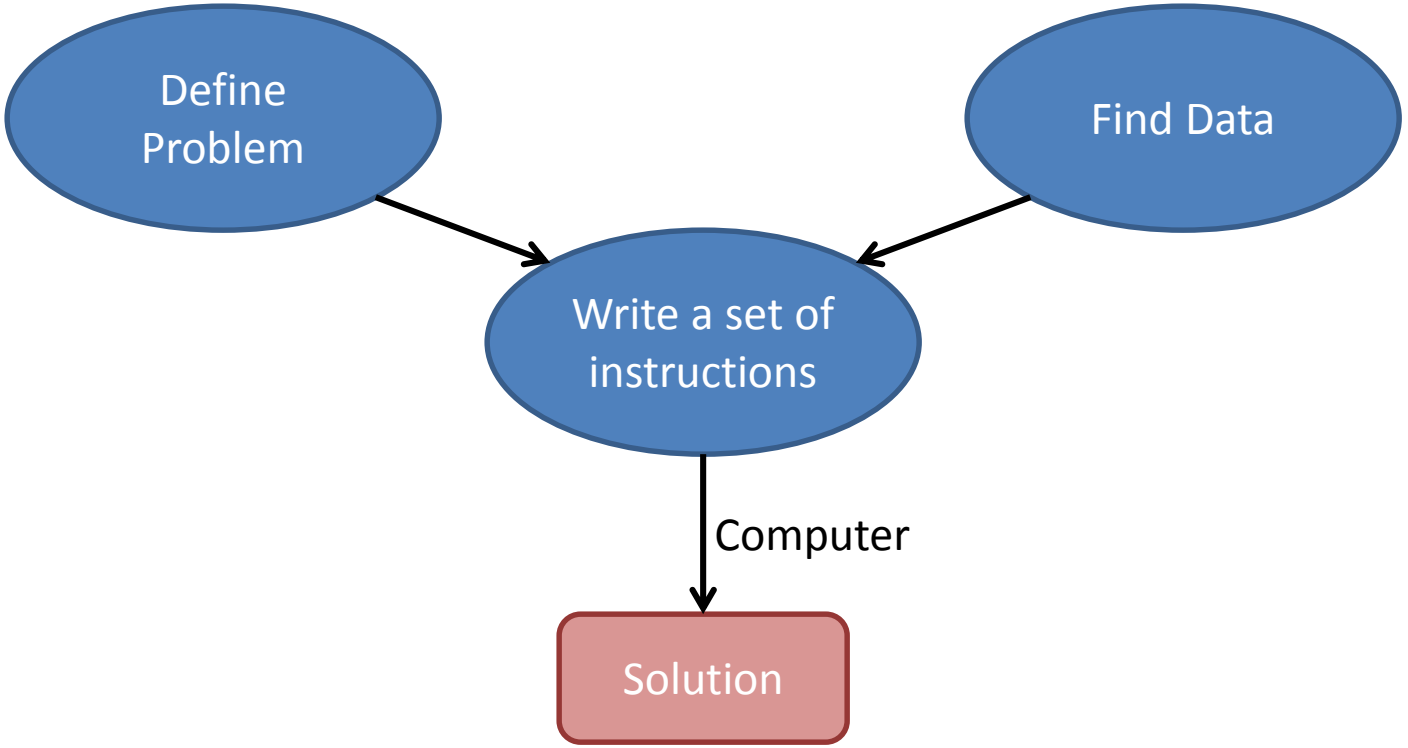
Today's Class

- Intro to text analysis problems
- Intro to Python

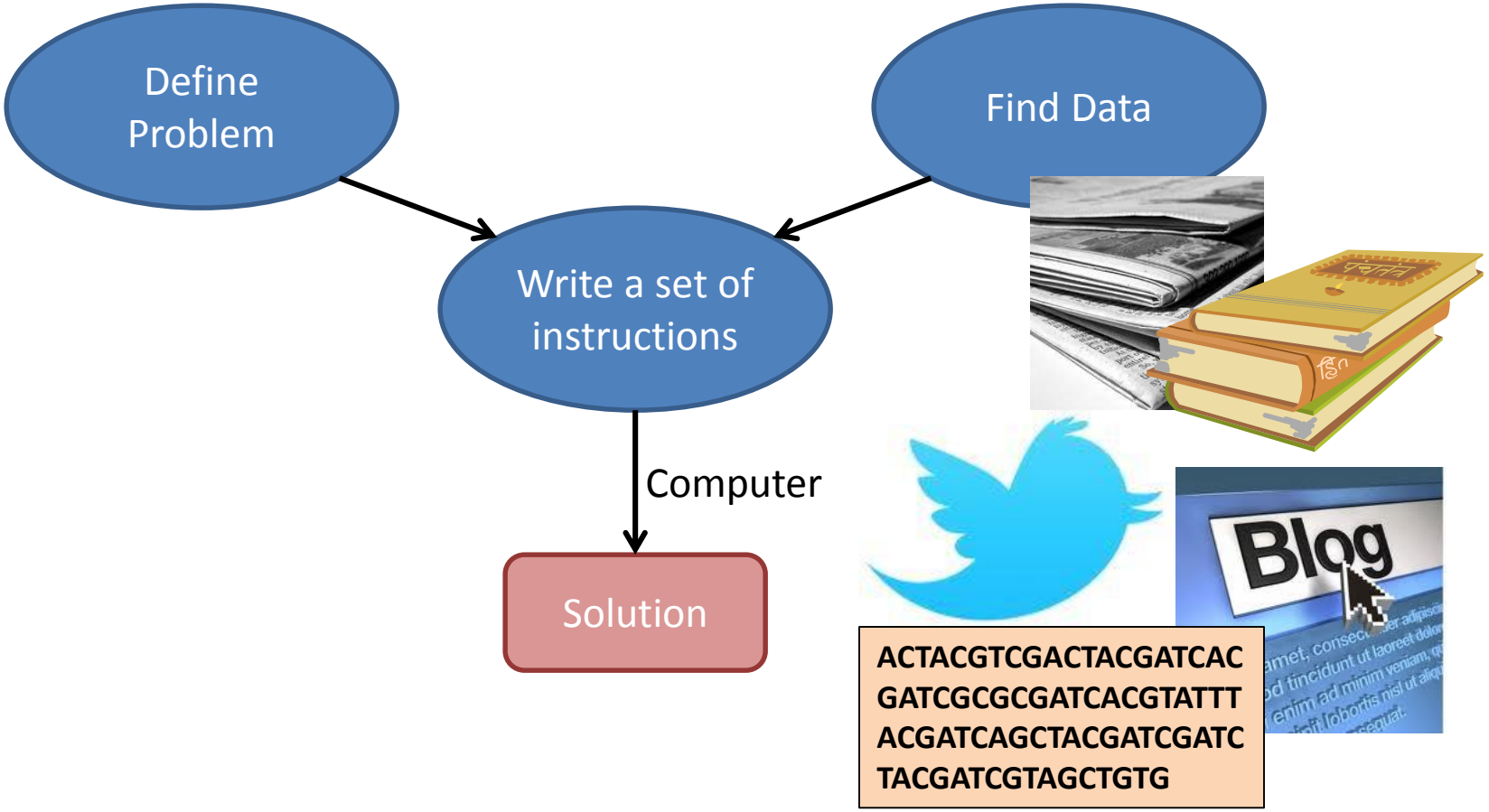
Text Analysis and Python

We're starting a *new unit* in our course!

