Natural Language Processing and Machine Learning

Using Python

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Example Files

Hosted on Github

https://github.com/shanbady/NLTK-Boston-Python-Meetup

i. What is “Natural Language Processing”?

    i. Where is this stuff used?

    ii. The Machine learning paradox

ii. A look at a few key terms

iii. Quick start – creating NLP apps in Python

What is Natural Language Processing?

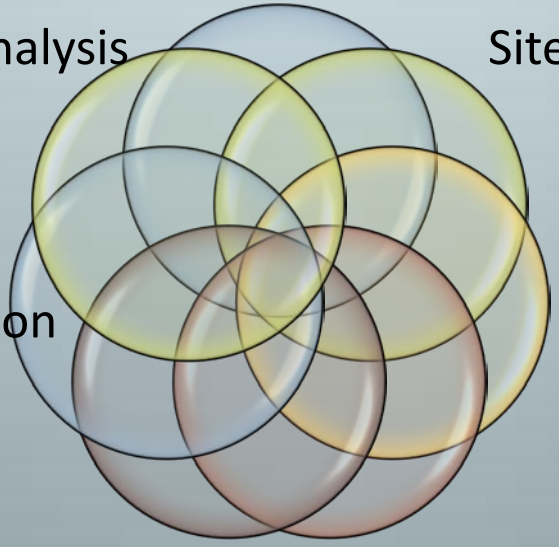
- Computer aided text analysis of human language.
- The goal is to enable machines to understand human language and extract meaning from text.
- It is a field of study which falls under the category of machine learning and more specifically computational linguistics.
- The “Natural Language Toolkit” is a python module that provides a variety of functionality that will aide us in processing text.

Natural language processing is heavily used throughout all web technologies

Search engines

Consumer behavior analysis

Site recommendations



Banking fraud detection

Spam filtering

Automated customer support systems

Knowledge bases and expert systems

Paradoxes in Machine Learning

Sentiment

Ambiguity

Intent

- Sarcasm
- Slang

Context

- Emphasis
- Time and date
  - Since when did “google” become a verb?

Context

Little sister: What's your name?

Me: Uhh….Shankar..?

Sister: Can you spell it?

Me: yes. S-H-A-N-K-A…..

Sister: WRONG! It's spelled "**I-T**"

Ambiguity

“I shot the man with ice cream.“

- A man with ice cream was shot
- A man had ice cream shot at him

Language translation is a complicated matter!

Go to: http://babel.mrfeinberg.com/

The problem with communication is the illusion that it has occurred

The problem with communication is the illusion that it has occurred

Das Problem mit Kommunikation ist die Illusion, dass es aufgetreten ist

The problem with communication is the illusion that it arose

Das Problem mit Kommunikation ist die Illusion, dass es entstand

The problem with communication is the illusion that it developed

Das Problem mit Kommunikation ist die Illusion, die sie entwickelte

The problem with communication is the illusion, which developed it

The problem with communication is the illusion that it has occurred

The problem with communication is the illusion, which developed it

EPIC FAIL

The “Human Test”

- Turing test
  - A test proposed to demonstrate that truly intelligent machines capable of understanding and comprehending human language should be indistinguishable from humans performing the same task.

Key Terms

Classification:

- Automatically organizing text by subject and tagging it with a proper category.
- Two types:
  - Supervised
  - Unsupervised

Tagging:

- Attaching part of speech, tense, related terms, and other properties to tokens of text.

Tokenizing:

- Process of breaking text into defined segments (usually using regexes or simple delimiters).

Stemming:

- - Process of breaking words to their stem removing plural forms, tense etc…
  Jump: jump-*ing*, jump-*ed*, jump-*s*

Collocations

- Short sequences of words that commonly appear together.
- Commonly used to provide search suggestions as users type.

