Section 08

NATURAL LANGUAGE TOOLKIT (NLTK)

Cscie63 Big Data Analytics

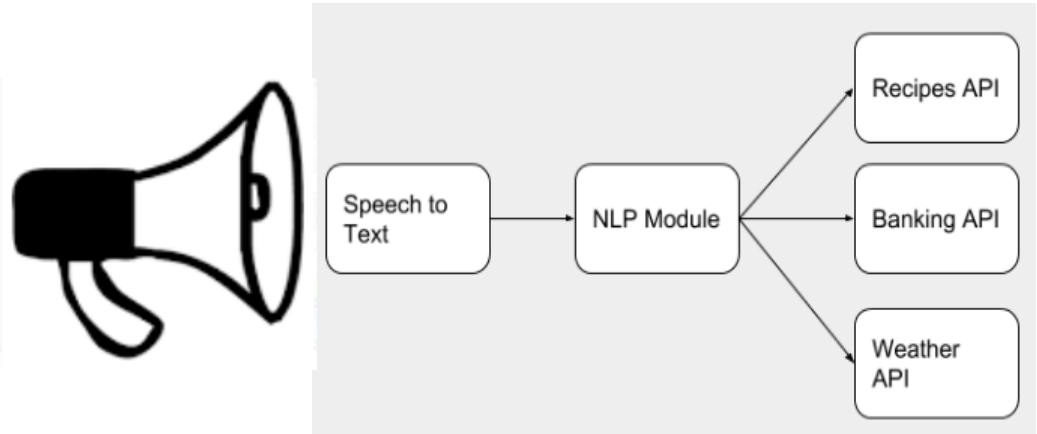
Harvard Extension School

Section 08 Agenda

- NLTK overview
- Python/Anaconda install
- Install NLTK (load data, XXX)
- Jupyter Notebook navigation
- How to import Collections and load data into Python / Tables
- Text & List & string manipulations
- Setting up Data Frames using Pandas
- Parts of Speech
- Python Notebook demo

NLTK Examples

Example 1



Siri: *What is the weather and traffic conditions for my drive to work?*
Alexa: *Dim the lights and thermostat.*
Google Assistant…

Example 2

1. **Tokenization**

```
['What', 'is', 'the', 'weather', 'in', 'Chicago', '?']
```

2. **Stop word removal**

```
['What', 'weather', 'Chicago', '?']
```

3. **Parts of Speech Tagging**

```
[('What', 'WP'), ('weather', 'NN'), ('Chicago', 'NNP'), ('?', '.')]
```

4. **Named Entity Recognition**

```
>>> print(nltk.ne_chunk(tagged))
(S What/WP weather/NN (GPE Chicago/NNP) ?/.)
```

Meaning of sentence can now be analyzed
'Chicago'=location & weather (can be associated with a weather service -> Call a Weather Web Service

http://xrds.acm.org/blog/2017/01/build-natural-language-processing-based-intelligent-assistant-using-python-easy/

Natural Language Toolkit

Online documentation: http://www.nltk.org/

- Used for unstructured text data to process data for classification, tokenization, stemming, tagging, parsing, and semantic reasoning
- Open Source package to Python with its own prepackaged data sets.
  - Very efficient for dealing with large text files & "functions for processing linguistic data"
- Excellent for extracting key words & phrases.

From Zoran's slide:

NLP applications

- Text Categorization
  - Classify documents by topics, language, author, spam filtering, information retrieval (relevant, not relevant), sentiment classification (positive, negative)
- Spelling & Grammar Corrections
- Information Extraction
- Speech Recognition
- Information Retrieval
  - Synonym Generation
- Summarization
- Machine Translation
- Question Answering
- Dialog Systems
  - Language generation

What is Anaconda?

https://en.wikipedia.org/wiki/Anaconda_(Python_distribution)

- ‘open source distribution of the **Python** and R **programming** languages for large-scale data processing, predictive analytics, and scientific computing, that aims to simplify package management and deployment. Package versions are managed by the package management system conda’

- ‘Python and over 150 scientific packages automatically installed at once’

https://www.anaconda.com/what-is-anaconda/

My Environment Set up

My environment:

1. Windows 10 64-bit

View basic information about your computer

Windows edition

Windows 10 Home

© 2017 Microsoft Corporation. All rights reserved.

System

Manufacturer:	Dell
Model:	Inspiron 5423
Processor:	Intel(R) Core(TM) i3-2367M CPU @ 1.40GHz 1.40 GHz
Installed memory (RAM):	6.00 GB (5.87 GB usable)
System type:	64-bit Operating System, x64-based processor
Pen and Touch:	No Pen or Touch Input is available for this Display

.

2. I have Anaconda 3.6.2 64-bit (latest installed). **2.7 will install similar to the following slides. It is fine to use 2.7 or 3.6.2.**

```
C:\Users\dhoward>python
Python 3.6.2 |Anaconda, Inc.| (default, Sep 19 2017, 08:03:39) [MSC v.1900 64 bit (AMD64)] on win32
Type "help", "copyright", "credits" or "license" for more information.
```

3. My environment variables:

C:\Users\dhoward\anaconda3_64bit

c:\users\dhoward\anaconda3_64bit\scripts

C:\Users\dhoward\anaconda3_64bit

c:\users\dhoward\anaconda3_64bit\scripts

Anaconda Windows Installation Instructions

Note: You do not need to install as Administrator unless admin privileges are needed…

Secure | https://docs.anaconda.com/anaconda/install/windows

ANACONDA. DOCUMENTATION

Search

Anaconda Distribution > Installing on Windows

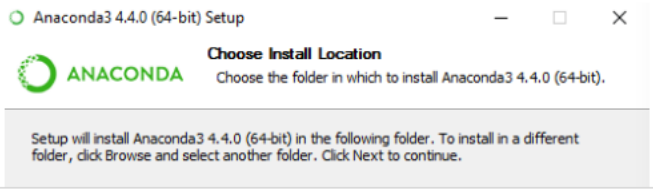
Installing on Windows

1. Download the Anaconda installer.
2. Optional: Verify data integrity with MD5 or SHA-256. More info on hashes
3. Double click the installer to launch.

   NOTE: If you encounter any issues during installation, temporarily disable your anti-virus software during install, then re-enable it after the installation concludes. If you have installed for all users, uninstall Anaconda and re-install it for your user only and try again.
4. Click Next.
5. Read the licensing terms and click "I Agree".
6. Select an install for "Just Me" unless you're installing for all users (which requires Windows Administrator privileges) and click Next.
7. Select a destination folder to install Anaconda and click the Next button. See FAQ.

   NOTE: Install Anaconda to a directory path that does not contain spaces or unicode characters.

   NOTE: Do not install as Administrator unless admin privileges are required.



2.7 Python documentation

https://docs.python.org/2/contents.html

Python Software Foundation [US] | https://docs.python.org/2/contents.html

Python » English 2.7.14 Documentation »