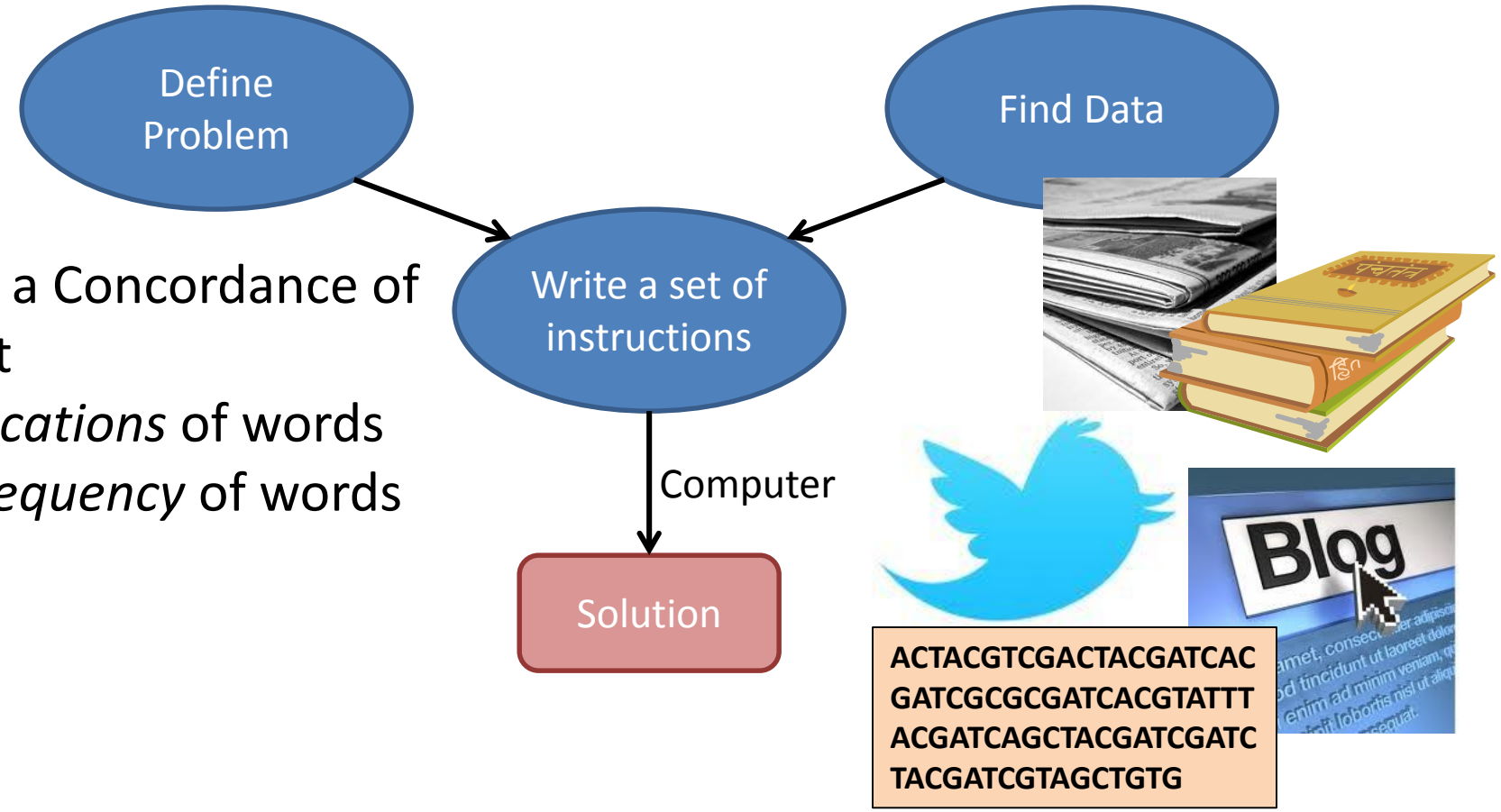
Textual Analysis



Textual Analysis



Textual Analysis



Concordances

Alphabetical index of all words in a text

Word	Page Numbers
Apple	4,7,10,27
Banana	77,110,130
Carrot	50,101
Date	9
…	…

Concordances

- Before computers, was a *huge* pain.
- What texts might have had concordances?

http://en.wikipedia.org/wiki/Concordance_(publishing)

Concordances

- Before computers, was a *huge* pain.
- What texts might have had concordances?
  - The Bible
  - The Quran
  - The Vedas
  - Shakespeare

http://en.wikipedia.org/wiki/Concordance_(publishing)

Concordances

- Before computers, was a *huge* pain.
- What texts might have had concordances?
  - The Bible
  - The Quran
  - The Vedas
  - Shakespeare

Not a "New" Problem: First Bible Concordance completed in 1230

http://en.wikipedia.org/wiki/Concordance_(publishing)

Concordances

- How long would the King James Bible take us?
  - 783,137 words

http://agards-bible-timeline.com/q10_bible-facts.html

Concordances

- How long would the King James Bible take us?
  - 783,137 words

800,000 * (3 min. to look up word and put page #) = 2,400,000 minutes
= 40,000 hours
= 1,667 days
= 4.5 years

http://agards-bible-timeline.com/q10_bible-facts.html

Concordances

- How long would the King James Bible take us?
  - 783,137 words

800,000 * (3 min. to look up word and put page #) = 2,400,000 minutes
= 40,000 hours
= 1,667 days
= 4.5 years

Takes 70 hours to read the King James Bible aloud

http://agards-bible-timeline.com/q10_bible-facts.html

Strong's Concordance

- Concordance of the King James Bible
- Published in 1890 by James Strong

ANT
Prv 6: 6 Go to the **a**, thou sluggard; consider her H5244

ANTICHRIST
1Jn 2:18 as ye have heard that **a** shall come, even *G500*
22 is **a**, that denieth the Father and the Son. *G500*
4: 3 this is that *spirit* of **a**, whereof ye have *G500*
2Jn 7 in the flesh. This is a deceiver and an **a**. *G500*

ANTICHRISTS
1Jn 2:18 are there many **a**; whereby we know that *G500*

ANTIOCH
Act 6: 5 Parmenas, and Nicolas a proselyte of **A**: *G491*
11:19 and Cyprus, and **A**, preaching the word *G490*
20 they were come to **A**, spake unto the *G490*
22 Barnabas, that he should go as far as **A**. *G490*
26 brought him unto **A**. And it came to pass, *G490*
26 disciples were called Christians first in **A**. *G490*
27 came prophets from Jerusalem unto **A**. *G490*
13: 1 church that was at **A** certain prophets *G490*
14 they came to **A** in Pisidia, and went *G490*
14:19 *certain* Jews from **A** and Iconium, who *G490*
21 again to Lystra, and *to* Iconium, and **A**, *G490*
26 And thence sailed to **A**, from whence *G490*
15:22 their own company to **A** with Paul and *G490*

Jas 1:21 Wherefore lay **a** all filthiness and *G659*

APELLES
Ro 16:10 Salute **A** approved in Christ. Salute them *G559*

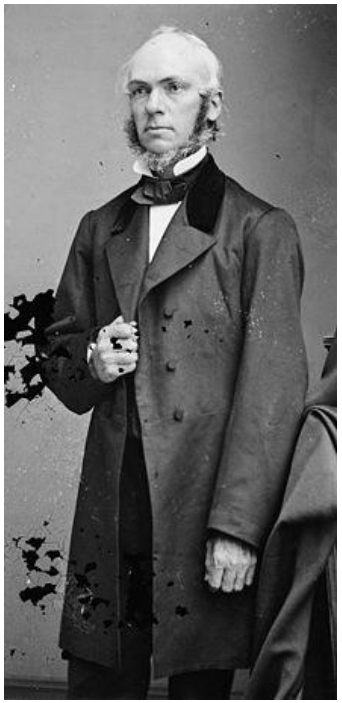
APES
1Ki 10:22 and silver, ivory, and **a**, and peacocks. H6971
2Ch 9:21 and silver, ivory, and **a**, and peacocks. H6971

APHARSACHITES
Ezr 5: 6 companions the **A**, which *were* on this H671
6: 6 companions the **A**, which *are* beyond the H671

APHARSATHCHITES
Ezr 4: 9 the Dinaites, the **A**, the Tarpelites, the H671

APHARSITES
Ezr 4: 9 the Tarpelites, the **A**, the Archevites, the H670

APHEK
Jos 12:18 The king of **A**, one; the king of Lasharon, H663
13: 4 unto **A**, to the borders of the Amorites: H663
19:30 Ummah also, and **A**, and Rehob: twenty H663
1Sa 4: 1 and the Philistines pitched in **A**. H663
29: 1 all their armies to **A**: and the Israelites H663
1Ki 20:26 and went up to **A**, to fight against Israel. H663



Wikipedia

From Concordance to Word Frequency

Suppose our text has 1000 words total.