N-Grams

- Tokens consisting of one or more words:
  - Unigrams
  - Bigrams
  - Trigrams

Setting up NLTK

- Source downloads available for mac and linux as well as installable packages for windows.
- Currently only available for Python 2.5 – 2.6
- http://www.nltk.org/download
- `easy_install nltk`
- Prerequisites
  - NumPy
  - SciPy

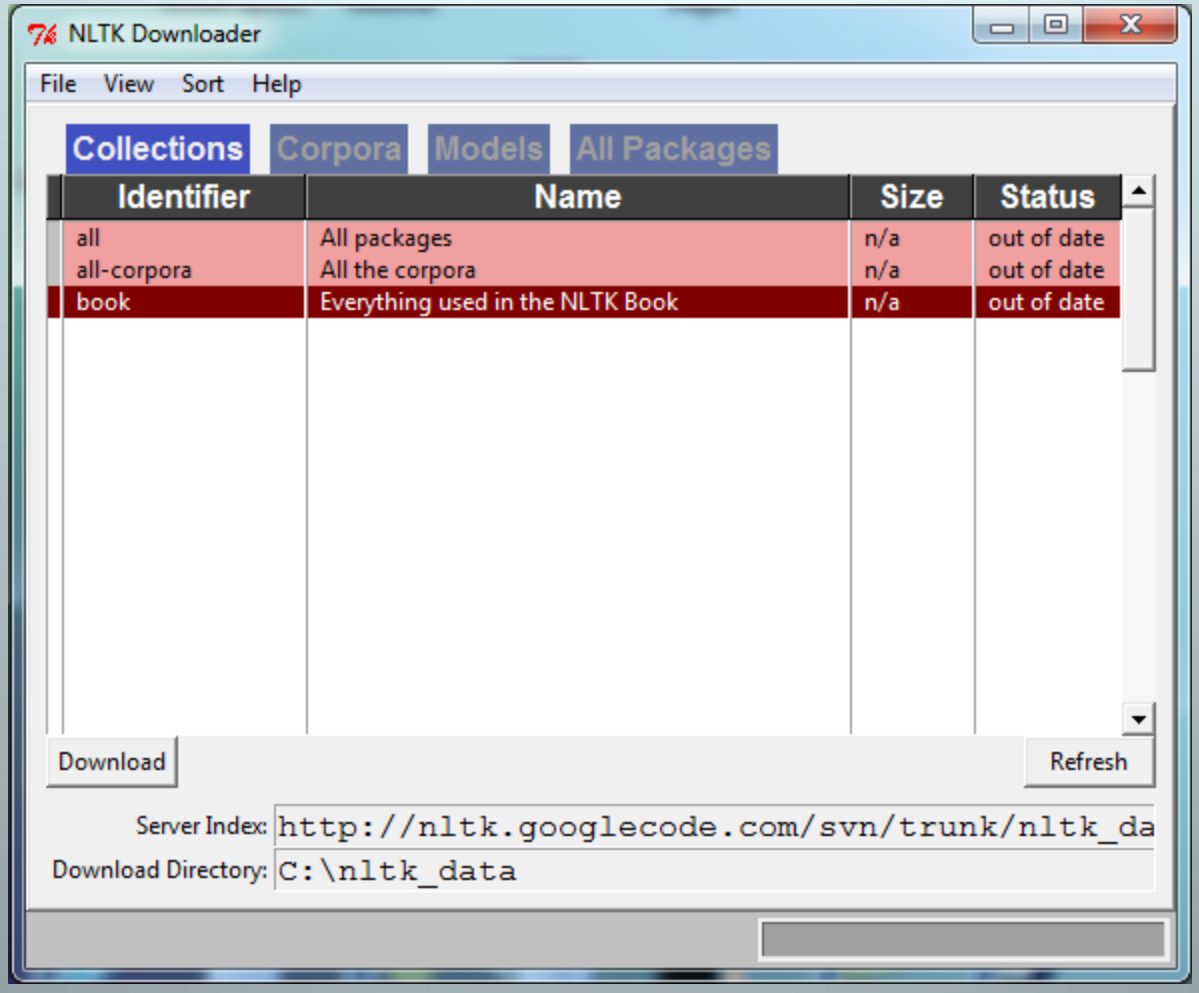
First steps

- NLTK comes with packages of corpora that are required for many modules.
- Open a python interpreter:

```
import nltk
nltk.download()
```

If you do not want to use the downloader with a gui (requires TKInter module)

Run: python -m nltk.downloader <name of package or “all”>



You may individually select packages or download them in bulk.