Next topic

What's New in Python

This Page

Report a Bug
Show Source

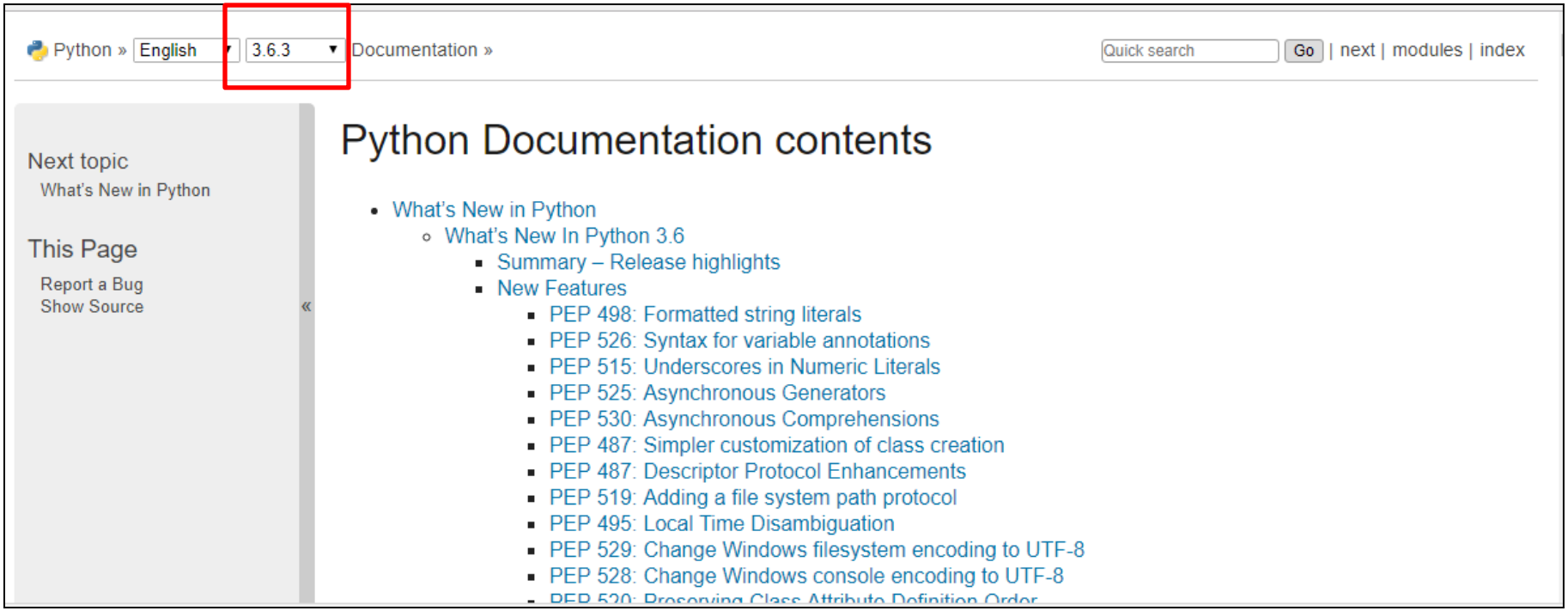
Quick search

Go

Python Documentation contents

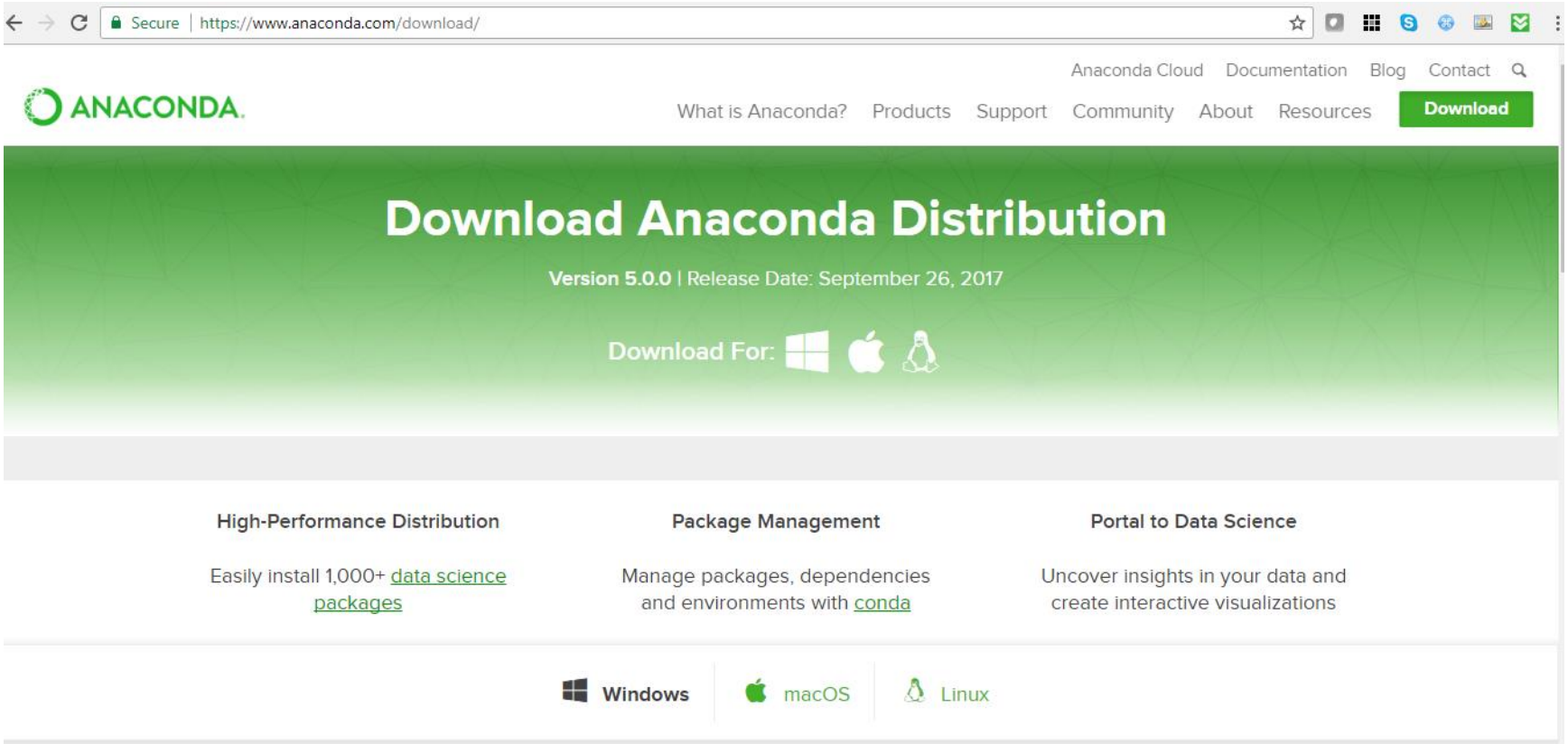
3.0 Python documentation

- https://docs.python.org/3/contents.html

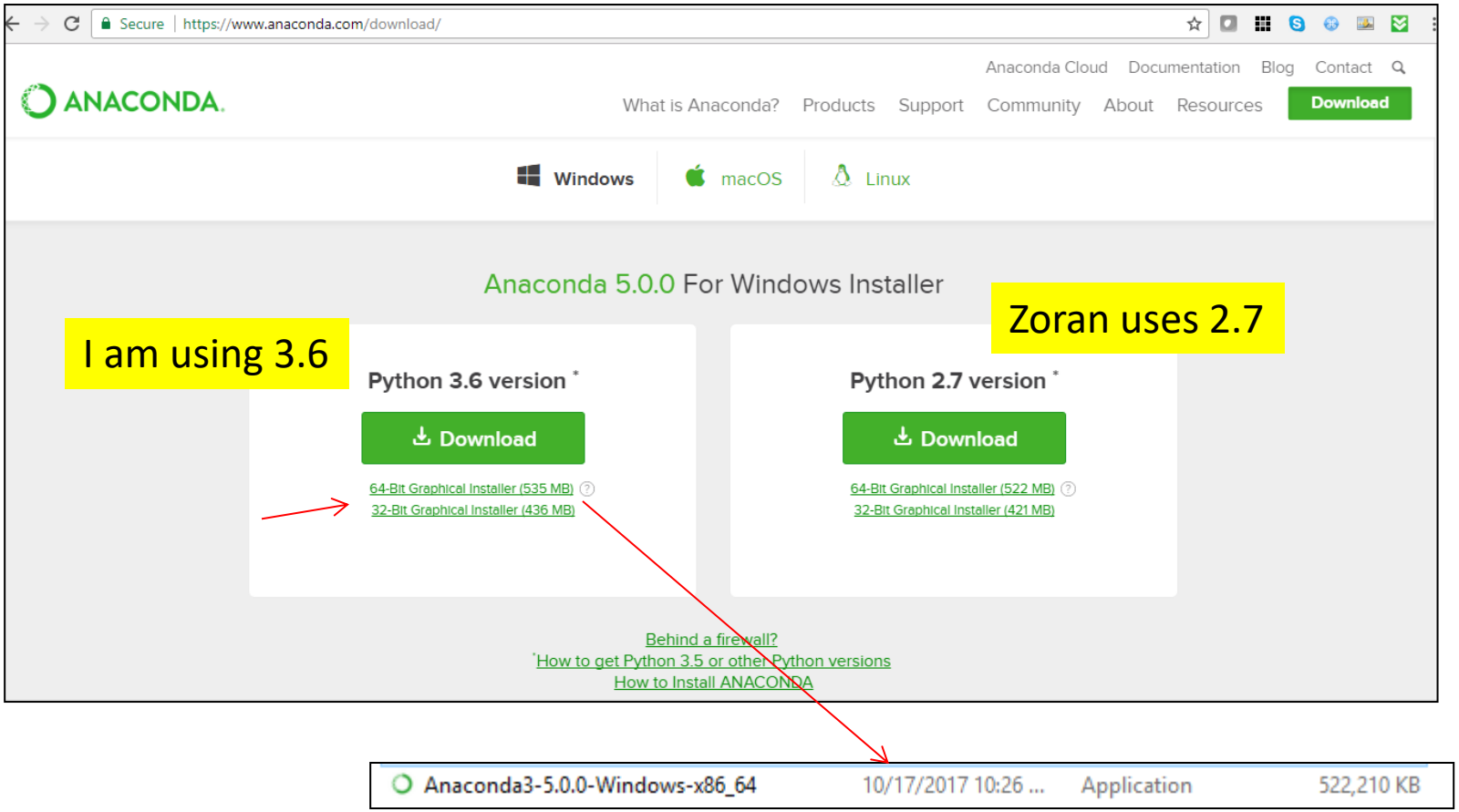


Where do you get Anaconda?

https://www.anaconda.com/download/

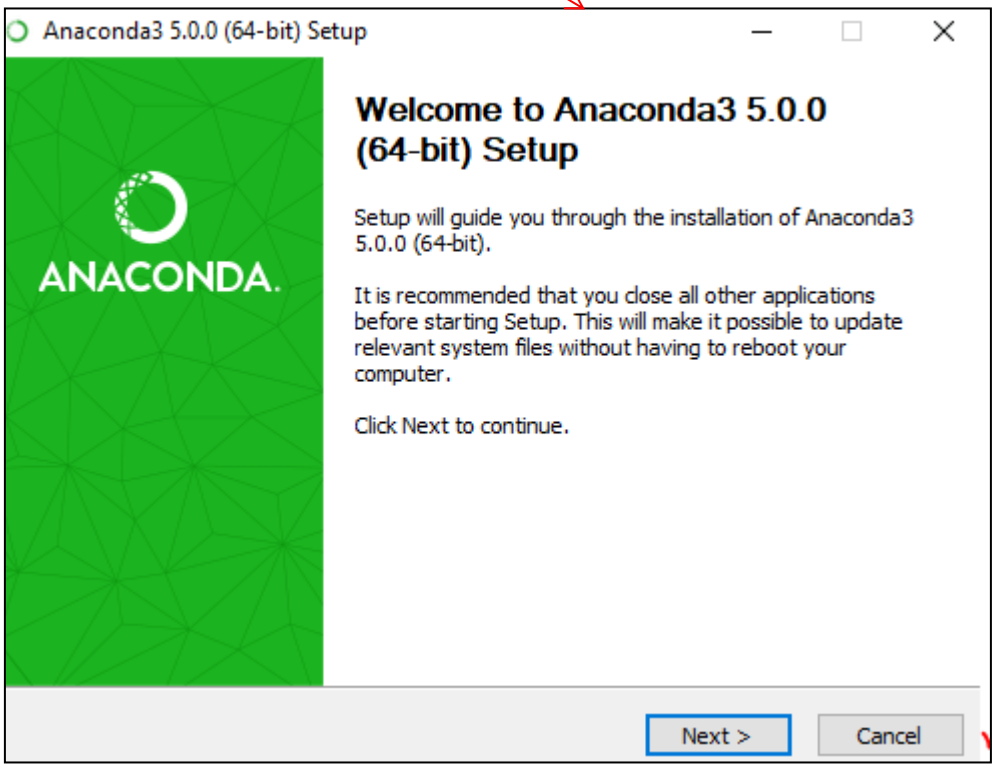


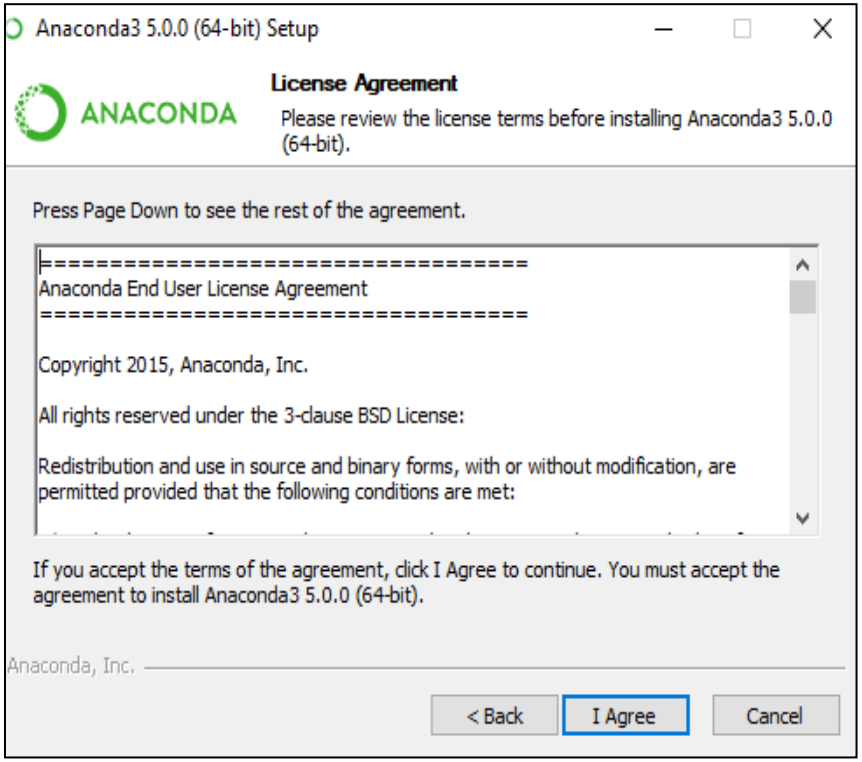
Scroll down to the bottom of the Anaconda Screen



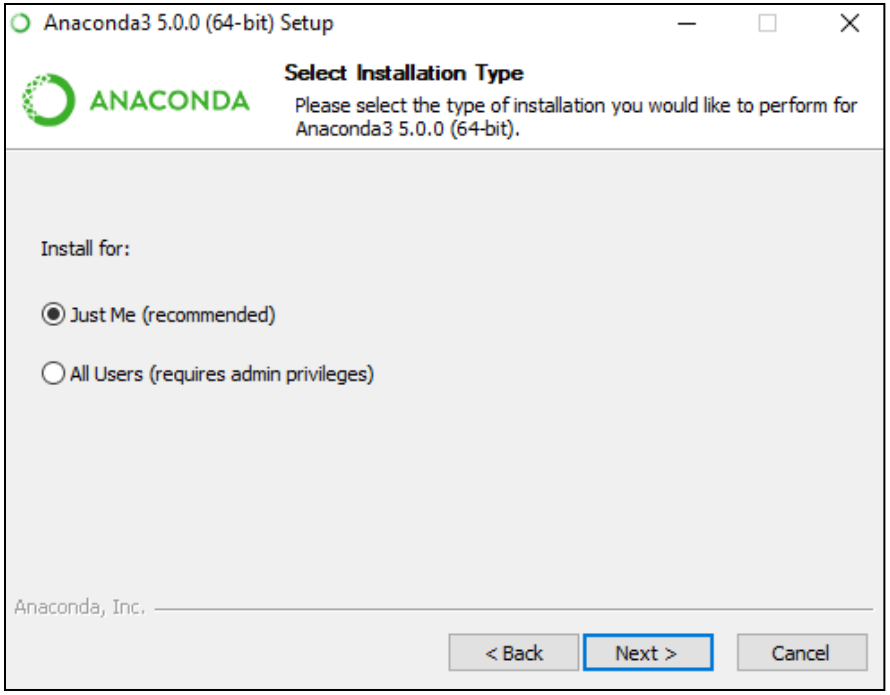
Anaconda3 (64-bit) Installation

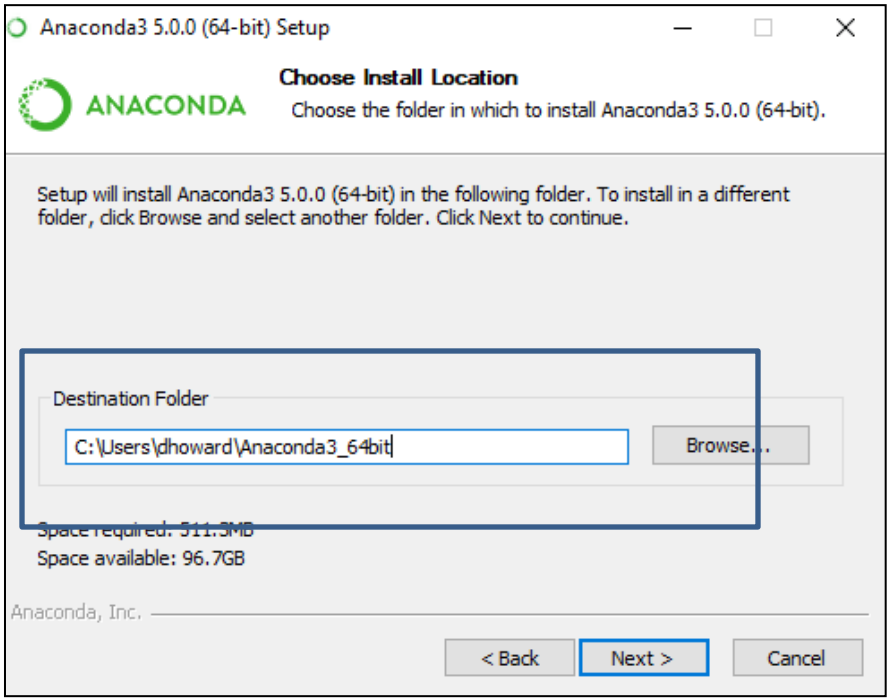
Anaconda3-5.0.0-Windows-x86_64	10/17/2017 10:26 ...	Application	522,210 KB