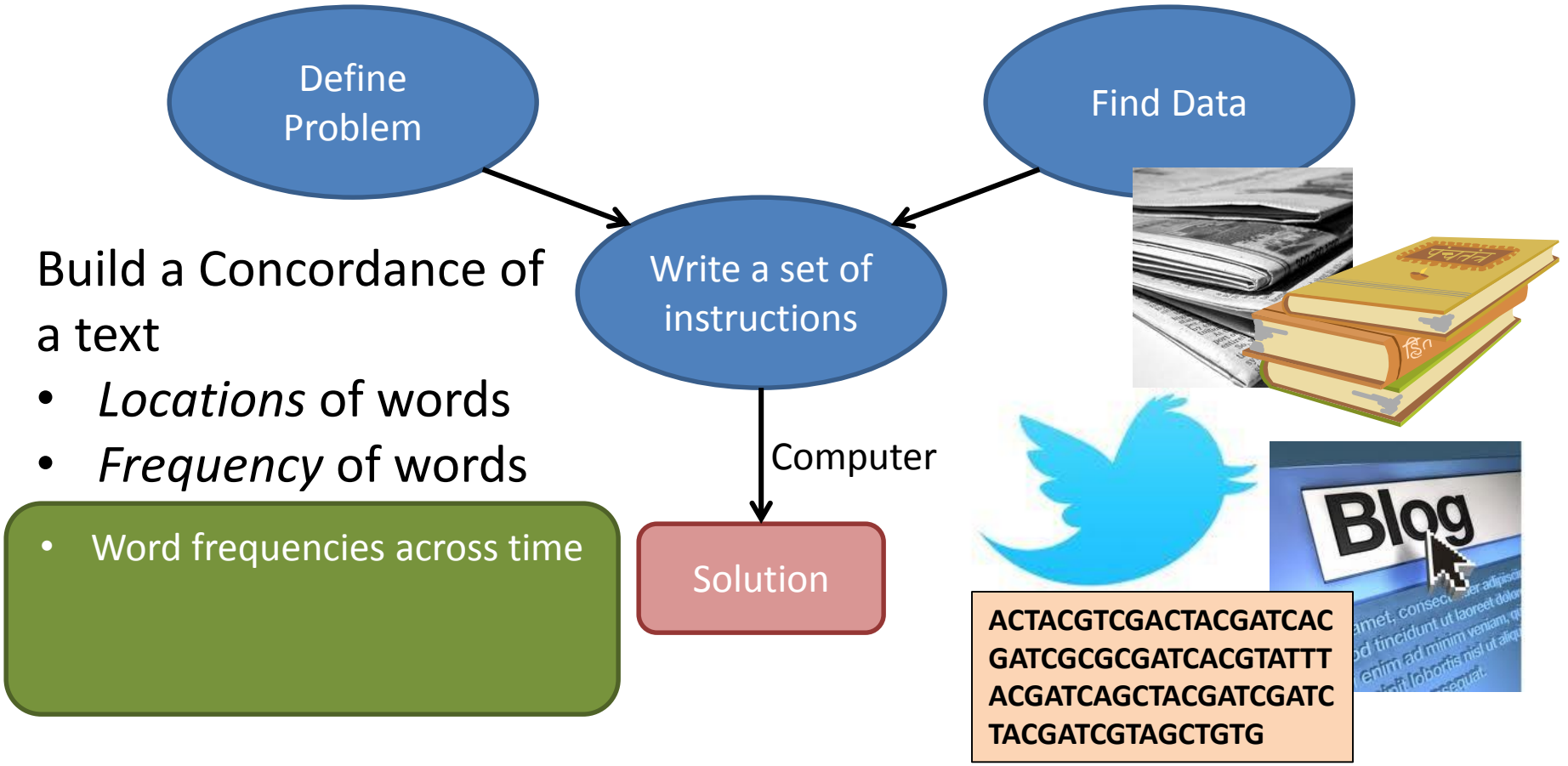
Word	Page Numbers	# of Occurrences	Word Frequency
Apple	4,7,10,27	4	4/1000
Banana	77,110,130	3	3/1000
Carrot	50,101	2	2/1000
Date	9	1	1/1000
…	…	…	…

Google Ngrams

- Google *(verb)* "Google n-grams"
- ngram: a set of *n* words
  - "hello" is a 1-gram
  - "hello there" is a 2-gram

- Click on "Google Ngram viewer" for more information
- Question: what is the data source here?

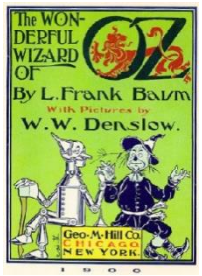
Textual Analysis

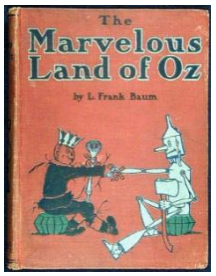


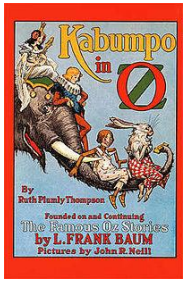
The Wizard of OZ

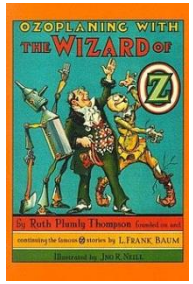
- About 40 Books, written by 7 different authors

#1 … #14 #15 #16 … #33









Lyman Frank Baum

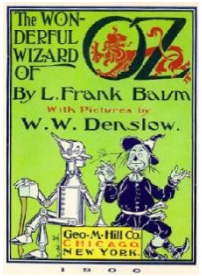
Ruth Plumly Thompson

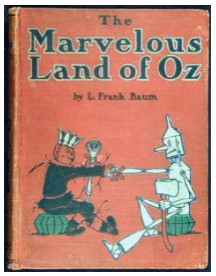
http://www.ssc.wisc.edu/~zzeng/soc357/OZ.pdf

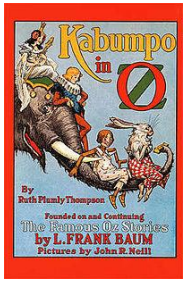
The Wizard of OZ

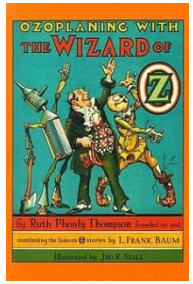
- About 40 Books, written by 7 different authors

#1 ... #14 #15 #16 ... #33









Lyman Frank Baum
(1856-1919)

Ruth Plumly Thompson

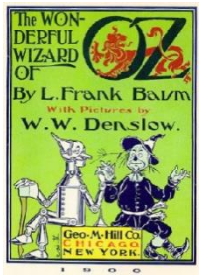
Published in 1921

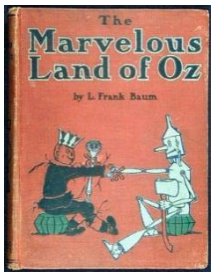
http://www.ssc.wisc.edu/~zzeng/soc357/OZ.pdf

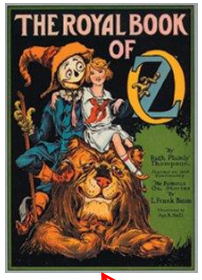
The Wizard of OZ

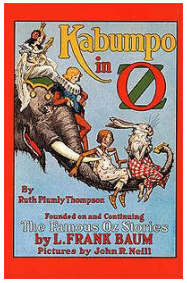
- About 40 Books, written by 7 different authors

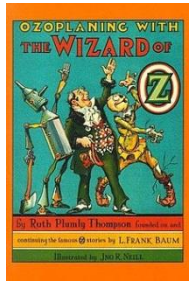
#1 ... #14 #15 #16 ... #33











Lyman Frank Baum
(1856-1919)