Let’s dive into some code!

Part of Speech Tagging

```
from nltk import pos_tag,word_tokenize

sentence1 = 'this is a demo that will show you
how to detects parts of speech with little effort
using NLTK!'

tokenized_sent = word_tokenize(sentence1)
print pos_tag(tokenized_sent)
```

```
[('this', 'DT'), ('is', 'VBZ'), ('a', 'DT'), ('demo', 'NN'), ('that', 'WDT'), ('will',
'MD'), ('show', 'VB'), ('you', 'PRP'), ('how', 'WRB'), ('to', 'TO'), ('detects',
'NNS'), ('parts', 'NNS'), ('of', 'IN'), ('speech', 'NN'), ('with', 'IN'), ('little',
'JJ'), ('effort', 'NN'), ('using', 'VBG'), ('NLTK', 'NNP'),('!', '.')]
```

Penn Bank Part-of-Speech Tags

CC	Coordinating conjunction
CD	Cardinal number
DT	Determiner
EX	Existential "there"
FW	Foreign word
IN	Prepostion or subordination conjunction
JJ	Adjective
JJR	Adjective- comparative
JJS	Adjective- superlative
LS	List item marker
MD	Modal
NN	Noun- singular or mass
NNS	Noun- plural
NP	Proper noun- singular
NPS	Proper noun- plural

Source: http://www.ai.mit.edu/courses/6.863/tagdef.html

NLTK Text

nltk.clean_html(*rawhtml*)

```
from nltk.corpus import brown
from nltk import Text


brown_words = brown.words(categories='humor')

brownText = Text(brown_words)

brownText.collocations()

brownText.count("car")

brownText.concordance("oil")

brownText.dispersion_plot(['car', 'document', 'funny', 'oil'])

brownText.similar('humor')
```

Find similar terms (word definitions) using Wordnet

```
import nltk
from nltk.corpus import wordnet as wn

synsets = wn.synsets('phone')

print [str(syns.definition) for syns in synsets]
```

1) 'electronic equipment that converts sound into electrical signals that can be transmitted over distances and then converts received signals back into sounds‘
2) '(phonetics) an individual sound unit of speech without concern as to whether or not it is a phoneme of some language‘
3) 'electro-acoustic transducer for converting electric signals into sounds; it is held over or inserted into the ear‘
4) 'get or try to get into communication (with someone) by telephone'

Meronyms and Holonyms

Meronyms and Holonyms are better described in relation to computer science terms as:

- Meronym terms: “has a” relationship
- Holonym terms: “part of” relationship
- Hyponym terms: “Is a” relationship

- Meronyms and holonyms are opposites
- Hyponyms and hypernyms are opposites

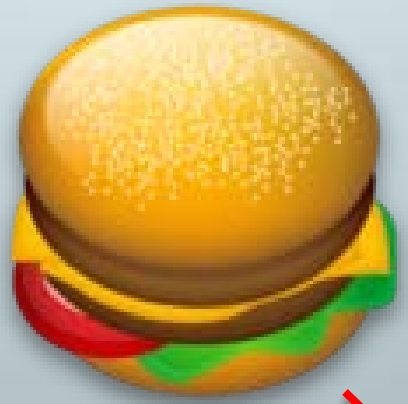
Burger is a holonym of:








Cheese, beef, tomato, and bread are meronyms of burger



Going back to the previous example …

```
from nltk.corpus import wordnet as wn

synsets = wn.synsets('phone')

print [str( syns.definition ) for syns in synsets]
```

"**syns.definition**" can be modified to output hypernyms , meronyms, holonyms etc:

<synset>.hypernyms	Hypernyms of synset
<synset>.hyponyms	Hyponyms of synset
<synset>.root_hypernyms	A hypernym of synset that is highest in the hierarchy
<synset>.common_hypernyms	Common hypernyms of two synsets
<synset>.lowest_common_hypernyms	A common hypernym of two synsets that appears at the lowest level in the hierarchy
<synset>.member_holonyms	Groups consisting of the specified members
<synset>.member_meronyms	Members of the specified group