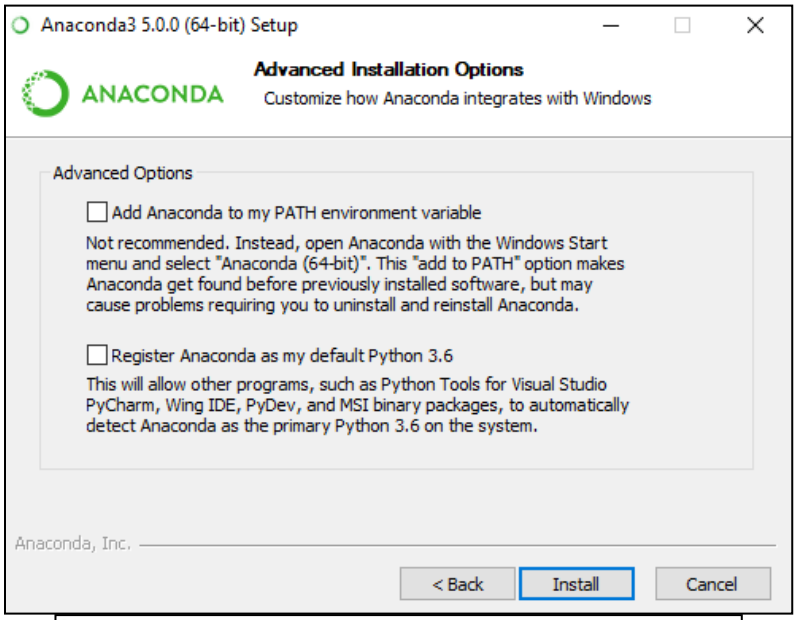
Anaconda3 (64-bit) Installation continued

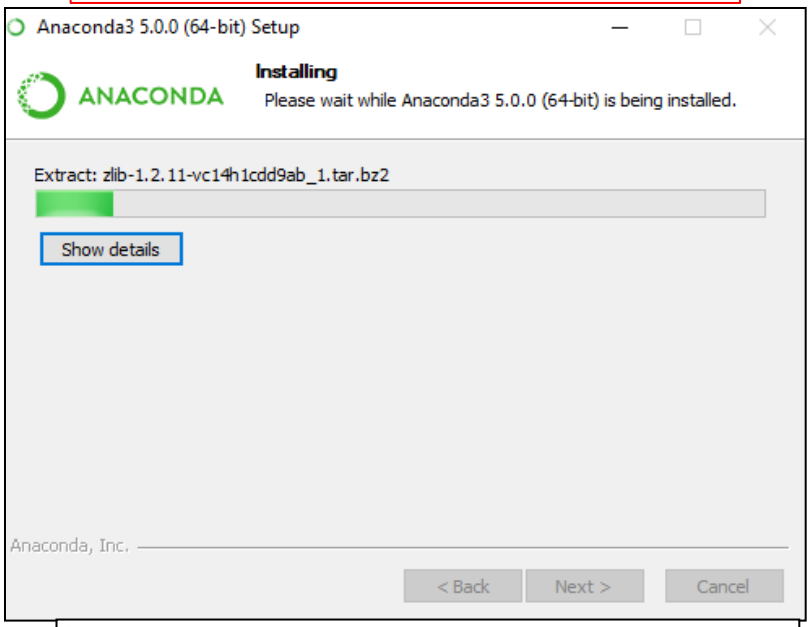


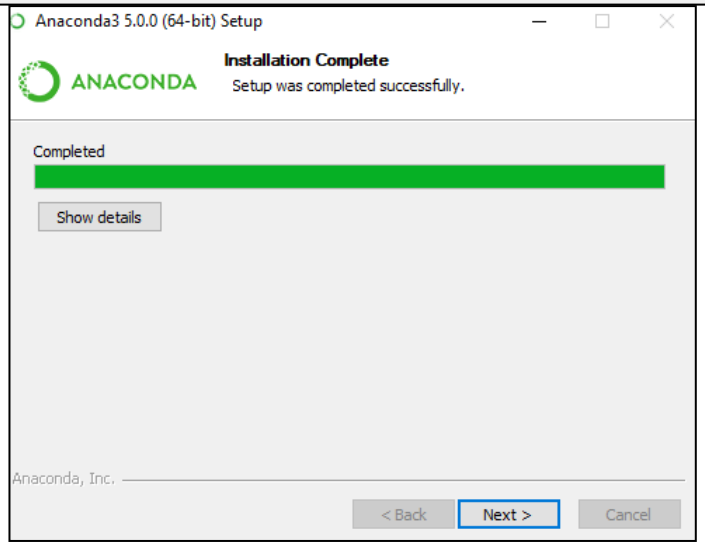


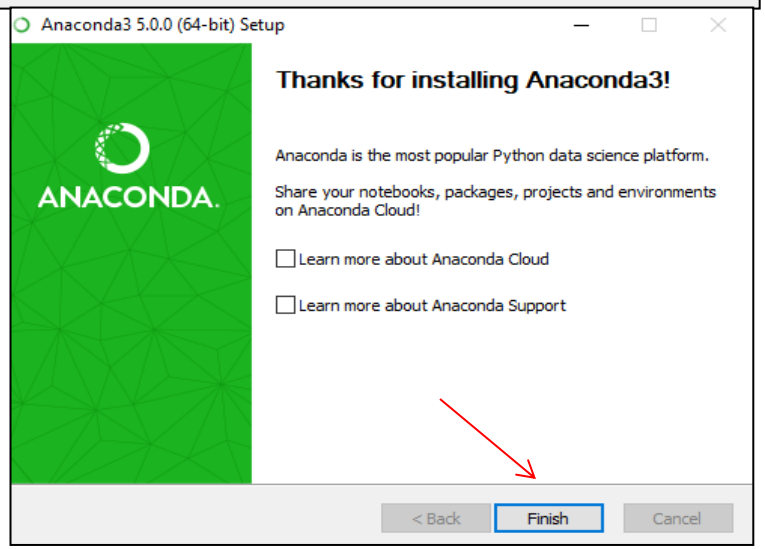
Anaconda3 (64-bit) Installation continued…

This step takes a very long time!









Test Anaconda

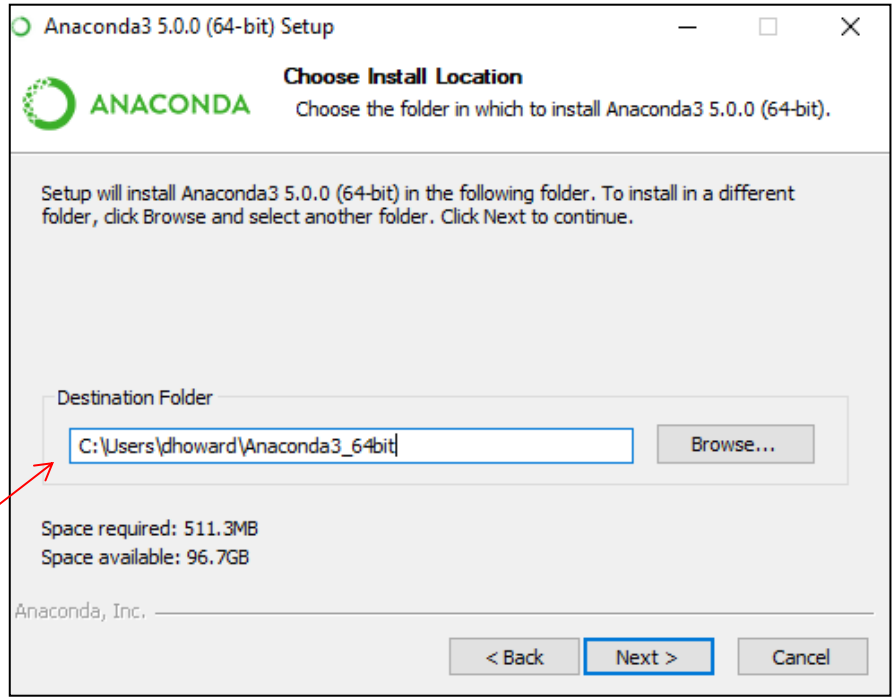
Start up Anaconda Python

- Go to directory where you installed it.

>python

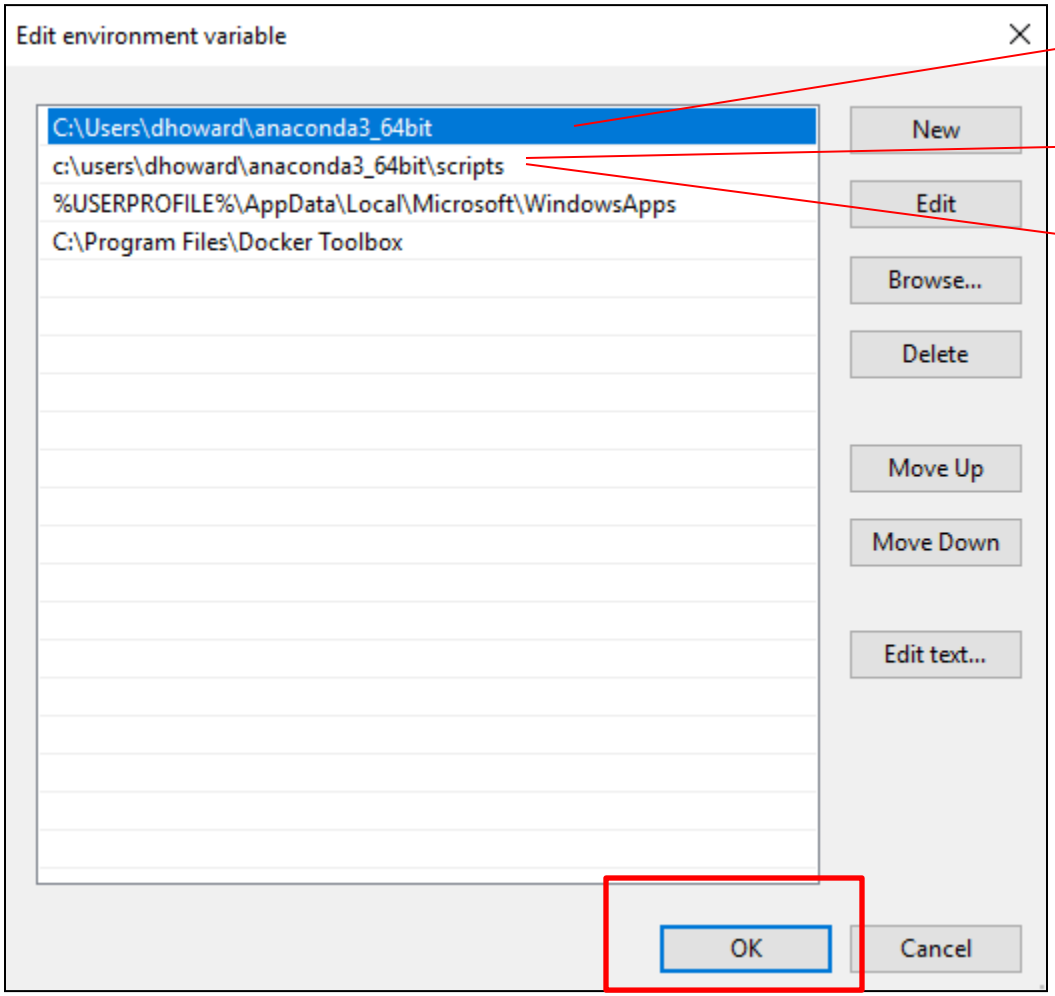
Note: in your Start up Menu you will see the following tools that was installed:

1. Anaconda Notebook
2. Jupyter Notebook
3. Anaconda Prompt




```
c:\Users\dhoward\Anaconda3_64bit>python
Python 3.6.2 |Anaconda, Inc.| (default, Sep 19 2017, 08:03:39) [MSC v.1900 64 bit (AMD64)] on win32
Type "help", "copyright", "credits" or "license" for more information.
>>>
```

Set up Environment Variable for Anaconda3



Path to Anaconda

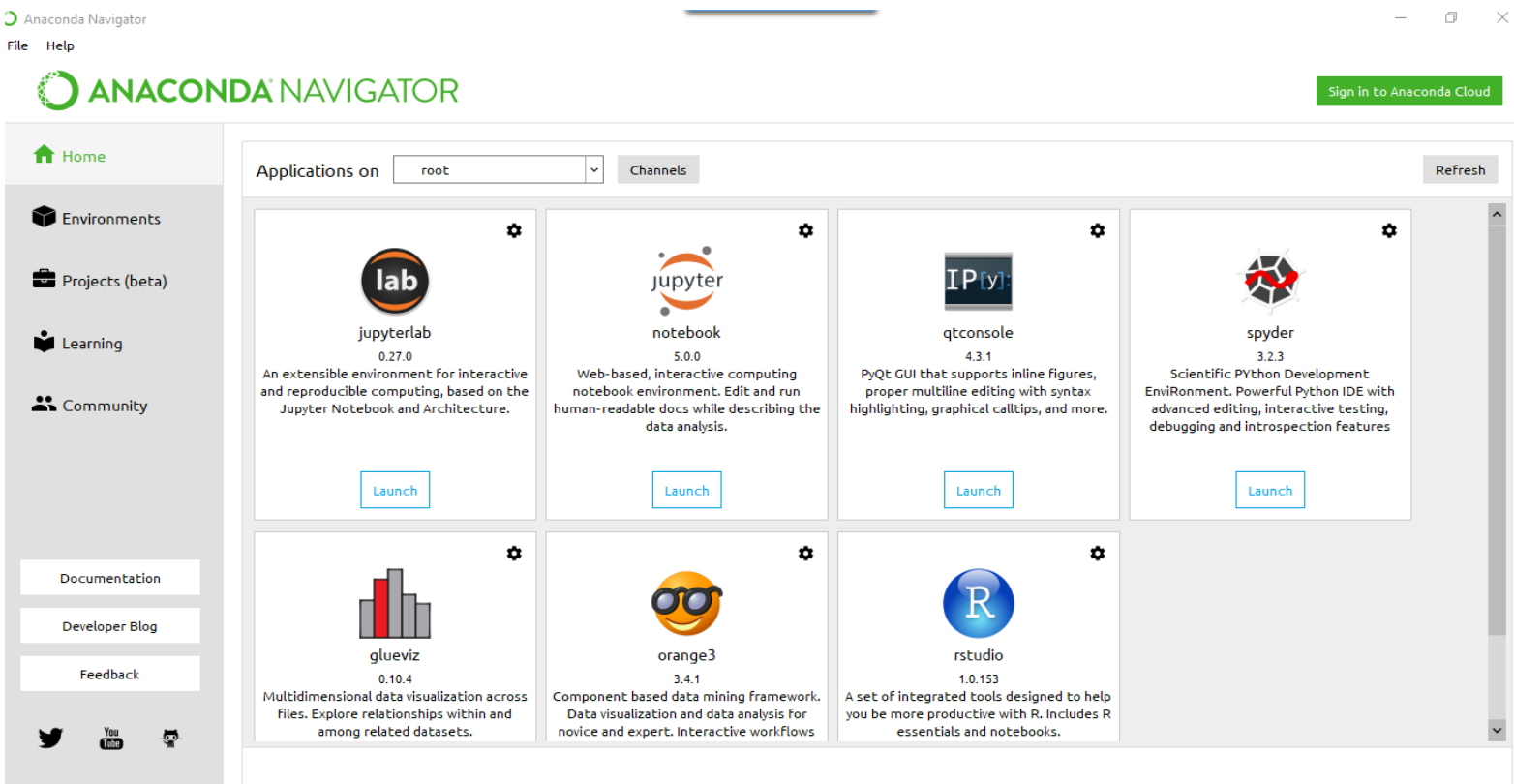
Path for pip

Path for conda

Verification of Successful Anaconda Install

https://docs.anaconda.com/anaconda/install/windows

- ‘verify it by opening Anaconda Navigator, a program that is included with Anaconda: from your Windows Start menu, select the shortcut Anaconda Navigator. If Navigator opens, you have successfully installed Anaconda.’



Open a new Command Window and Test it out!

Check Python version (note: there are 2 hyphens)
>python –version

```
C:\Users\dhoward>python --version
Python 3.6.2 :: Anaconda, Inc.
```

Where is Python installed?
>where python
C:\Users\dhoward\anaconda3_64\python.exe
Where is pip installed?
>where pip
Where is conda installed?
>where conda

```
C:\Users\dhoward>where python
C:\Users\dhoward\anaconda3_64bit\python.exe

C:\Users\dhoward>where pip
c:\Python27\Scripts\pip.exe
c:\Users\dhoward\anaconda3_64bit\Scripts\pip.exe

C:\Users\dhoward>where conda
c:\Users\dhoward\anaconda3_64bit\Scripts\conda.exe
```

How do I start Python Anaconda?
Start the Anaconda Interpreter:
C:\>python

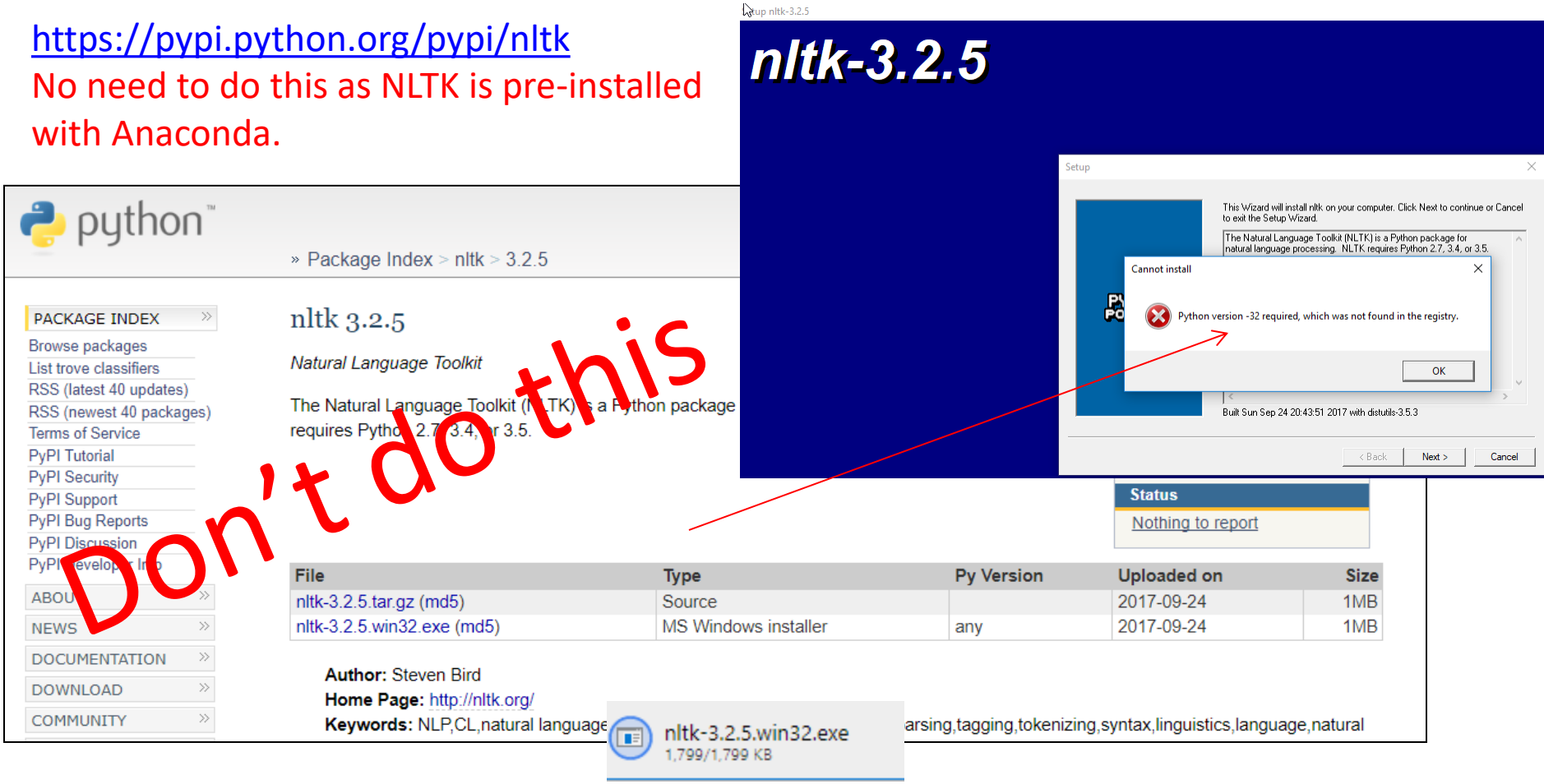
Notice: version 3.6.2 and 64-bit

```
C:\Users\dhoward>python
Python 3.6.2 |Anaconda, Inc.| (default, Sep 19 2017, 08:03:39) [MSC v.1900 64 bit (AMD64)] on win32
Type "help", "copyright", "credits" or "license" for more information.
>>> 3+5
8
>>>
```

NLTK Download Page

https://pypi.python.org/pypi/nltk

No need to do this as NLTK is pre-installed with Anaconda.



NLTK install (Anaconda)

C:\Users\dhoward>where python

C:\Users\dhoward\anaconda3_64bit\python.exe

c:\Users\dhoward>pip install nltk **(nltk is already packaged with Anaconda)**

Requirement already satisfied: nltk in c:\python27\lib\site-packages

Requirement already satisfied: six in c:\python27\lib\site-packages (from nltk)

Let's check now:

```
c:\Users\dhoward>python
Python 3.6.2 |Anaconda, Inc.| (default, Sep 19 2017, 08:03:39) [MSC v.1900 64 bit (AMD64)] on win32
Type "help", "copyright", "credits" or "license" for more information.
>>> import nltk
>>>
```

Jupyter Install on CentOS VM

@639 Much Thanks to Eduardo Morales!

- **Need to plot - Install Jupyter!!!**

  The answer to all your plotting needs is Jupyter! (I wish someone had told me before.)
- Jupyter is not in either of the VMs we currently have. You have to install it. Here's how to install it in CentOS:
- Open a Terminal and enter as super-user, then

pip install ipython

python -m pip install --upgrade

pip python -m pip install jupyter

then run it with this:

jupyter notebook

- However, later on you'll trip with the lack of Panda. So install it once and for all:

pip install pandas

Python 2.7 Install on CentOs

- You could use your VM for this homework but not necessary.

Python 2.7 will be required to perform this exercise. We will need to install Python 2.7 without disrupting the Python2.6 which is installed on the HDFS system.