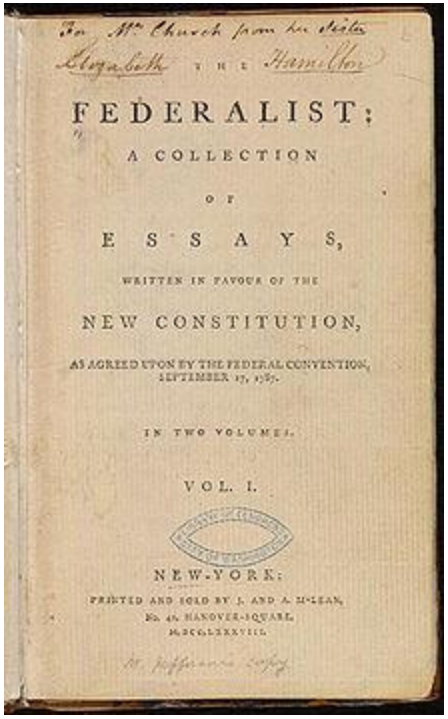
Ruth Plumly Thompson

Published in 1921

http://www.ssc.wisc.edu/~zzeng/soc357/OZ.pdf

The Federalist Papers

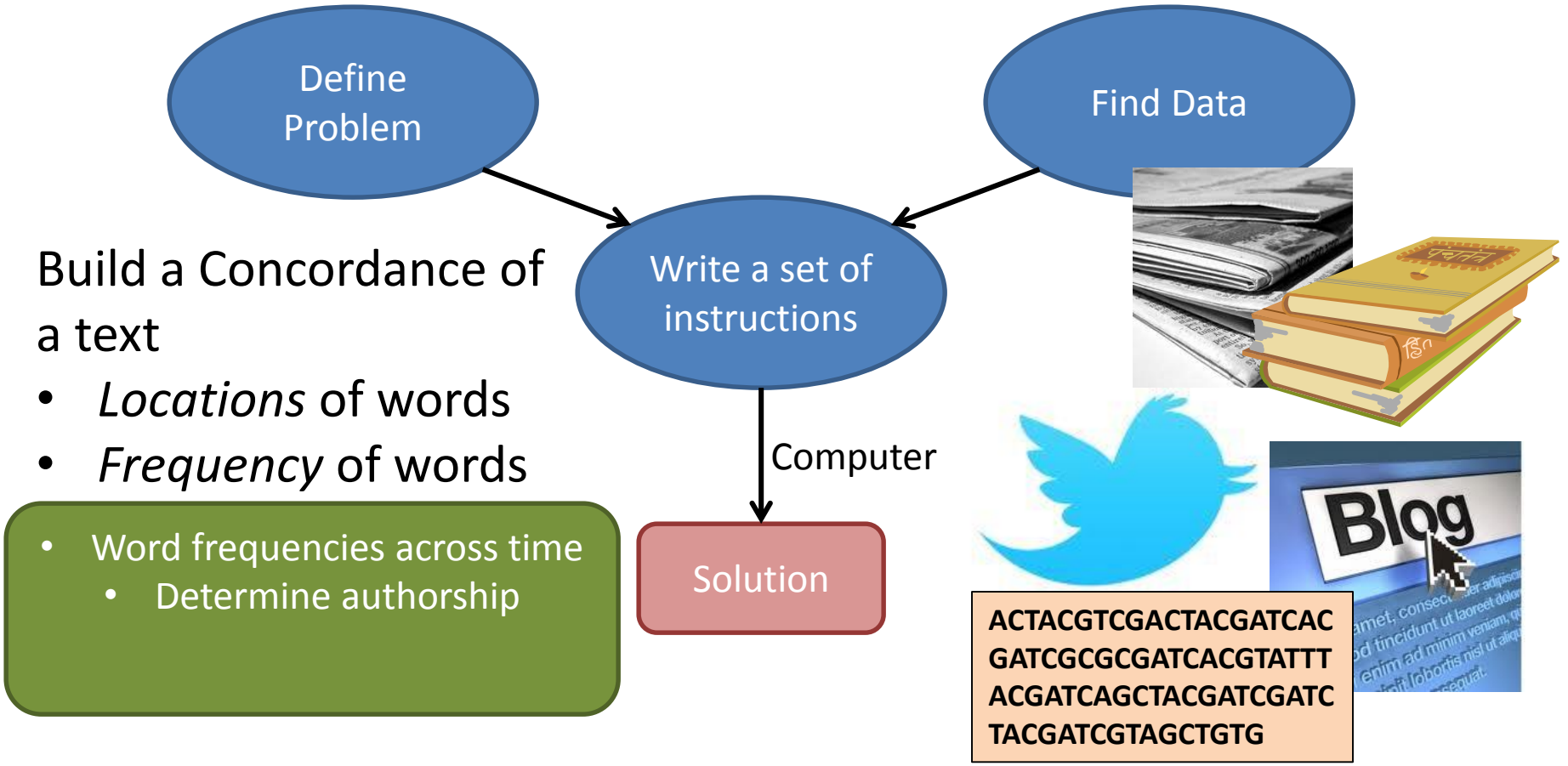
- 85 articles written in 1787 to promote the ratification of the US Constitution
- In 1944, Douglass Adair guessed authorship
  - Alexander Hamilton (51)
  - James Madison (26)
  - John Jay (5)
  - 3 were a collaboration
- Confirmed in 1964 by a computer analysis



