Python for Data Science

Natural Language Processing: nltk

Dr. Ilkay Altintas and Dr. Leo Porter

Twitter: #UCSDpython4DS

By the end of this video, you should be able to:

- Describe what natural language processing (NLP) means
- List a few examples of NLP in everyday life
- Explain what NLTK is

Intro to Natural Language Processing (NLP)

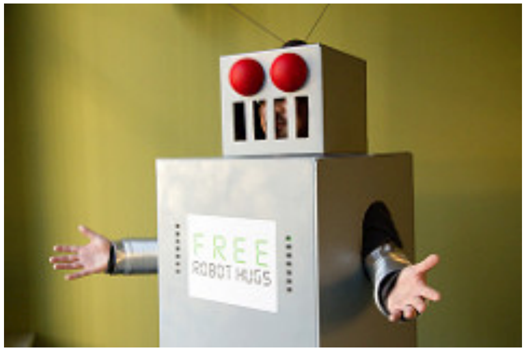
- Algorithms to analyze, understand and derive meaning from human language

- Hard computational problem because human language is **ambiguous**, needs **context** and ability to **link concepts**

- **Applications:** summarize text, generate keywords, identify sentiment of text

Real Life examples of NLP

- Speech recognition engines like Siri, Google Now or Alexa
- Automatic translation like Google Translate or Facebook automatic translation of statuses
- Chat bots that can answer question via Facebook Messenger, for example provided by Techcrunch, Disney or Whole Foods



nltk

Natural Language Toolkit in Python

- Work with human language data
- Includes over 50 datasets
- Complete library of easy to use algorithms for processing text
- Available for free under open source license

http://nltk.org

Python for Data Science

Natural Language Processing: nltk corpora

Dr. Ilkay Altintas and Dr. Leo Porter

Twitter: #UCSDpython4DS

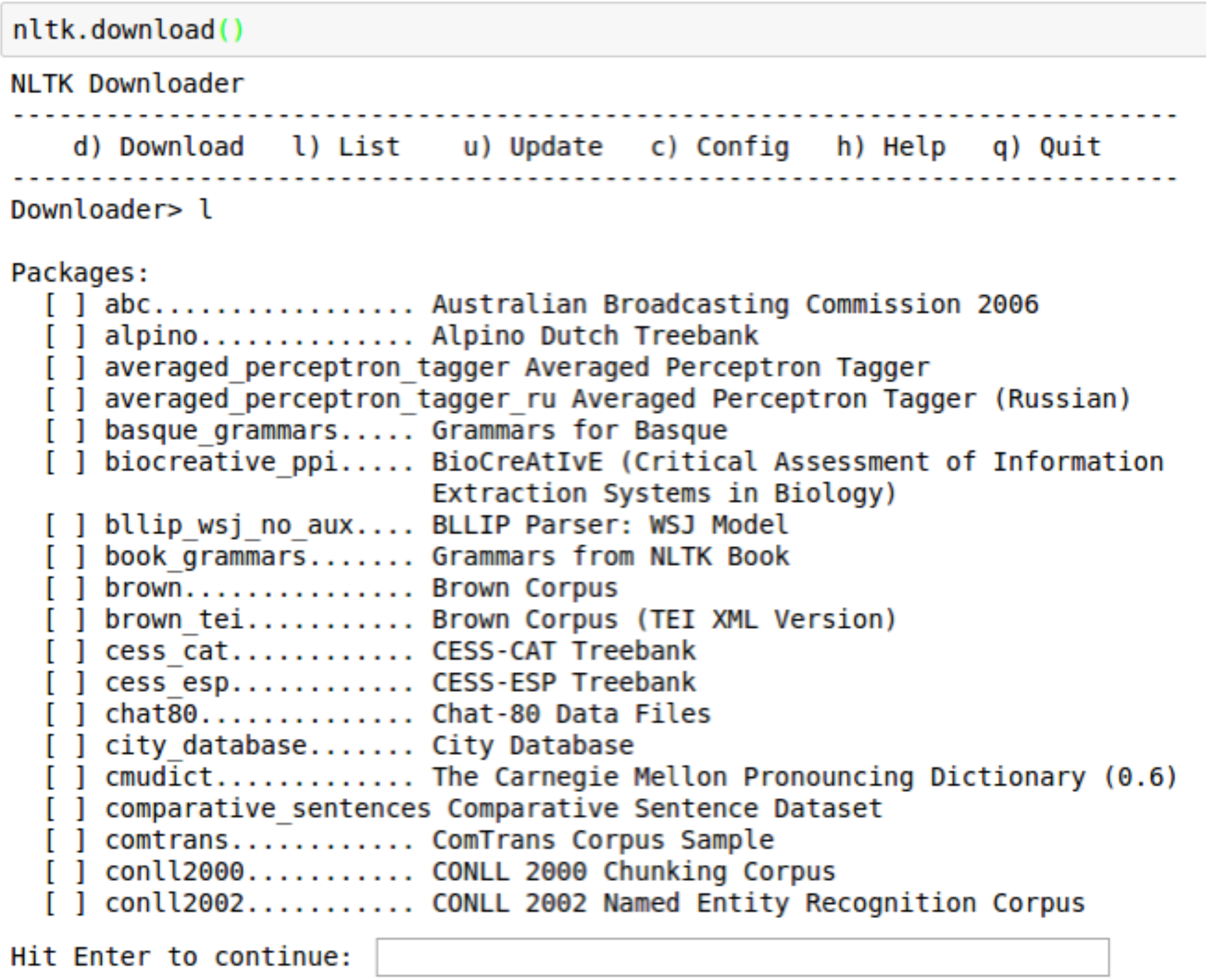
By the end of this video, you should be able to:

- Describe what corpus means
- List some datasets in the nltk corpora
- Recite the basic features of the movie reviews corpus in nltk

nltk corpora

corpus (plural corpora) is a collection of text in digital form, assembled for text processing

nltk provides a **download interface** to pre-processed text datasets.



```
nltk.download()
```

```
NLTK Downloader
---------------------------------------------------------------------------
    d) Download   l) List    u) Update   c) Config   h) Help   q) Quit
---------------------------------------------------------------------------
Downloader> l

Packages:
  [ ] abc................. Australian Broadcasting Commission 2006
  [ ] alpino.............. Alpino Dutch Treebank
  [ ] averaged_perceptron_tagger Averaged Perceptron Tagger
  [ ] averaged_perceptron_tagger_ru Averaged Perceptron Tagger (Russian)
  [ ] basque_grammars..... Grammars for Basque
  [ ] biocreative_ppi..... BioCreAtIvE (Critical Assessment of Information
                           Extraction Systems in Biology)
  [ ] bllip_wsj_no_aux.... BLLIP Parser: WSJ Model
  [ ] book_grammars....... Grammars from NLTK Book
  [ ] brown............... Brown Corpus
  [ ] brown_tei........... Brown Corpus (TEI XML Version)
  [ ] cess_cat............ CESS-CAT Treebank
  [ ] cess_esp............ CESS-ESP Treebank
  [ ] chat80.............. Chat-80 Data Files
  [ ] city_database....... City Database
  [ ] cmudict............. The Carnegie Mellon Pronouncing Dictionary (0.6)
  [ ] comparative_sentences Comparative Sentence Dataset
  [ ] comtrans............ ComTrans Corpus Sample
  [ ] conll2000........... CONLL 2000 Chunking Corpus
  [ ] conll2002........... CONLL 2002 Named Entity Recognition Corpus

Hit Enter to continue:
```

nltk movie reviews corpus

nltk.download("movie_reviews")

```
~ altintas$ ls nltk_data/corpora/movie_reviews

   README neg pos
```

2000 files:

- 1000 positive reviews in the pos/ folder
- 1000 negative reviews in the neg/ folder

nltk movie reviews corpus

```
nltk.download("movie_reviews")
```

2000 files:

- 1000 positive reviews in the pos/ folder
- 1000 negative reviews in the neg/ folder
- average 800 words per review

Python for Data Science

Natural language processing: tokenize

Dr. Ilkay Altintas and Dr. Leo Porter

Twitter: #UCSDpython4DS

By the end of this video, you should be able to:

- Explain what Tokenization means
- Use nltk word tokenizer

Tokenization

The first step in analyzing text is to split it into words: Tokenization

Corner cases:

- punctuation
- contractions
- hyphenated words

Example: "New York-based"

First Attempt without nltk

Naively just split on whitespace

See **Tokenize text in words**

Tokenize with nltk

nltk.word_tokenize

Sophisticated tokenizer specific to English,
it requires the *punkt* corpus.

It correctly identifies also punctuation.

Natural language processing: build a bag-of-words model

Dr. Ilkay Altintas and Dr. Leo Porter

Twitter: #UCSDpython4DS

Python for Data Science

By the end of this video, you should be able to:

- Explain what bag-of-words mean
- Understand how you can build machine learning features from words
- Give examples of stopwords

Bag-of-words Model

Bag-of-words = text as unordered collection of words

- simple model
- discards sentence structure
- useful to identify topic or sentiment

Building Features with Words

	outstanding	movie	family	worse	uninvolving	interesting
Review 1	True	True	False	False	False	False
Review 2	False	True	False	True	True	False
Review 3	True	True	True	False	False	False

Filter out Stopwords and Punctuation

The movie_reviews tokenized words also include punctuation and stopwords.

Stopwords are very common words that have no intrinsic meaning like "the", "is", "which".