Source:
http://www.sjsu.edu/faculty/hahn.koo/teaching/ling115/lecture_notes/ling115_wordnet.pdf

<synset>.substance_holonyms	Things made of the specified substance
<synset>.substance_meronyms	Substance of the specified thing
<synset>.part_holonyms	Things consisting of the specified parts
<synset>.part_meronyms	Parts of the specified whole
<synset>.attributes	List of synsets that describes the attributes of synset
<synset>.entailments	What is entailed by the specified synset
<synset>.similar_tos	List of similar adjectival senses

Source:
http://www.sjsu.edu/faculty/hahn.koo/teaching/ling115/lecture_notes/ling115_wordnet.pdf

```
from nltk.corpus import wordnet as wn
synsets = wn.synsets('car')
print [str(syns.part_meronyms() ) for syns in synsets]
```

[Synset('gasoline_engine.n.01'),

Synset('car_mirror.n.01'),

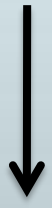
Synset('third_gear.n.01'),

Synset('hood.n.09'),

Synset('automobile_engine.n.01'),

Synset('grille.n.02'),

```
from nltk.corpus import wordnet as wn
synsets = wn.synsets('wing')
print [str(syns.part_holonyms() ) for syns in synsets]
```



[Synset('airplane.n.01')]

[Synset('division.n.09')]

[Synset('bird.n.02')]

[Synset('car.n.01')]

[Synset('building.n.01')]

```
import nltk
from nltk.corpus import wordnet as wn
synsets = wn.synsets('trees')
print [str(syns.part_meronyms()) for syns in synsets]
```

- synset('burl.n.02')
- synset('crown.n.07')
- synset('stump.n.01')
- synset('trunk.n.01')
- synset('limb.n.02')

```
from nltk.corpus import wordnet as wn

for hypernym in wn.synsets('robot')[0].hypernym_paths()[0]:
    print hypernym.lemma_names
```

```
['entity']
['physical_entity']
['object', 'physical_object']
['whole', 'unit']
['artifact', 'artefact']
['instrumentality', 'instrumentation']
['device']
['mechanism']
['automaton', 'robot', 'golem']
```

Fun things to Try

Feeling lonely?

Eliza is there to talk to you all day! What human could ever do that for you??

```
from nltk.chat import eliza
eliza.eliza_chat()
```

……starts the chatbot

```
Therapist
---------
Talk to the program by typing in plain English, using normal upper-
and lower-case letters and punctuation.  Enter "quit" when done.
================================================================================
Hello.  How are you feeling today?
```

Englisch to German to Englisch to German……

```
from nltk.book import *
babelize_shell()
```

```
Babel> the internet is a series of tubes
Babel> german
Babel> run
0> the internet is a series of tubes
1> das Internet ist eine Reihe SchlSuche
2> the Internet is a number of hoses
3> das Internet ist einige SchlSuche
4> the Internet is some hoses
Babel>
```

Do you Speak Girbbhsi??

Take the following meaningful text

A new study in the journal Animal Behavior shows that dogs rely a great deal on face recognition to tell their own person from other people. Researchers describe how dogs in the study had difficulty recognizing their owners when two human subjects had their faces covered.

Let's have NLTK analyze and generate some gibberish!

```
import nltk
words = 'text'
tokens = nltk.word_tokenize(words)
text = nltk.Text(tokens)
print text.generate()
```

Results May Vary but these were mine

A new study in the study had difficulty recognizing their owners when two human subjects had their faces covered . **their owners when two human subjects had their faces covered** . on face recognition to tell their own person from other people. **Researchers describe how dogs in the journal Animal Behavior shows that dogs rely** a great deal on face recognition to tell their own person from other people. **Researchers describe how dogs in the study had difficulty recognizing** their owners when two human subjects had their faces covered . **subjects had their faces covered** . dogs rely a great

A new study in the journal Animal Behavior shows that dogs rely a great deal on face recognition to tell their own person from other people. Researchers describe how dogs in the study had difficulty recognizing their owners when two human subjects had their faces covered.