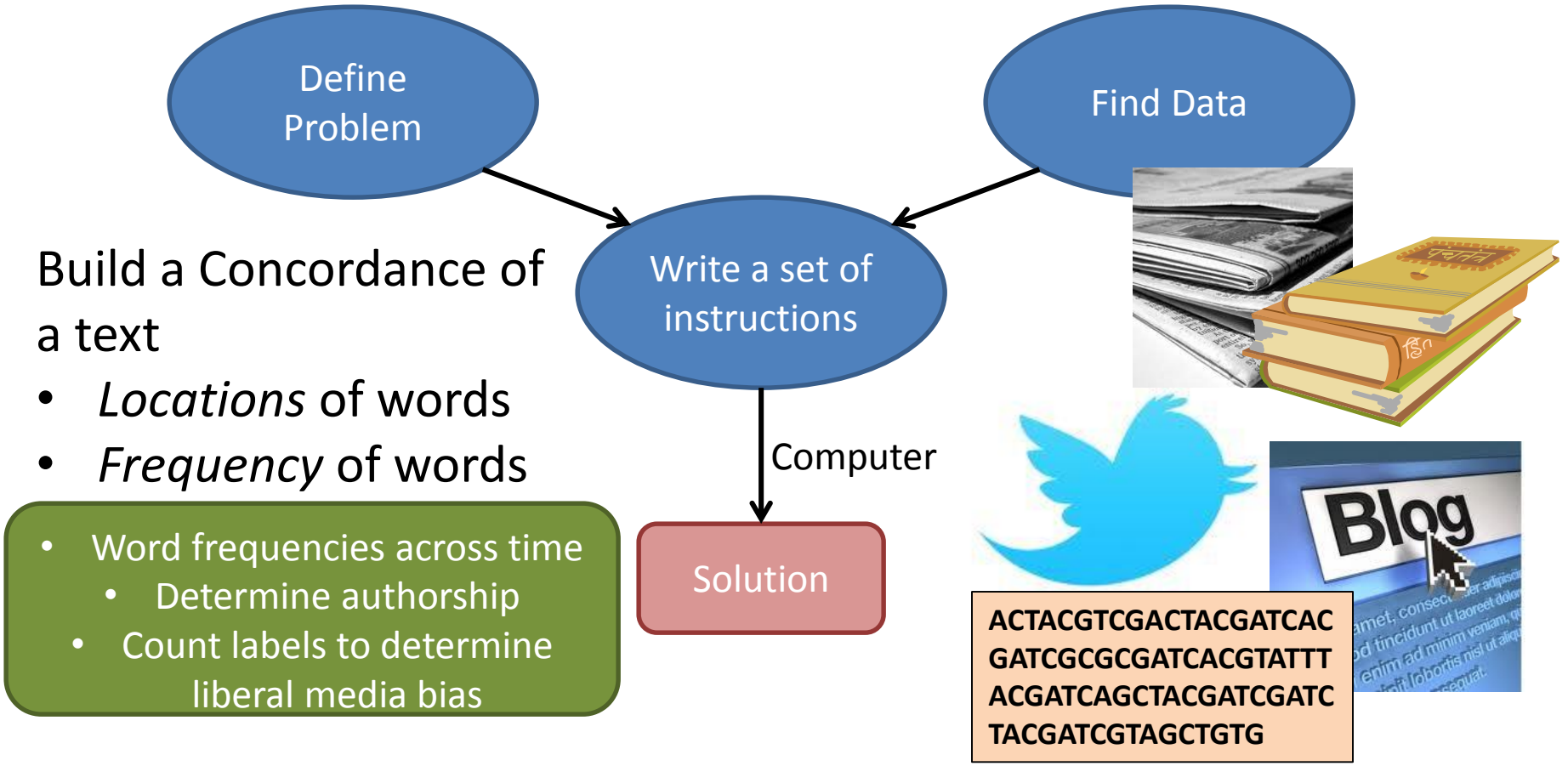
Wikipedia

http://pages.cs.wisc.edu/~gfung/federalist.pdf

Textual Analysis

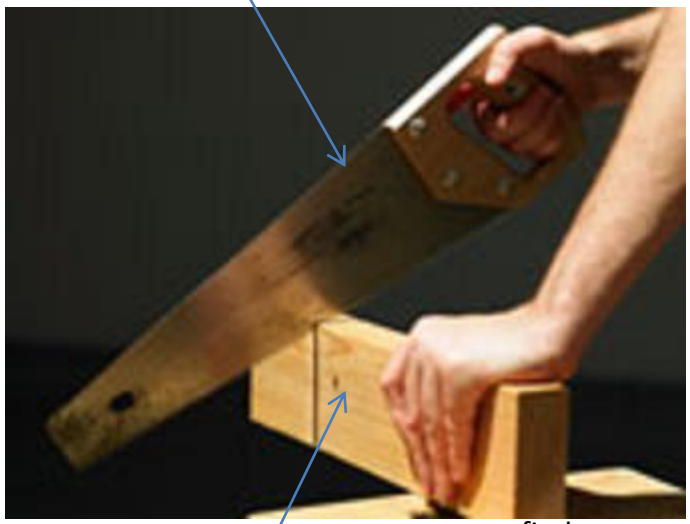


Textual Analysis



How are we going to analyze texts?

Excel

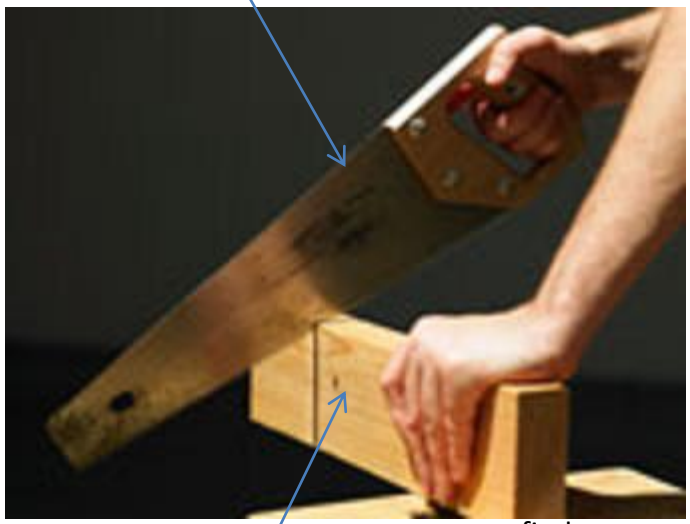


firehow.com

Numerical Data

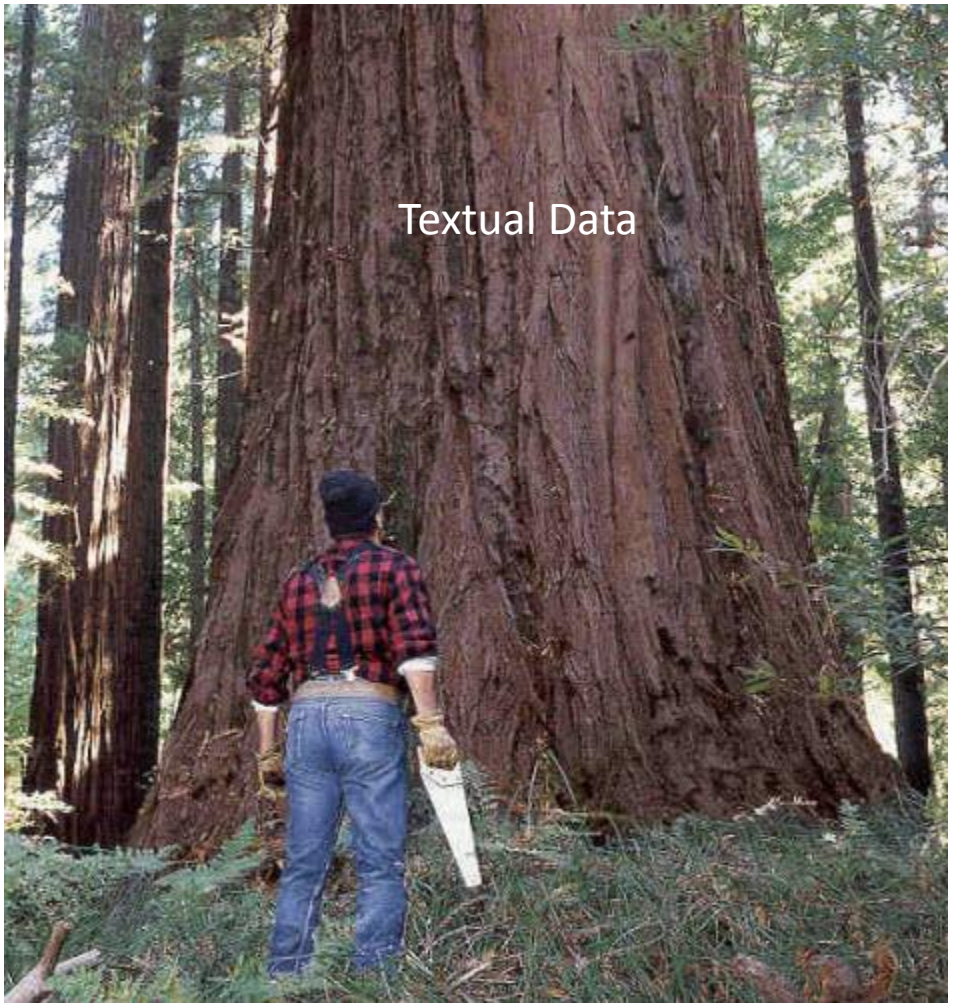
How are we going to analyze texts?