Install Python2.7 on CentOS 6.7 (coexisting with Python2.6.6)

```
$ cat /etc/redhat-release
CentOS release 6.7 (Final)

$ sudo yum groupinstall "Development tools"

$ sudo yum install zlib-devel
$ sudo yum install bzip2-devel
$ sudo yum install openssl-devel
$ sudo yum install ncurses-devel
$ sudo yum install sqlite-devel

(in ~cloudera/python2.7)
$ wget --no-check-certificate https://www.python.org/ftp/python/2.7.6/Python-
2.7.6.tar.xz
$ tar xf Python-2.7.6.tar.xz
$ cd Python-2.7.6
$ ./configure --prefix=/usr/local
$ make
$ sudo make install (to install in /usr/local/bin)
```

Create a virtual environment for Python 2.7

```
$ pip install virtualenv
$ virtualenv -p /usr/local/bin/python2.7 hw07
$ source hw07/bin/activate

$ deactivate (to stop the virtual environment)
```

CentOS NLTK Install - continued

Install nltk on the HDFS virtual system

```
$ pip install nltk
```

cloudera@quickstart:~

File Edit View Search Terminal Help

```
(hw07) [cloudera@quickstart ~]$ pip install nltk
Collecting nltk
/home/cloudera/hw07/lib/python2.7/site-packages/pip/_vendor/requests/packages/urllib3/
util/ssl_.py:318: SNIMissingWarning: An HTTPS request has been made, but the SNI (Subj
ect Name Indication) extension to TLS is not available on this platform. This may caus
e the server to present an incorrect TLS certificate, which can cause validation failu
res. You can upgrade to a newer version of Python to solve this. For more information,
 see https://urllib3.readthedocs.io/en/latest/security.html#snimissingwarning.
  SNIMissingWarning
/home/cloudera/hw07/lib/python2.7/site-packages/pip/_vendor/requests/packages/urllib3/
util/ssl_.py:122: InsecurePlatformWarning: A true SSLContext object is not available.
This prevents urllib3 from configuring SSL appropriately and may cause certain SSL con
nections to fail. You can upgrade to a newer version of Python to solve this. For more
 information, see https://urllib3.readthedocs.io/en/latest/security.html#insecureplatf
ormwarning.
  InsecurePlatformWarning
  Downloading nltk-3.2.2.tar.gz (1.2MB)
    100% |[redacted]| 1.2MB 321kB/s
Requirement already satisfied: six in ./hw07/lib/python2.7/site-packages (from nltk)
Building wheels for collected packages: nltk
  Running setup.py bdist_wheel for nltk ... done
  Stored in directory: /home/cloudera/.cache/pip/wheels/42/b5/27/718985cd9719e8a44a405
d264d98214c7a607fb65f3a006f28
```

Download NLTK books on your CentOS Vm

Download NLTK books

```
cloudera@quickstart:~
File  Edit  View  Search  Terminal  Help
(hw07) [cloudera@quickstart ~]$ python
Python 2.7.6 (default, Mar 19 2017, 12:17:41)
[GCC 4.4.7 20120313 (Red Hat 4.4.7-17)] on linux2
Type "help", "copyright", "credits" or "license" for more information.
>>> import nltk
>>> nltk.download()
NLTK Downloader
---------------------------------------------------------------------------
    d) Download   l) List    u) Update   c) Config   h) Help   q) Quit
---------------------------------------------------------------------------
Downloader> d book
    Downloading collection u'book'
       |
       | Downloading package abc to /home/cloudera/nltk_data...
       |   Unzipping corpora/abc.zip.
       | Downloading package brown to /home/cloudera/nltk_data...
       |   Unzipping corpora/brown.zip.
       | Downloading package chat80 to /home/cloudera/nltk_data...
```

Import the book selection and make some test examinations

```
cloudera@quickstart:~
File  Edit  View  Search  Terminal  Help
(hw07) [cloudera@quickstart ~]$ python
Python 2.7.6 (default, Mar 19 2017, 12:17:41)
[GCC 4.4.7 20120313 (Red Hat 4.4.7-17)] on linux2
Type "help", "copyright", "credits" or "license" for more information.
>>> import nltk
>>> from nltk.book import *
*** Introductory Examples for the NLTK Book ***
Loading text1, ..., text9 and sent1, ..., sent9
Type the name of the text or sentence to view it.
Type: 'texts()' or 'sents()' to list the materials.
text1: Moby Dick by Herman Melville 1851
text2: Sense and Sensibility by Jane Austen 1811
text3: The Book of Genesis
text4: Inaugural Address Corpus
text5: Chat Corpus
text6: Monty Python and the Holy Grail
text7: Wall Street Journal
text8: Personals Corpus
text9: The Man Who Was Thursday by G . K . Chesterton 1908
>>>
```

Credit:
Stephen Ford

Jupyter Notebook

- Jupyter Notebook comes with Anaconda distribution. You don't need to install anything. Just run the password command (see below)
- Try it out as it has many advantages – saves your work very nicely too!
- FIRST: Run the following to define your password:

>jupyter notebook password

Enter password: **** Verify password: ****

To run Jupyter:

Go to your browser and enter:

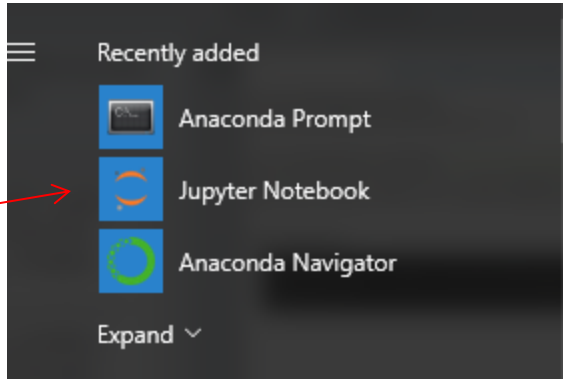
localhost:8888

OR

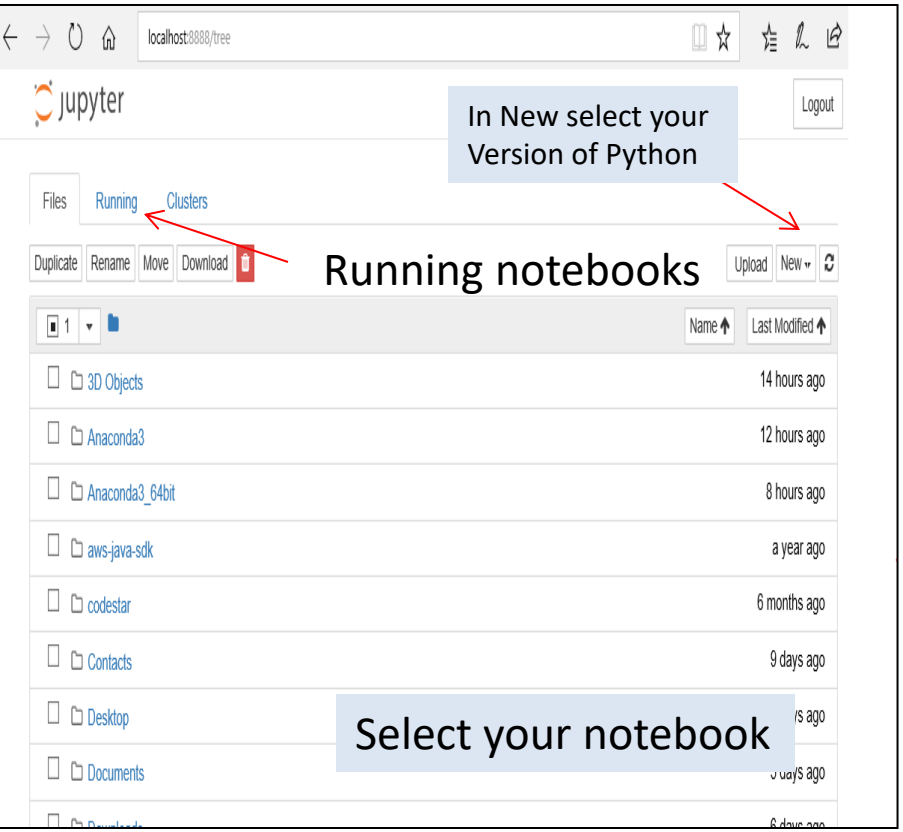
>juypter notebook → This starts the notebook server from the command line.

```
$ jupyter notebook
[I 08:58:24.417 NotebookApp] Serving notebooks from local directory: /Users/catherine
[I 08:58:24.417 NotebookApp] 0 active kernels
[I 08:58:24.417 NotebookApp] The Jupyter Notebook is running at: http://localhost:8888/
[I 08:58:24.417 NotebookApp] Use Control-C to stop this server and shut down all kernels
```

Find the icon in your Start menu

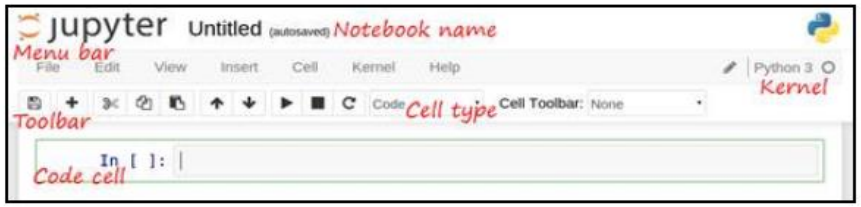


Navigating in Jupyter



- Helpful commands:

https://datahub.packtpub.com/tutorials/basics-jupyter-notebook-python/



A new notebook

Ctrl + Enter: run the cell
Shift + Enter: run the cell and select the cell below
Alt + Enter: run the cell and insert a new cell below
Ctrl + S: save the notebook
Edit Mode:
Esc: switch to command mode
Ctrl + Shift + –: split the cell
Command Mode:
Enter: switch to edit mode
Up or k: select the previous cell
Down or j: select the next cell
y / m: change the cell type to code cell/Markdown cell
a / b: insert a new cell above/below the current cell
x / c / v: cut/copy/paste the current cell
dd: delete the current cell
z: undo the last delete operation
Shift + =: merge the cell below
h: display the help menu with the list of keyboard shortcuts

Keyboard Shortcuts Edit Mode

- Select cell, press ESC and h to see this menu

Keyboard shortcuts

Edit Mode (press `Enter` to enable)

`Tab` : code completion or indent	`Ctrl-Right` : go one word right
`Shift-Tab` : tooltip	`Ctrl-Backspace` : delete word before
`Ctrl-]` : indent	`Ctrl-Delete` : delete word after
`Ctrl-[` : dedent	`Ctrl-M` : command mode
`Ctrl-A` : select all	`Ctrl-Shift-F` : open the command palette
`Ctrl-Z` : undo	`Ctrl-Shift-P` : open the command palette
`Ctrl-Shift-Z` : redo	`Esc` : command mode
`Ctrl-Y` : redo	`Shift-Enter` : run cell, select below
`Ctrl-Home` : go to cell start	`Ctrl-Enter` : run selected cells
`Ctrl-Up` : go to cell start	`Alt-Enter` : run cell, insert below
`Ctrl-End` : go to cell end	`Ctrl-Shift-Minus` : split cell
`Ctrl-Down` : go to cell end	`Ctrl-S` : Save and Checkpoint

Close

Keyboard Shortcuts Command Mode

- Select cell, press ESC and h to see this menu

Keyboard shortcuts

The Jupyter Notebook has two different keyboard input modes. **Edit mode** allows you to type code/text into a cell and is indicated by a green cell border. **Command mode** binds the keyboard to notebook level commands and is indicated by a grey cell border with a blue left margin.