How Similar?

```
#!/usr/bin/env python
from nltk.corpus import wordnet as wn

similars = []

Aword = ‘language'
Bword = ‘barrier‘
```

```
# grab synsets of each word
synsetsA = wn.synsets(Aword)
synsetsB = wn.synsets(Bword)
```

```
groupA= [wn.synset(str(synset.name)) for synset in synsetsA]
groupB = [wn.synset(str(synset.name)) for synset in synsetsB]
```

path_similarity()

"**Path Distance Similarity:** Return a score denoting how similar two word senses are, based on the shortest path that connects the senses in the is-a (hypernym/hypnoym) taxonomy."

wup_similarity()

"**Wu-Palmer Similarity:** Return a score denoting how similar two word senses are, based on the depth of the two senses in the taxonomy and that of their Least Common Subsumer (most specific ancestor node)."

Source: http://nltk.googlecode.com/svn/trunk/doc/api/nltk.corpus.reader.wordnet.WordNetCorpusReader-class.html

```
for sseta in groupA:
    for ssetb in groupB:

        path_similarity = sseta.path_similarity(ssetb)
        wup_similarity = sseta.wup_similarity(ssetb)

        if path_similarity is not None:
            similars.append({
                'path':path_similarity,
                'wup':wup_similarity,
                'wordA':sseta,
                'wordB':ssetb,
                'wordA_definition':sseta.definition,
                'wordB_definition':ssetb.definition
            })
```

```
similars = sorted( similars, key=\
lambda item:  item['path'] , reverse=True)
```

```
for item in similars:

    print item['wordA'],"- “, item['wordA_definition']

    print item['wordB'], "-",  item['wordB_definition']

    print 'Path similarity - ',item['path'],"\n“
```

Language

the cognitive processes involved in producing and understanding linguistic communication

Similarity: 0.111~

Barrier

any condition that makes it difficult to make progress or to achieve an objective

It trickles down from there

Synset('linguistic_process.n.02')
the cognitive processes involved in producing and understanding linguistic communication
    Synset('barrier.n.02')
    any condition that makes it difficult to make progress or to achieve an objective
    Path similarity - 0.111111111111

Synset('language.n.05')
the mental faculty or power of vocal communication
    Synset('barrier.n.02')
    any condition that makes it difficult to make progress or to achieve an objective
    Path similarity - 0.111111111111

Synset('language.n.01')
a systematic means of communicating by the use of sounds or conventional symbols
    Synset('barrier.n.02')
    any condition that makes it difficult to make progress or to achieve an objective
    Path similarity - 0.1

Synset('language.n.01')
a systematic means of communicating by the use of sounds or conventional symbols
    Synset('barrier.n.03')
    anything serving to maintain separation by obstructing vision or access
    Path similarity - 0.1

Poetic Programming

- We will create a program to extract “Haikus” from any given English text.
- A haiku is a poem in which each stanza consists of three lines.
- The first line has 5 syllables, the second has 7 and the last line has 5.

Inspired by a GitHub project “Haiku Finder” :

https://github.com/jdf/haikufinder

We will be re-implementing this program and adding a few other little features.

You will need

- The nltk_contrib package from Google Code:
  http://code.google.com/p/nltk/downloads/list
- The following corpora:
  - Wordnet
  - Cmudict

- A few paragraphs of text that we will use to create haikus from

```
from nltk_contrib.readability.textanalyzer import syllables_en
from nltk.corpus import cmudict,wordnet as wn
from nltk import word_tokenize
import re
```

```
textchunk = '''‘  # we will make Ted Stevens sound more poetic
    They want to deliver vast amounts of information over the Internet.
    And again, the Internet is not something that you just dump
    something on.

    It's not a big truck. It's a series of tubes.

    And if you don't understand, those tubes can be filled and if they are
    filled, when you put your message in, it gets in line and it's going to
    be delayed by anyone that puts into that tube enormous amounts of
    material, enormous amounts of material

    '''
```

```
textchunk += '‘‘# throw in a few “bush-isms”

    I want to share with you an interesting program for two
    reasons, one, it's interesting, and two, my wife thought of
    it or has actually been involved with it; she didn't think of
    it. But she thought of it for this speech.

    This is my maiden voyage. My first speech since I was the
    president of the United States and I couldn't think of a
    better place to give it than Calgary, Canada.

’’’
```

```
poem = ' '
wordmap = []


words = word_tokenize(textchunk)


for iter,word in enumerate(words):
    # if it is a word, add a append a space to it
    if word.isalpha():
        word += "   "

    syls = syllables_en.count(word)
    wordmap.append((word,syls))
```