Excel



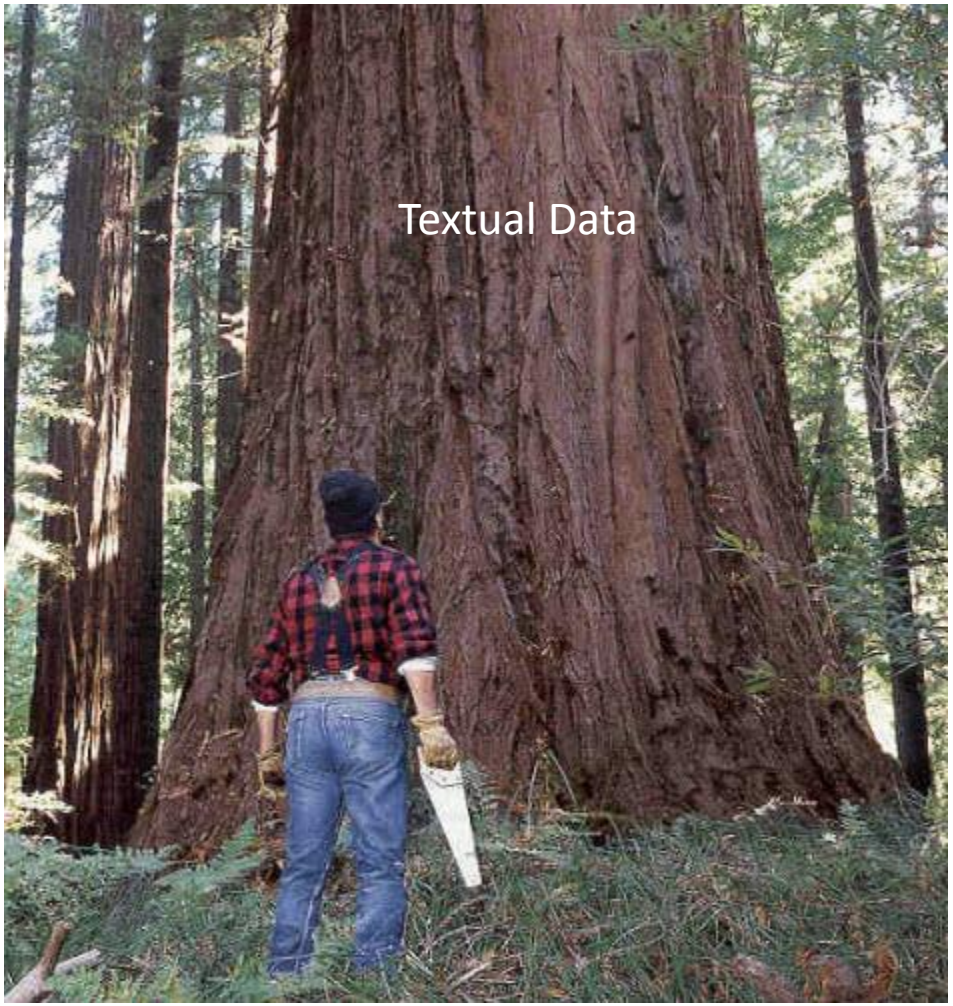
firehow.com

Numerical Data



How are we going to analyze texts?

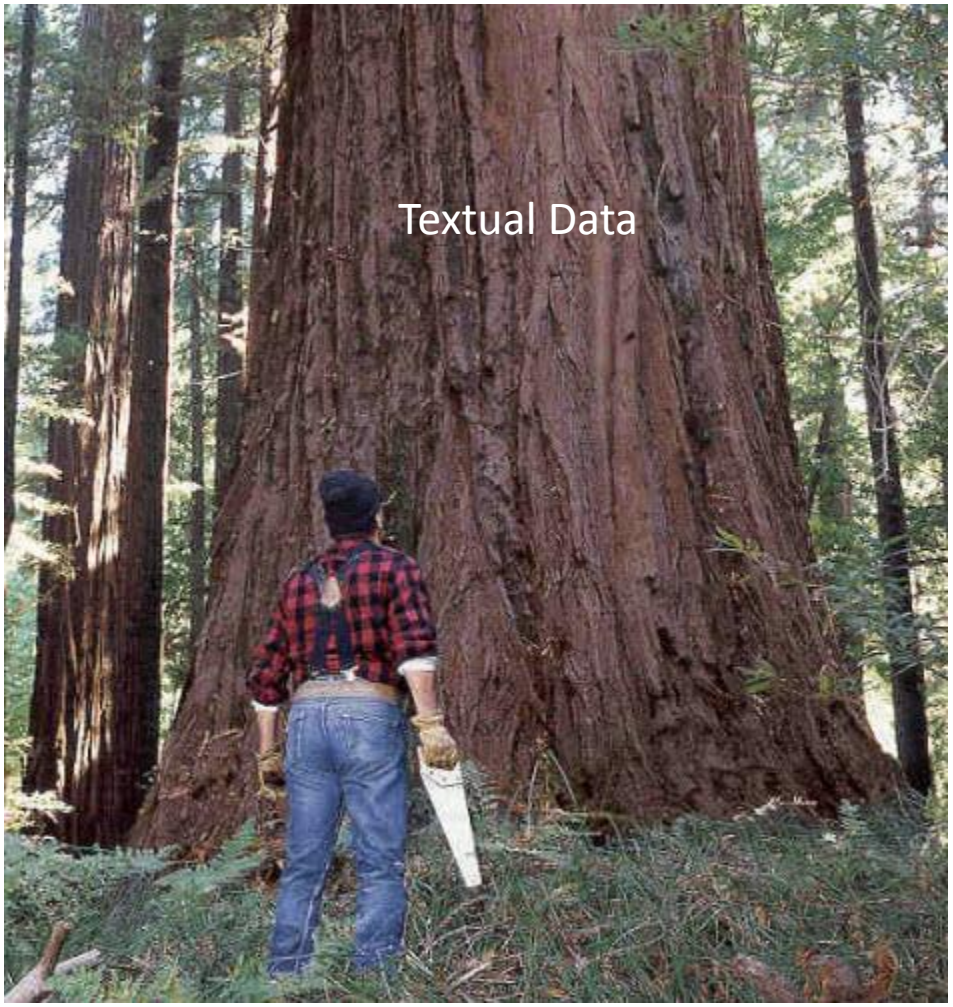
Makita Cordless Chain Saw, $270



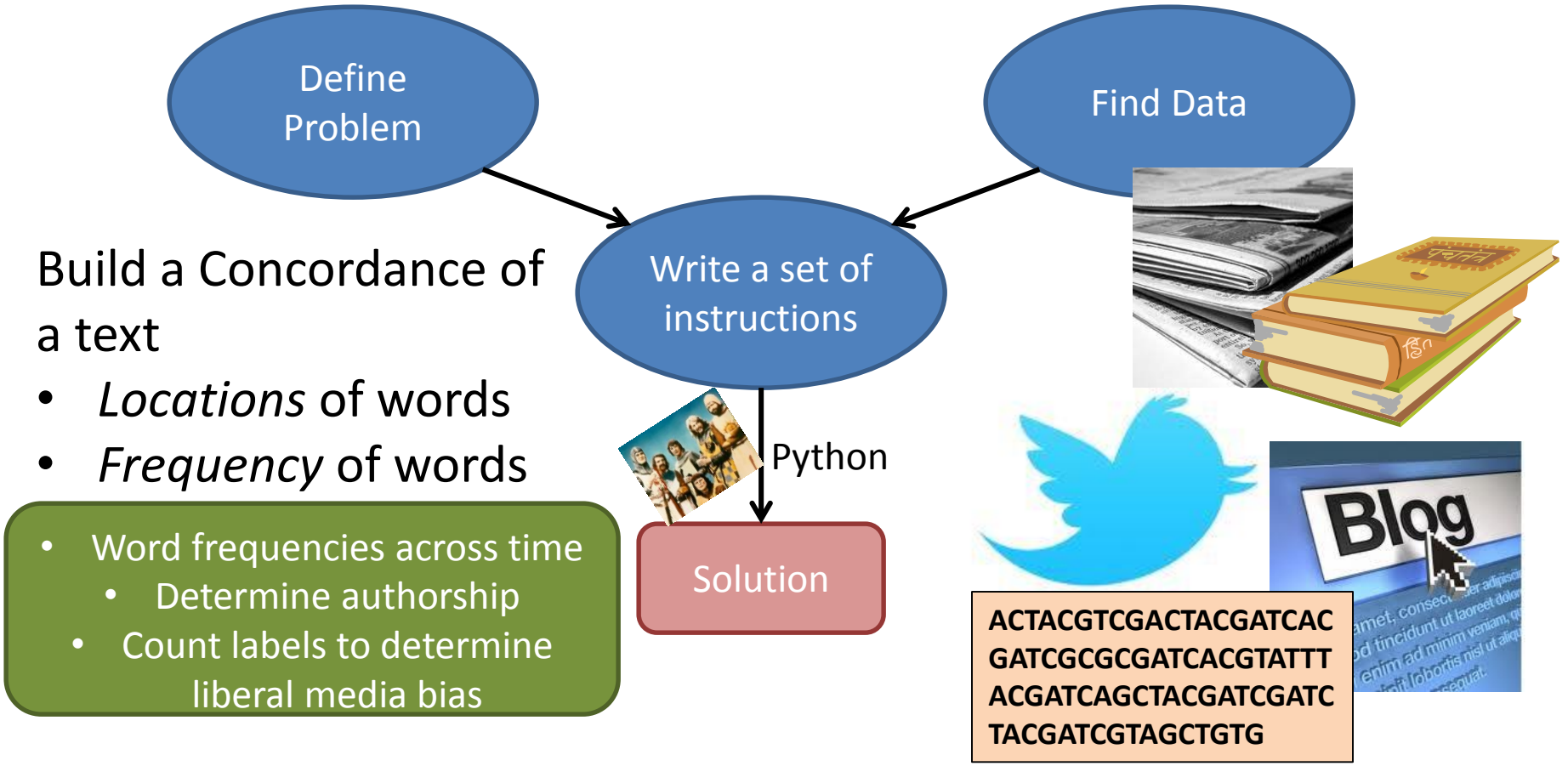
How are we going to analyze texts?