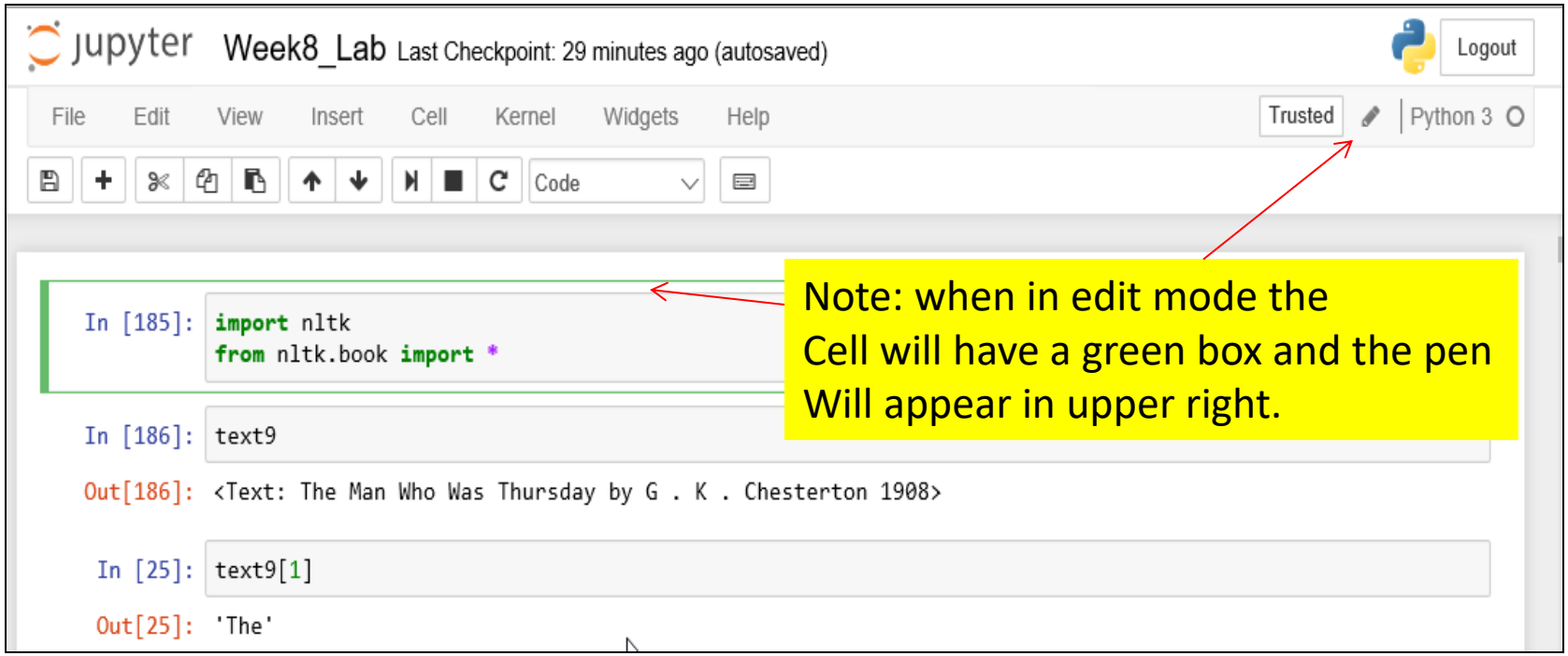
Command Mode (press `Esc` to enable)

Edit Shortcuts

`F` : find and replace	`Shift-Down` : extend selected cells below
`Ctrl-Shift-F` : open the command palette	`Shift-J` : extend selected cells below
`Ctrl-Shift-P` : open the command palette	`A` : insert cell above
`Enter` : enter edit mode	`B` : insert cell below
`P` : open the command palette	`X` : cut selected cells
`Shift-Enter` : run cell, select below	`C` : copy selected cells
`Ctrl-Enter` : run selected cells	`Shift-V` : paste cells above

Close

My Jupyter Session



NLTK Data

www.nltk.org/nltk_data

NLTK Data

www.nltk.org/nltk_data/

NLTK Corpora

NLTK has built-in support for dozens of corpora and trai
corpus downloader, >>> nltk.download()

Please consult the README file included with each corp

1. *ACE Named Entity Chunker (Maximum entropy)* [
   id: maxent_ne_chunker; size: 13404747; author: ; co
2. *Australian Broadcasting Commission 2006* [downl
   id: abc; size: 1487851; author: Australian Broadcas
3. *Alpino Dutch Treebank* [download | source]
   id: alpino; size: 2797255; author: ; copyright: ; lice
4. *BioCreAtIvE (Critical Assessment of Information E*
   id: biocreative_ppi; size: 223566; author: ; copyrig
5. *Brown Corpus* [download | source]
   id: brown; size: 3314357; author: W. N. Francis and
6. *Brown Corpus (TEI XML Version)* [download | sou
   id: brown_tei; size: 8737738; author: W. N. Francis
7. *CESS-CAT Treebank* [download | source]
   id: cess_cat; size: 5396688; author: ; copyright: ; li
   Martí, MarionaTaulé, Lluís Márquez, Manuel Bertr
   http://www.lsi.upc.edu/~mbertran/cess-ece/publicat

ble 1.2:

Some of the Corpora and Corpus Samples Distributed with NLTK: For information about downloading and using them, please consult the NLTK w

Corpus	Compiler	Contents
Brown Corpus	Francis, Kucera	15 genres, 1.15M words, tagged, categorized
CESS Treebanks	CLiC-UB	1M words, tagged and parsed (Catalan, Spanish)
Chat-80 Data Files	Pereira & Warren	World Geographic Database
CMU Pronouncing Dictionary	CMU	127k entries
CoNLL 2000 Chunking Data	CoNLL	270k words, tagged and chunked
CoNLL 2002 Named Entity	CoNLL	700k words, pos- and named-entity-tagged (Dutch, Spanish)
CoNLL 2007 Dependency Treebanks (sel)	CoNLL	150k words, dependency parsed (Basque, Catalan)
Dependency Treebank	Narad	Dependency parsed version of Penn Treebank sample
FrameNet	Fillmore, Baker et al	10k word senses, 170k manually annotated sentences
Floresta Treebank	Diana Santos et al	9k sentences, tagged and parsed (Portuguese)
Gazetteer Lists	Various	Lists of cities and countries
Genesis Corpus	Misc web sources	6 texts, 200k words, 6 languages
Gutenberg (selections)	Hart, Newby, et al	18 texts, 2M words
Inaugural Address Corpus	CSpan	US Presidential Inaugural Addresses (1789-present)
Indian POS-Tagged Corpus	Kumaran et al	60k words, tagged (Bangla, Hindi, Marathi, Telugu)
MacMorpho Corpus	NILC, USP, Brazil	1M words, tagged (Brazilian Portuguese)
Movie Reviews	Pang, Lee	2k movie reviews with sentiment polarity classification
Names Corpus	Kantrowitz, Ross	8k male and female names
NIST 1999 Info Extr (selections)	Garofolo	63k words, newswire and named-entity SGML markup
Nombank	Meyers	115k propositions, 1400 noun frames
NPS Chat Corpus	Forsyth, Martell	10k IM chat posts, POS-tagged and dialogue-act tagged
Open Multilingual WordNet	Bond et al	15 languages, aligned to English WordNet
PP Attachment Corpus	Ratnaparkhi	28k prepositional phrases, tagged as noun or verb modifiers
Proposition Bank	Palmer	113k propositions, 3300 verb frames
Question Classification	Li, Roth	6k questions, categorized
Reuters Corpus	Reuters	1.3M words, 10k news documents, categorized
Roget's Thesaurus	Project Gutenberg	200k words, formatted text
RTE Textual Entailment	Dagan et al	8k sentence pairs, categorized
SEMCOR	Rus, Mihalcea	880k words, part-of-speech and sense tagged
Senseval 2 Corpus	Pedersen	600k words, part-of-speech and sense tagged
SentiWordNet	Esuli, Sebastiani	sentiment scores for 145k WordNet synonym sets
Shakespeare texts (selections)	Bosak	8 books in XML format
State of the Union Corpus	CSPAN	485k words, formatted text
Stopwords Corpus	Porter et al	2,400 stopwords for 11 languages
Swadesh Corpus	Wiktionary	comparative wordlists in 24 languages
Switchboard Corpus (selections)	LDC	36 phonecalls, transcribed, parsed
Univ Decl of Human Rights	United Nations	480k words, 300+ languages
Penn Treebank (selections)	LDC	40k words, tagged and parsed
TIMIT Corpus (selections)	NIST/LDC	audio files and transcripts for 16 speakers
VerbNet 2.1	Palmer et al	5k verbs, hierarchically organized, linked to WordNet
Wordlist Corpus	OpenOffice.org et al	960k words and 20k affixes for 8 languages
WordNet 3.0 (English)	Miller, Fellbaum	145k synonym sets

Types of Corpus Data Files

1. **Gutenberg Corpus** – electronic text archive from the Project Gutenberg and contains 25,000 free electronic books
2. **Web and Chat Text** - (discussion forums, overheard conversations, movie scripts, personal Advertisements, wine reviews.
3. **Brown Corpus** – 1st million word electronic corpus built by Brown Univ in 1961. Contains 5000 sources categorized by genre (e.g., news, editorials,…).
4. **Reuters Corpus** – contains 10,788 news totaling 1.3 million words with 90 topics.
5. **Inaugural Address Corpus –** 55 U.S. presidential addresses which has a time dimension.
6. **Annotated Text Corporations** – linguistic annotations (named entities, semantic meanings,…)
7. **Other Languages** – (also prints special characters for each language).
8. **Text Corpus Structure –** unstructured, news collections,
9. **Your own Corpus** – your own collection of files can be imported…

1.8 Text Corpus Structure

We have seen a variety of corpus structures so far; these are summarized in 1.3. The simplest kind lacks any structure: it is just a collection of texts. Often, texts are grouped into categories that might correspond to genre, source, author, language, etc. Sometimes these categories overlap, notably in the case of topical categories as a text can be relevant to more than one topic. Occasionally, text collections have temporal structure, news collections being the most common example.

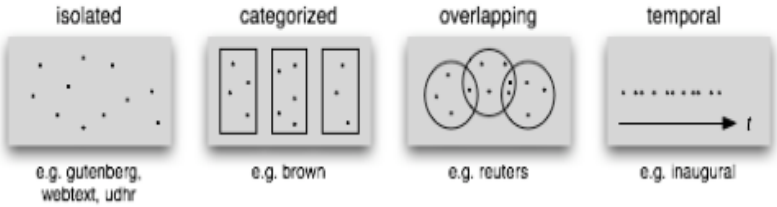
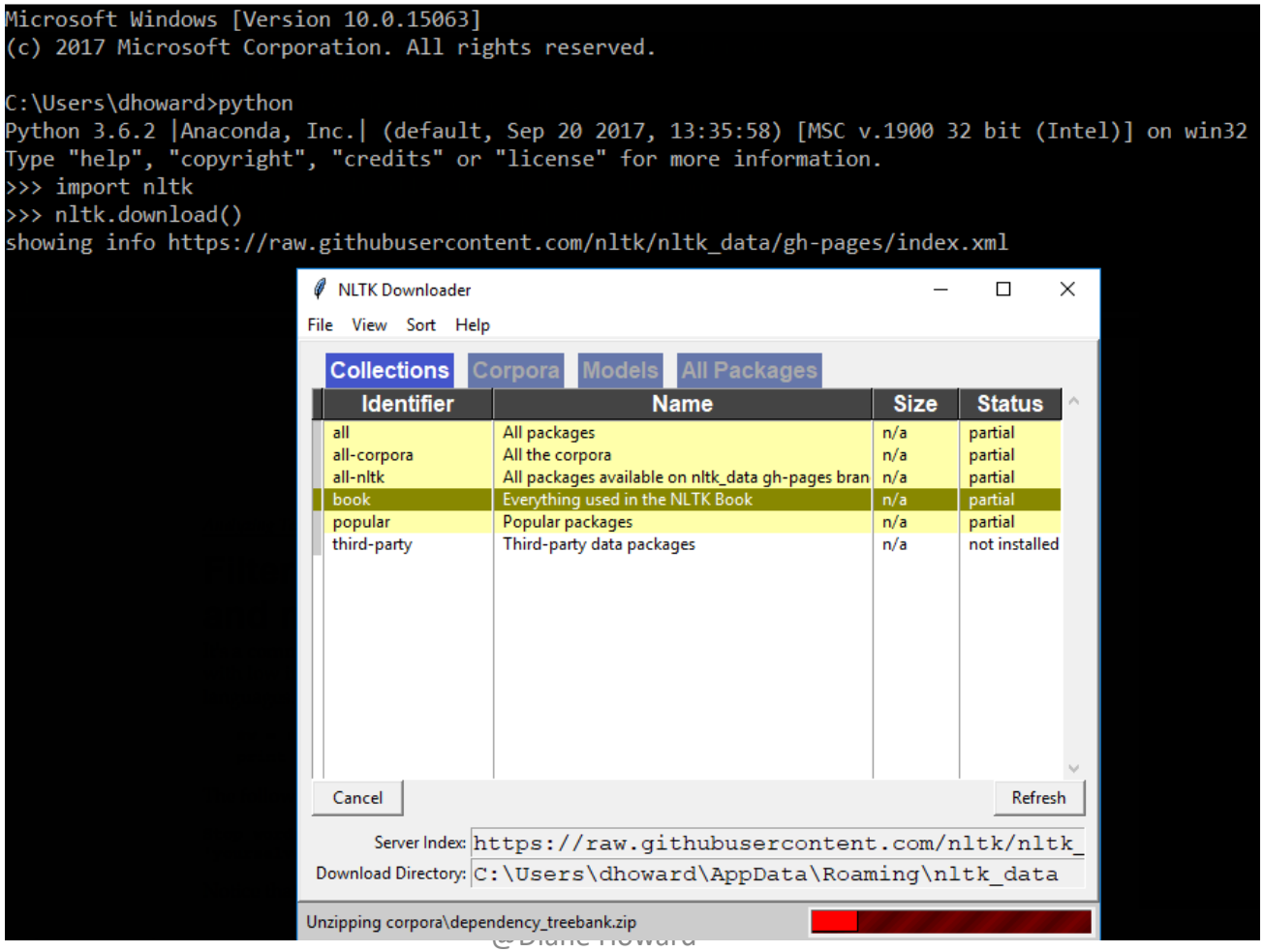


Figure 1.3: Common Structures for Text Corpora: The simplest kind of corpus is a collection of isolated texts with no particular organization; some corpora are structured into categories like genre (Brown Corpus); some categorizations overlap, such as topic categories (Reuters Corpus); other corpora represent language use over time (Inaugural Address Corpus).