Natural Language Processing: Plotting Frequency of Words

Dr. Ilkay Altintas and Dr. Leo Porter

Twitter: #UCSDpython4DS

By the end of this video, you should be able to:

- Count how many times an item appears in a list
- Plot word frequency in logarithmic axes
- Plot word counts histograms

Number of Words in Movie Reviews Corpus

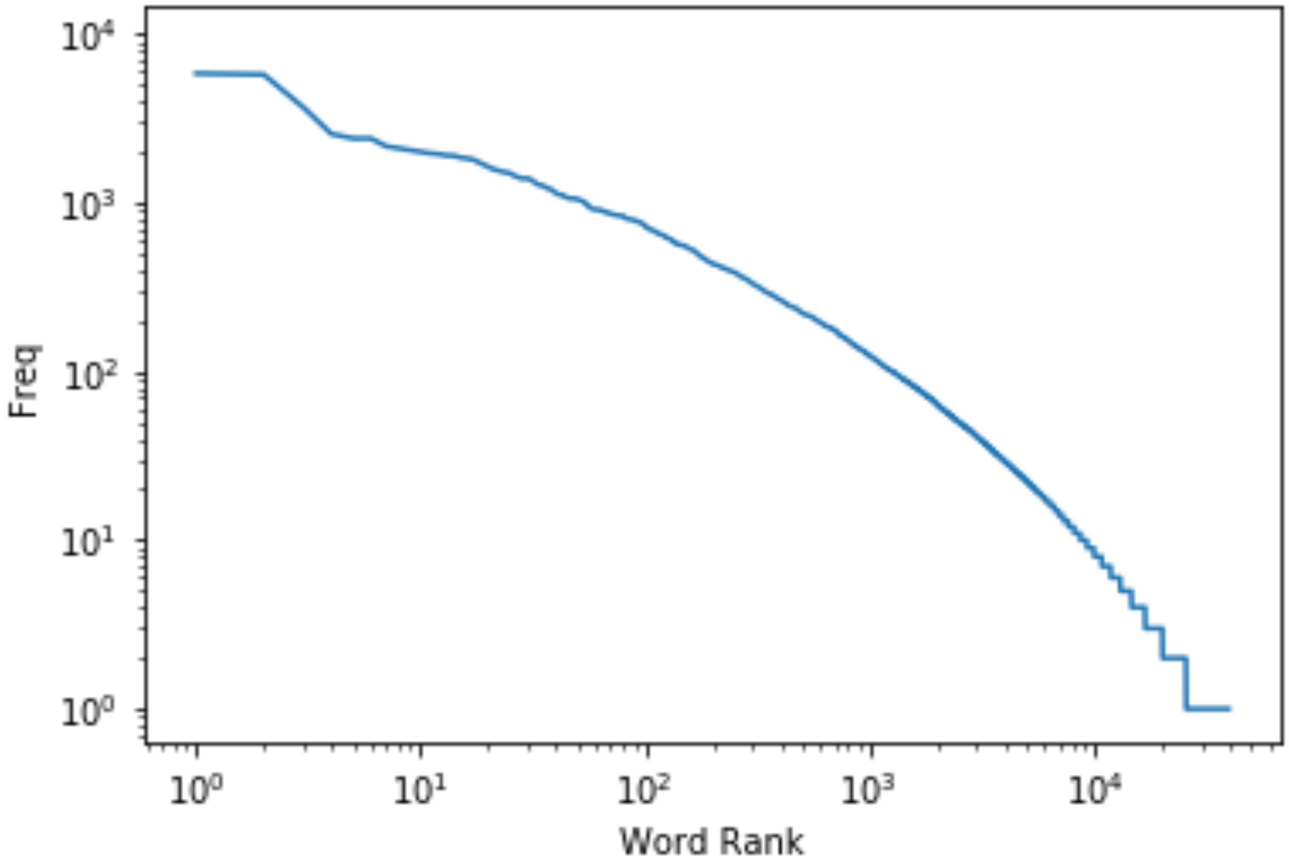
- ~1.6 million words
- just 710 thousand after filtering punctuation and stopwords

Using Counter

- Part of the collections package in the Python Standard Library
- Counts how many time an item is repeated

```
counter = Counter(filtered_words)
counter["movie"]
5771
```

Plotting Word Frequency



Histogram of Word Counts

- Use hist from matplotlib to create a histogram
- Choose bin number and optionally log axes

Python for Data Science

Natural Language Processing: Sentiment Analysis

Dr. Ilkay Altintas and Dr. Leo Porter

Twitter: #UCSDpython4DS

Python for Data Science

By the end of this video, you should be able to:

- Explain what is Sentiment Analysis
- Train a Sentiment Analysis classifier with nltk
- Check accuracy on training and test data

What is Sentiment Analysis

- Identify attitude or emotion encoded in a text
- Can be implemented as a Machine Learning Classifier

- **Example:** prediction on the appearance of words in a review

Build features/label pairs

The function implemented previously creates a set of features.

Create a pair of feature and positive/negative label for each review.

Naive Bayes Classifier

Naive Bayes Classifier is a simple classifier based on Conditional Probabilities.

In the training phase, it detects the probability that each feature (word) appears in a category (positive or negative).

Once trained, it collects the "votes" for all words in the new review and finds the most probable label.