Python: A Programming Language
Free!

9poundhammer.blogspot.com



Textual Analysis



“Python”

“Python”

- **A language** for giving the computer instructions. It has syntax and semantics.

“Python”

- **A language** for giving the computer instructions. It has syntax and semantics.
- Might say “write a Python program”, meaning “write instructions in the Python language”

“Python”

- **A language** for giving the computer instructions. It has syntax and semantics.
- Might say “write a Python program”, meaning “write instructions in the Python language”
- There is an **interpreter** (e.g., IDLE) that takes Python instructions and executes them with the CPU, etc.

Install

- **Let's install** Python 3.5.x
- www.python.org/downloads/

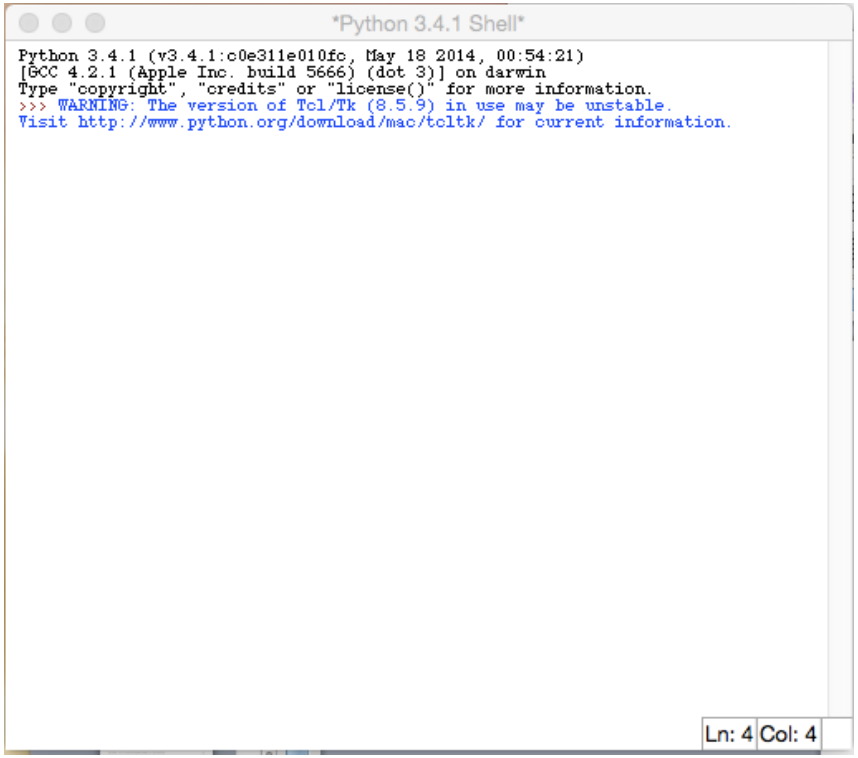
Install – Mac OS X

- On Mac OS X double click the pkg file you downloaded. Follow the instructions by agreeing and click next.

Install - Windows

Let's open IDLE

- On Mac OS X open a terminal window
  Type: idle3
- On Windows
  Start ->
  All Programs ->
  Python ->
  IDLE



Introduction to Python

- **Expressions** are *inputs* that Python evaluates
  - Expressions return an *output*
  - Like using a **calculator**

1. **Expressions**
2. Assignments
   a) Variables
3. Types
   a) Integers
   b) Floats
   c) Strings
   d) Lists

Introduction to Python

- **Expressions** are *inputs* that Python evaluates
  - Expressions return an *output*
  - Like using a **calculator**

Type the expressions below

after '>>>' and hit Enter

```
>>> 4+2
6
>>> 4-2
2
>>> 4*2
8
>>> 4/2
2.0
```

1. **Expressions**
2. Assignments
   a) Variables
3. Types
   a) Integers
   b) Floats
   c) Strings
   d) Lists

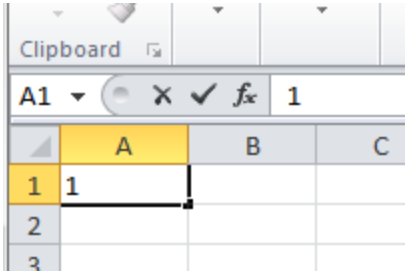
Introduction to Python

- **Assignments** do not have an output, they are *stored in memory*.

1. Expressions
2. **Assignments**
   a) Variables
3. Types
   a) Integers
   b) Floats
   c) Strings
   d) Lists

Introduction to Python

- **Assignments** do not have an output, they are *stored in memory*.
  - We've done this kind of thing with spreadsheets

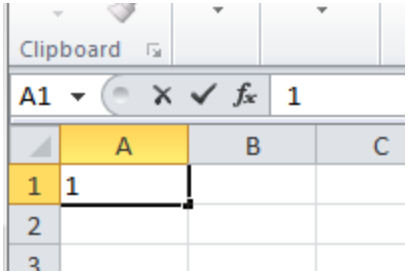


We have *assigned* the number 1 to cell A1.

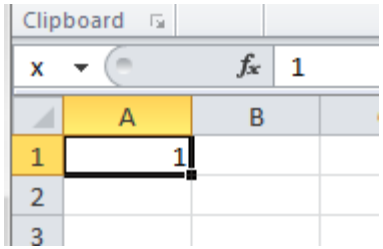
1. Expressions
2. **Assignments**
   a) Variables
3. Types
   a) Integers
   b) Floats
   c) Strings
   d) Lists

Introduction to Python

- **Assignments** do not have an output, they are *stored in memory*.
  - We've done this kind of thing with spreadsheets



We have *assigned* the number 1 to cell A1.



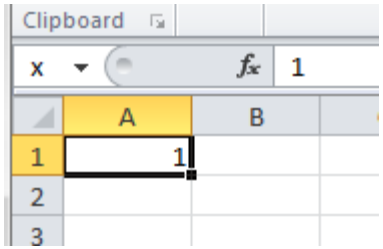
Let's rename cell A1 to x.

1. Expressions
2. **Assignments**
   a) Variables
3. Types
   a) Integers
   b) Floats
   c) Strings
   d) Lists

Introduction to Python

- **Assignments** do not have an output, they are *stored in memory*.
  - We've done this kind of thing in Spreadsheets

```
>>> x = 1
```

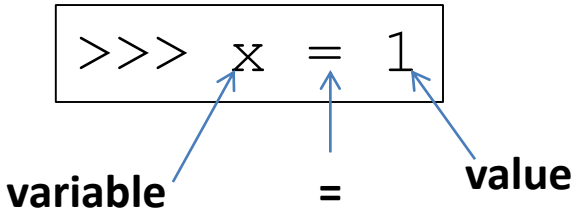


Let's rename cell A1 to x.