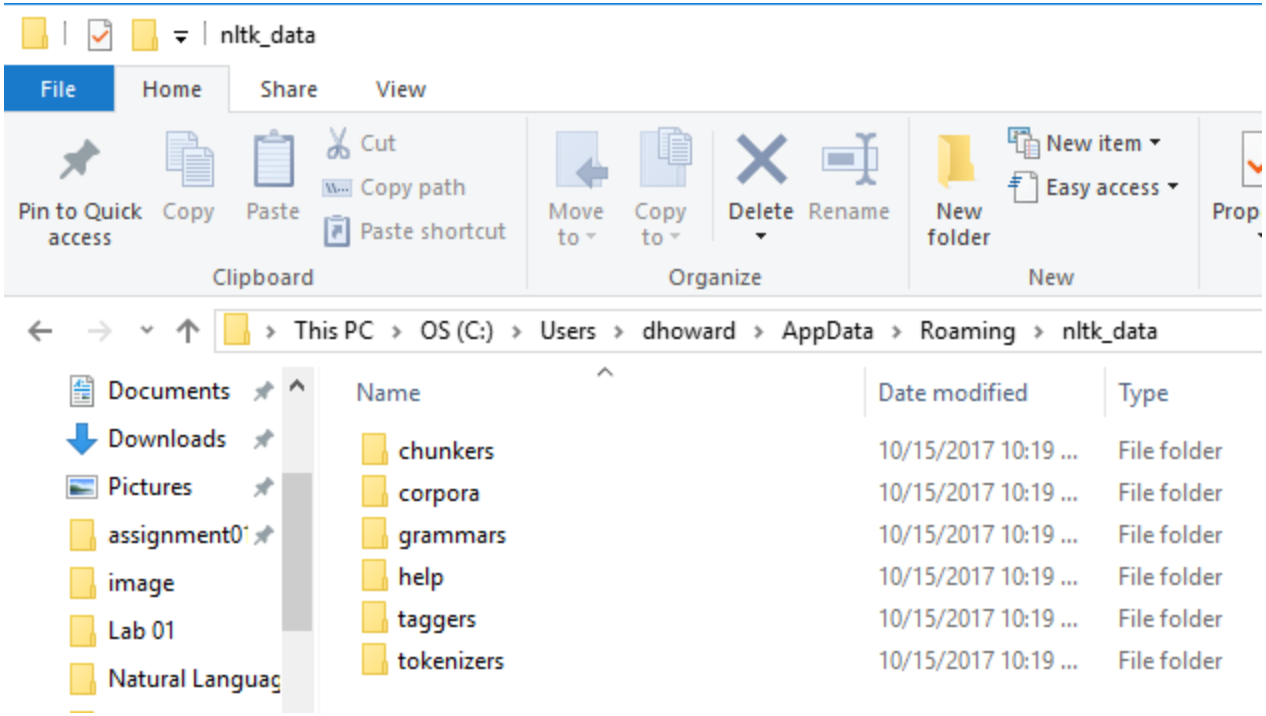
Let’s get started with NLTK:

- *Import the NLTK datasets.*
- *Select the book Collection in the Identifier column*
- *Notice where the download directory stores the text files for you.*



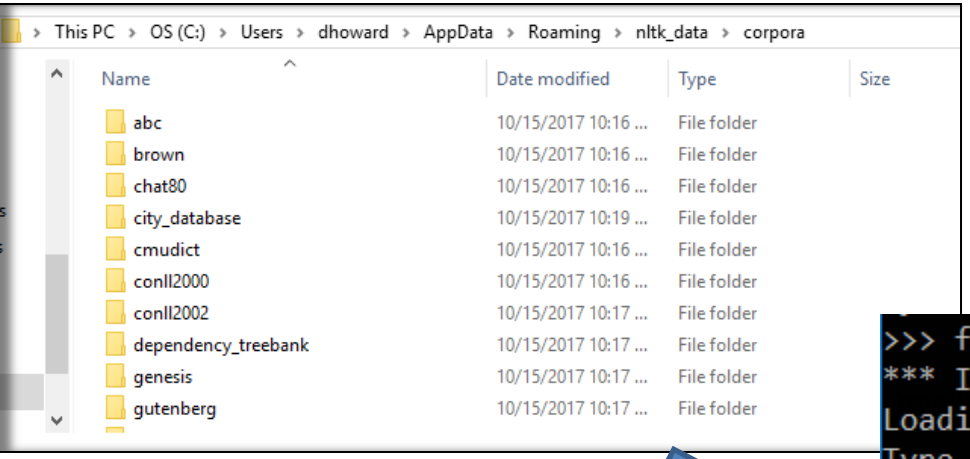
Examine our Book directory

C:\Users\dhoward\AppData\Roaming\nltk_data



Importing data

- from nltk.book import *




```
>>> from nltk.book import *
*** Introductory Examples for the NLTK Book ***
Loading text1, ..., text9 and sent1, ..., sent9
Type the name of the text or sentence to view it.
Type: 'texts()' or 'sents()' to list the materials.
text1: Moby Dick by Herman Melville 1851
text2: Sense and Sensibility by Jane Austen 1811
text3: The Book of Genesis
text4: Inaugural Address Corpus
text5: Chat Corpus
text6: Monty Python and the Holy Grail
text7: Wall Street Journal
text8: Personals Corpus
text9: The Man Who Was Thursday by G . K . Chesterton 1908
```

How to access data

```
>>> from nltk.book import *
*** Introductory Examples for the NLTK Book ***
Loading text1, ..., text9 and sent1, ..., sent9
Type the name of the text or sentence to view it.
Type: 'texts()' or 'sents()' to list the materials.
text1: Moby Dick by Herman Melville 1851
text2: Sense and Sensibility by Jane Austen 1811
text3: The Book of Genesis
text4: Inaugural Address Corpus
text5: Chat Corpus
text6: Monty Python and the Holy Grail
text7: Wall Street Journal
text8: Personals Corpus
text9: The Man Who Was Thursday by G . K . Chesterton 1908
>>>
>>> text9
<Text: The Man Who Was Thursday by G . K . Chesterton 1908>
>>> text4
<Text: Inaugural Address Corpus>
```

'text' in Python is a list of words (i.e, 'a sequence of words and punctuations')

NLTK Functions for extracting words, categories, sentences, fileids

Table 1.3:

Basic Corpus Functionality defined in NLTK: more documentation can be found using `help(nltk.corpus.reader)` and by reading the online Corpus HOWTO at `http://nltk.org/howto`.

Example	Description
`fileids()`	the files of the corpus
`fileids([categories])`	the files of the corpus corresponding to these categories
`categories()`	the categories of the corpus
`categories([fileids])`	the categories of the corpus corresponding to these files
`raw()`	the raw content of the corpus
`raw(fileids=[f1,f2,f3])`	the raw content of the specified files
`raw(categories=[c1,c2])`	the raw content of the specified categories
`words()`	the words of the whole corpus
`words(fileids=[f1,f2,f3])`	the words of the specified fileids
`words(categories=[c1,c2])`	the words of the specified categories
`sents()`	the sentences of the whole corpus
`sents(fileids=[f1,f2,f3])`	the sentences of the specified fileids
`sents(categories=[c1,c2])`	the sentences of the specified categories
`abspath(fileid)`	the location of the given file on disk
`encoding(fileid)`	the encod
`open(fileid)`	open a str
`root`	if the path
`readme()`	the conte

```
>>> words=gb.words("austen-sense.txt")
>>> words[1:25]
['Sense', 'and', 'Sensibility', 'by', 'Jane', 'Austen', '1811', ']', 'CHAPTER', '1', 'The', 'family', 'of', 'Dashwoo
d', 'had', 'long', 'been', 'settled', 'in', 'Sussex', '.', 'Their', 'estate', 'was']
>>> raw=gb.raw('austen-sense.txt')
>>> raw[1:25]
'Sense and Sensibility by'
>>> words=gb.words("austen-sense.txt")
>>> words[1:25]
['Sense', 'and', 'Sensibility', 'by', 'Jane', 'Austen', '1811', ']', 'CHAPTER', '1', 'The', 'family', 'of', 'Dashwoo
d', 'had', 'long', 'been', 'settled', 'in', 'Sussex', '.', 'Their', 'estate', 'was']
>>> sents=gb.sents("austen-sense.txt")
>>> sents[1:25]
[['CHAPTER', '1'], ['The', 'family', 'of', 'Dashwood', 'had', 'long', 'been', 'settled', 'in', 'Sussex', '.'], ['The
ir', 'estate', 'was', 'large', ',', 'and', 'their', 'residence', 'was', 'at', 'Norland', 'Park', ',', 'in', 'the', '
centre', 'of', 'their', 'property', ',', 'where', ',', 'for', 'many', 'generations', ',', 'they', 'had', 'lived', 'i
```

Access Gutenburg Corpus Books

- ‘Project Gutenberg contains thousands of books, it represents established literature’
- It is a great resource for a small sampling from Gutenburg.

```
# import gutenberg texts
>>> from nltk.corpus import gutenberg as gb
>>> gb.fileids()
['austen-emma.txt', 'austen-persuasion.txt',
'austen-sense.txt', 'bible-kjv.txt',
'blake-poems.txt', 'bryant-stories.txt',
'burgess-busterbrown.txt', 'carroll-alice.txt',
'chesterton-ball.txt', 'chesterton-brown.txt',
'chesterton-thursday.txt', 'edgeworth-parents.txt',
'melville-moby_dick.txt', 'milton-paradise.txt',
'shakespeare-caesar.txt', 'shakespeare-hamlet.txt',
'shakespeare-macbeth.txt', 'whitman-leaves.txt']
```

alias – use these for shortening names

These are unique file identifiers for the 18 Gutenburg Corpus text files.

http://www.nltk.org/book/ch02.html

Text manipulation examples

```
>>> text9
<Text: The Man Who Was Thursday by G . K . Chesterton 1908>
>>> text9[1]
'The'
>>>a=text9
>>>a[0]
>>>'['
>>>a[15]
>>>'Edmund'
```

Note: indexes start at zero

Jupyter example

```
In [186]: 1 text9
Out[186]:
Type:          Text
String form:   <Text: The Man Who Was Thursday by G . K . Chesterton 1908>
Length:        69213
File:          c:\users\dhoward\anaconda3 64bit\lib\site-packages\nltk\text.py
In [25]:
Out[25]:
```

```
>>> text9[1:13]    → slicing (sublists)
['The', 'Man', 'Who', 'Was', 'Thursday', 'by', 'G', '.', 'K', '.', 'Chesterton', '1908']
>>> text9.index('Was')
4
>>> a=text9[1:13]   → store sublist in 'a' to manipulate each field in the list
>>> print(a)
['The', 'Man', 'Who', 'Was', 'Thursday', 'by', 'G', '.', 'K', '.', '.', 'Chesterton', '1908']
>>> len(text7)    → length of the entire text
100676
>>> len(text9)
69213
```

Jupyter example

```
In [155]: 1 len(set(text7))
Out[155]:
Type:          Text
String form:   <Text: Wall Street Journal>
Length:        100676
File:          c:\users\dhoward\anaconda3 64bit\lib\site-packages\nltk\text.py
In [45]:
```