1. Expressions
2. **Assignments**
   a) **Variables**
3. Types
   a) Integers
   b) Floats
   c) Strings
   d) Lists

Introduction to Python

- **Assignments** do not have an output, they are *stored in memory*.
  - We've done this kind of thing in Spreadsheets



Memory	
Variable Name	Value
x	1

1. Expressions
2. **Assignments**
   a) **Variables**
3. Types
   a) Integers
   b) Floats
   c) Strings
   d) Lists

Introduction to Python

- **Assignments** do not have an output, they are *stored in memory*.
  - We've done this kind of thing in Spreadsheets

```
>>> x = 1
```

  - We can now use x in expressions!

```
>>> x+1
2
>>> (x+2)*3
9
```

Memory	
Variable Name	Value
x	1

1. Expressions
2. **Assignments**
   a) **Variables**
3. Types
   a) Integers
   b) Floats
   c) Strings
   d) Lists

Introduction to Python

- You can name your variables anything

```
>>> numberOfEggs = 100
>>> myNumber = 12345
>>> noninteger = 4.75
```

- Well, *almost* anything
  - No spaces, operators, punctuation, number in the first position
- Variables usually start with a lowercase letter and, if useful, describe something about the value.

1. Expressions
2. **Assignments**
   a) **Variables**
3. Types
   a) Integers
   b) Floats
   c) Strings
   d) Lists

Choices

- Why are *those* the rules for names?
- Someone thought about it and made a choice
- Usually based on years of experience
- Many choices seem crazy...
  - Until one day you see they're obviously correct

Introduction to Python

- Try this:

```
>>> 3/2
```

1. Expressions
2. Assignments
   a) Variables
3. **Types**
   a) Integers
   b) Floats
   c) Strings
   d) Lists

Introduction to Python

- Try this:

```
>>> 3/2
```

- There are *two* types of numbers in Python. The `type()` function is useful.

```
>>> type(3)
<class 'int'>
>>> type(3/2)
<class 'float'>
```

1. Expressions
2. Assignments
   a) Variables
3. **Types**
   a) Integers
   b) Floats
   c) Strings
   d) Lists

Introduction to Python

- Try this:

```
>>> 3/2
```

- There are *two* types of numbers in Python. The `type()` function is useful.

```
>>> type(3)
<class 'int'>
>>> type(3/2)
<class 'float'>
```

- Floats are *numbers that display with decimal points*.

```
>>> 3.0/2.0
1.5
```

1. Expressions
2. Assignments
   a) Variables
3. **Types**
   a) Integers
   b) Floats
   c) Strings
   d) Lists

Introduction to Python

- Try this:

```
>>> 3/2
```

- There are *two* types of numbers in Python. The `type()` function is useful.

```
>>> type(3)
<class 'int'>
>>> type(1.5)
<class 'float'>
```

- Floats are *decimals*.

```
>>> 3.0/2.0
1.5
```

General Rule: Expressions for a particular type will *output* that same type! **Except for the division operator (/)**

1. Expressions
2. Assignments
   a) Variables
3. **Types**
   a) Integers
   b) Floats
   c) Strings
   d) Lists

Introduction to Python

- **Strings** are sequences of characters, surrounded by single quotes.

```
>>> 'hi'
'hi'
>>> myString = 'hi there'
>>> myString
'hi there'
```

1. **Expressions**
2. Assignments
   a) Variables
3. **Types**
   a) Integers
   b) Floats
   c) Strings
   d) Lists

Introduction to Python

- **Strings** are sequences of characters, surrounded by single quotes.

```
>>> 'hi'
'hi'
>>> myString = 'hi there'
>>> myString
'hi there'
```

- The + operator concatenates

General Rule: Expressions for a particular type will *output* that same type!

1. **Expressions**
2. Assignments
   a) Variables
3. **Types**
   a) Integers
   b) Floats
   c) Strings
   d) Lists

Introduction to Python

- **Strings** are sequences of characters, surrounded by single quotes.

```
>>> 'hi'
'hi'
>>> myString = 'hi there'
>>> myString
'hi there'
```

- The + operator concatenates

```
>>> endString = ' class!'
>>> myString + endString
'hi there class!'
>>> newString = myString + endString
>>> newString
'hi there class!'
```

1. **Expressions**
2. Assignments
   a) Variables
3. **Types**
   a) Integers
   b) Floats
   c) Strings
   d) Lists

Introduction to Python

- **Lists** are an ordered collection of items

```
>>> [5,10,15]
[5, 10, 15]
>>> myList = [5,10,15]
>>> myList
[5, 10, 15]
>>> stringList = ['hi','there','class']
>>> stringList
['hi', 'there', 'class']
```

1. Expressions
2. Assignments
   a) Variables
3. **Types**
   a) Integers
   b) Floats
   c) Strings
   d) Lists

Introduction to Python

- **Lists** are an ordered collection of items

```
>>> [5,10,15]
[5, 10, 15]
>>> myList = [5,10,15]
>>> myList
[5, 10, 15]
>>> stringList = ['hi','there','class']
>>> stringList
['hi', 'there', 'class']
```

- Individual items are *elements*
- The + operator concatenates

```
>>> myList + stringList
[5, 10, 15, 'hi', 'there', 'class']
```

1. Expressions
2. Assignments
   a) Variables
3. **Types**
   a) Integers
   b) Floats
   c) Strings
   d) Lists

Introduction to Python

- To get an element from a list, use the expression `>>> myList[i]` where `i` is the *index*. Often spoken: "myList sub i"
- **List indices start at 0!**

```
>>> myList[0]
5
>>> myList[1]
10
>>> myList[2]
15
```

- What does `>>> myList[1] = 4` do?

1. Expressions
2. Assignments
   a) Variables
3. **Types**
   a) Integers
   b) Floats
   c) Strings
   d) Lists

Introduction to Python

- To get a **range** of elements from a list, use the expression `>>> myList[i:j]` where `i` is the start index (inclusive) and `j` is the end index (**exclusive**).

```
>>> myList
[5, 4, 15]
>>> myList[0:2]
[5, 4]
>>> myList[1:3]
[4, 15]
>>> newList = [2,5,29,1,9,59,3]
>>> newList
[2, 5, 29, 1, 9, 59, 3]
>>> newList[2:6]
[29, 1, 9, 59]
```

1. Expressions
2. Assignments
   a) Variables
3. **Types**
   a) Integers
   b) Floats
   c) Strings
   d) Lists

Introduction to Python

- **Indexing** and **ranges** also work on Strings.

```
>>> myString
'hi there'
>>> myString[0]
'h'
>>> myString[5]
'e'
>>> myString[6]
'r'
>>> myString[0:6]
'hi the'
```

1. Expressions
2. Assignments
   a) Variables
3. **Types**
   a) Integers
   b) Floats
   c) Strings
   d) Lists

Introduction to Python

- Remember what assignments do

Memory	
Variable Name	Value
x	1
amountOfEggs	100
myNumber	12345
noninteger	4.75
myString	'hi there'
endString	' class!'
myList	[5,4,15]
stringList	['hi','there','class']
newList	[2,5,29,1,9,59,3]

1. Expressions
2. **Assignments**
   a) Variables
3. Types
   a) Integers
   b) Floats
   c) Strings
   d) Lists

Class Review

Python So Far (to be updated/refined!)

1. Expressions
   - Evaluate *input* and returns some *output* (calculator)
2. Variable Assignments: <variable> = <expression>
   - Store the value of the expression in the variable instead of outputting the value.
   - There is *always* an equals sign in an assignment
   - Variables can be named many things
   - List assignments: <listvar>[<index>] = <expression>
3. Types
   - Integers vs. Floats (Decimals)
   - Strings in single quotes
   - Lists are sets of other types
   - We can index into Strings & Lists

Expressions for a particular type will *output* that same type! Floats have a higher priority

A brief review of things you didn't know you'd learned

- In a spreadsheet, there are many **types** of data
- Numbers (start with +/- or a digit)
- Strings (nondigit-start, or start with ')
- Formulas (start with =)
- Ranges (B2, B2:B4, B2:D5)
- Errors (#N/A)
- Blanks

What shows up in a cell

- If a formula evaluates to a number or string, that number or string
- If it evaluates to a range, the value in the first cell of that range ...sometimes
  - If you write =A1:A6, you get A1
  - If you write =OFFSET(A1:A6, 0, 0), Gsheets fills in adjacent cells; excel just fills in one cell
- If evaluation leads to an error, then #N/A
- Mostly, we never notice any of this
- In Python, the rules have greater consistency, and because results aren't instantly visible, knowing the rules matters more