List Manipulations

- **Lists** = collection of data; a sequence of items; groups together other values (strings, ints, …)
- comma-separated values (items) between square brackets.
- a=text9

https://docs.python.org/3.4/library/functions.html

- Some Methods:

append

clear

count

extend

insert

…

reverse

sort

List Comprehensions

- ‘concise way to create new list where each element is the result of some operations applied to each member of another sequence or iterable’
- ‘consists of brackets containing an expression followed by a for clause, then zero or more for or if clauses’
- $\{w \mid w \in V \ \& \ P(w)\}$ Property P . “The set of all w such that w is an element of a Vocabulary and w has Property P.”
- **Python format:**
- [w for w in V if p(w)] → output is a list

```
>>> squares = []
>>> for x in range(10):
...     squares.append(x**2)
...
>>> squares
[0, 1, 4, 9, 16, 25, 36, 49, 64, 81]
```

```
squares = [x**2 for x in range(10)]
```

https://docs.python.org/2/tutorial/datastructures.html

String Manipulation Methods

```
>>> query = 'Hi from Diane!'
>>> query[8]
'D'
>>> query[2:]
' from Diane!'
>>> query + ' Have a great day!'
'Hi from Diane! Have a great day!'
```

```
query = 'Hi from Diane!'
```

```
Type:        str
String form: Hi from Diane!
Length:      14
Docstring:
```

```
for fileid in gb.fileids():
...     filelist.append(fileid)
...     fdist=nltk.FreqDist(w.lower() for w in gb.words(fileid))
...     print(fdist.most_common(50))
```

```
for fileid in gb.fileids():
```

```
Type:        str
String form: whitman-leaves.txt
Length:      18
Docstring:
```

- String Methods:

capitalize
center
count
decode
encode
endswith
find
index
isdigit
...
lower
...
upper

Difference between Lists & Strings

- Strings & lists are both **sequence**s.
- Both can be indexed , sliced and joined by concatenation (operators: +, -_.
- BUT you CANNOT join strings and lists.

- strings are **immutable** — you can't change a string once you create it
- strings are **immutable** — you can't change a string once you have create it

- Be careful of recognizing strings vs. lists.

```
>>> beatles[0] = "John Lennon"
>>> del beatles[-1]
>>> beatles ['John Lennon', 'Paul', 'George']
```

List

```
>>> query[0] = 'F'
Traceback (most recent call last): File "<stdin>", line 1, in ?
TypeError: object does not support item assignment
```

String

http://www.nltk.org/book/ch03.html

Frequency Distribution

- Used to determine frequency of words in a text.
  Note: words must be tokenized. Sentences must be tokenized to words, etc.

```
>>>import nltk
>>>from nltk.corpus import gutenberg as gb
>>> for fileid in gb.fileids():
...     filelist.append(fileid)
...     fdist=nltk.FreqDist(w.lower() for w in gb.words(fileid))
...     print(fdist.most_common(50))
```

Frequency Distribution Functions

- These functions (FreqDist, CondFreqDist) describe the frequency (count) of each vocabulary item in the text.

```
>>> text4
<Text: Inaugural Address Corpus>

>>> fdist1=FreqDist(text4)

>>> fdist1 or use print(fdist1)
<FreqDist with 9754 samples and 145735 outcomes>

>>> fdist1.most_common(5)   → prints word and frequency
[('the', 9281), ('of', 6970), (',', 6840), ('and', 4991), ('.', 4676)]
```

Conditional Frequency Distribution

- Can combine 2 or more Frequency Distributions

Create a table displaying relative frequencies with "modals"
(can, could, may, might, will, would and should) are used in 18 texts provided by NLTK in the extract from Gutenberg Corpus

What is a modal? A helping verb
How do we define modals in Python? Lists!

```
>>>modals=['can','could','may','might','will','would','should']
>>> modals[0]
'can'
>>> modals[2:4]
['may', 'might']
>>> m=modals
>>> m[2:4]
['may', 'might']
```

```
import nltk
from nltk.corpus import gutenberg as gb

print ("")
print ("Relative frequencies of modals in 18 Gutenberg Corpus")
print ("")
titles = gb.fileids()
modals = ['can', 'could', 'may', 'might', 'will', 'should']
cfd = nltk.ConditionalFreqDist(
    (text, word)
    for text in gb.fileids()
    for word in gb.words(text))
cfd.tabulate(conditions=titles, samples=modals)
```

Relative frequencies of modals in 18 Gutenberg Corpus

	can	could	may	might	will	should
austen-emma.txt	270	825	213	322	559	366
austen-persuasion.txt	100	444	87	166	162	185
austen-sense.txt	206	568	169	215	354	228
bible-kjv.txt	213	165	1024	475	3807	768
blake-poems.txt	20	3	5	2	3	6
bryant-stories.txt	75	154	18	23	144	38
burgess-busterbrown.txt	23	56	3	17	19	13
carroll-alice.txt	57	73	11	28	24	27
chesterton-ball.txt	131	117	90	69	198	75
chesterton-brown.txt	126	170	47	71	111	56
chesterton-thursday.txt	117	148	56	71	109	54
edgeworth-parents.txt	340	420	160	127	517	271
melville-moby_dick.txt	220	215	230	183	379	181
milton-paradise.txt	107	62	116	98	161	55
shakespeare-caesar.txt	16	18	35	12	129	38
shakespeare-hamlet.txt	33	26	56	28	131	52
shakespeare-macbeth.txt	21	15	30	5	62	41
whitman-leaves.txt	88	49	85	26	261	42

Pandas

- Pandas = powerful Python data analysis toolkit. Data is stored in Data Frames.

- Install pandas using conda:

```
C:\Users\dhoward>conda install pandas
Fetching package metadata .............
Solving package specifications: .

Package plan for installation in environment c:\users\dhoward\anaconda3_64bit:

The following packages will be UPDATED:

    conda: 4.3.27-py36hcbae3bd_0 --> 4.3.30-py36h7e176b0_0

Proceed ([y]/n)? y

conda-4.3.30-p 100% |################################| Time: 0:00:00   2.48 MB/s
```

Data Frame

```
np_object=[]
for fileid in gb.fileids():
    num_chars = len(gb.raw(fileid))
    num_words = len(gb.words(fileid))
    num_sents = len(gb.sents(fileid))
    num_vocab = len(set(w.lower() for w in gb.words(fileid)))
    x= [fileid, round(num_chars/num_words), round(num_words/num_sents), round(num_words/num_vocab)
]
   np_object.append(x)   --
```

PUT DATA in DataFrame and fancy up columns and row headings

```
df= pd.DataFrame(np_object, columns=['Title', '#chars/#words', '#words/#sents', '#words/#vocab'])
```

```
14 df= pd.DataFrame(np_object, columns=['Title', '#chars/#words', '#words/#sents', '#words/#vocab'])
```

```
Type:        DataFrame
String form:
Title   #chars/#words   #words/#sents   #words/#vocab
           0            austen-emma. <...>        12              7
```

Parts of Speech

- ‘A **part-of-speech** tagger, or **POS**-tagger - processes a sequence of words, and attaches a **part of speech** tag to each word’
- text-to-speech processors use this methodology.

Universal Part-of-Speech Tagset

Tag	Meaning	English Examples
ADJ	adjective	*new, good, high, special, big, local*
ADP	adposition	*on, of, at, with, by, into, under*
ADV	adverb	*really, already, still, early, now*
CONJ	conjunction	*and, or, but, if, while, although*
DET	determiner, article	*the, a, some, most, every, no, which*
NOUN	noun	*year, home, costs, time, Africa*
NUM	numeral	*twenty-four, fourth, 1991, 14:24*
PRT	particle	*at, on, out, over per, that, up, with*
PRON	pronoun	*he, their, her, its, my, I, us*
VERB	verb	*is, say, told, given, playing, would*
.	punctuation marks	*. , ; !*
X	other	*ersatz, esprit, dunno, gr8, univeristy*

http://www.nltk.org/book/ch05.html

Breaking down documents, sentences, phrases into parts of speech

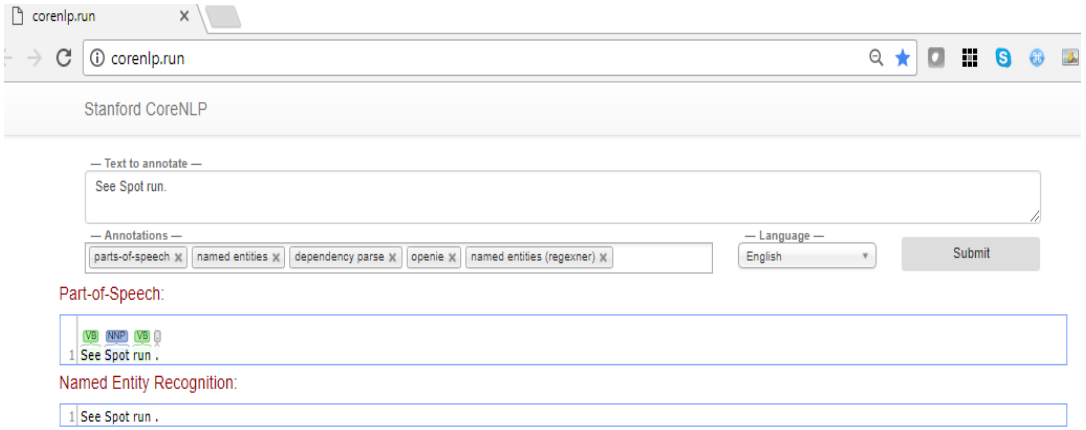
1. Tokenize to words.
2. Tag Data – Determines parts of speech

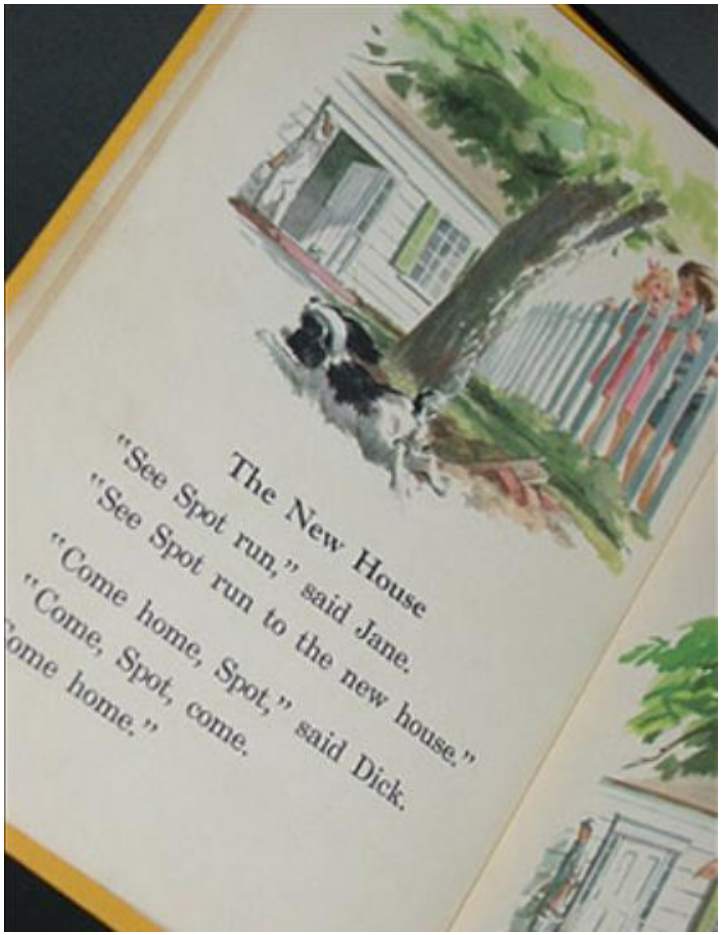
```
>>>mysentence = "See Spot Run"
>>>tokenized_text = nltk.word_tokenize(mysentence)
>>>tagged_text = nltk.pos_tag(tokenized_text)
>>>print(tagged_text)
```

3. Define your Grammar for each word. Simplified categories:

Breaking down a sentence into parts of speech

See Spot run.





Helpful References I used

- http://www.nltk.org/book
- https://www.digitalocean.com/community/tutorials/understanding-lists-in-python-3
- The_Quick_Python_Book_Third_Edition_v5_MEAP.pdf
- Plus many other URLs sprinkled throughout.

BACKUP SLIDES

What do we have on Cloudera?