Tokenize the words

NLTK function to count syllables

Define a function to provide a fallback word in case we end up with lines that do not have the syllable count we need.

```
def findSyllableWord(word,syllableSize):
    synsets = wn.synsets(word)
    for syns in synsets:
        name = syns.name
        lemmas =  syns.lemma_names
        for wordstring in lemmas:
            if(syllables_en.count(wordstring) == syllableSize and
wordstring != word):
                return {'word':word,'syllable':syllableSize}
    return  {'word':word,'syllable':syllables_en.count(word)}
```

Given a word , this function tries to find similar words from WordNet that match the required syllable size

We loop through the each word keeping tally of syllables and breaking each line when it reaches the appropriate threshold

```
lineNo = 1
charNo = 0
tally = 0
for syllabicword in wordmap:
    s = syllabicword[1]
    wordtoAdd = syllabicword[0]
    if lineNo == 1:
        if tally < 5:
            if tally + int(s) > 5 and wordtoAdd.isalpha():
                num = 5 - tally
                similarterm = findSyllableWord(wordtoAdd,num)
                wordtoAdd = similarterm['word']
                s = similarterm['syllable']
            tally += int(s)
            poem += wordtoAdd
        else:
            poem += "  ---"+str(tally)+"\n"
            if wordtoAdd.isalpha():
                poem += wordtoAdd
            tally = s
            lineNo = 2
    if lineNo == 2:
```

…. Abridged

print poem

Its not perfect but its still pretty funny!

I want to share with ---5
you an interesting program ---8
for two reasons ,one ---5

it 's interesting ---5
and two ,my wife thought of it ---7
or has actually ---5

been involved with ---5
it ;she didn't think of it. But she thought ---7
of it for this speech. ---5

This is my maiden ---5
voyage. My first speech since I ---7
was the president of ---5 **…. Abridged**

Let’s build something even cooler

Lets write a spam filter!

A program that analyzes legitimate emails “Ham” as well as “spam” and learns the features that are associated with each.

Once trained, we should be able to run this program on incoming mail and have it reliably label each one with the appropriate category.

What you will need

1. NLTK (of course) as well as the “stopwords” corpus

    1. A good dataset of emails; Both spam and ham

    2. Patience and a cup of coffee
       (these programs tend to take a while to complete)

Finding Great Data: The Enron Emails

- A dataset of 200,000+ emails made publicly available in 2003 after the Enron scandal.
- Contains both spam and actual corporate ham mail.
- For this reason it is one of the most popular datasets used for testing and developing anti-spam software.

The dataset we will use is located at the following url:
http://labs-repos.iit.demokritos.gr/skel/i-config/downloads/enron-spam/preprocessed/

It contains a list of archived files that contain plaintext emails in two folders , *Spam* and *Ham.*

1. Extract one of the archives from the site into your working directory.

2. Create a python script, lets call it “spambot.py”.

3. Your working directory should contain the “spambot” script and the folders “spam” and “ham”.

“Spambot.py”

```
from nltk import word_tokenize,\
WordNetLemmatizer,NaiveBayesClassifier\
,classify,MaxentClassifier

from nltk.corpus import stopwords
import random
import os, glob,re
```

```
wordlemmatizer = WordNetLemmatizer()
commonwords = stopwords.words('english')
hamtexts  = []
spamtexts  = []
```

load common English words into list

start globbing the files into the appropriate lists

```
for infile in glob.glob( os.path.join('ham/','*.txt') ):
    text_file = open(infile, "r")
    hamtexts.append(text_file.read())
    text_file.close()

for infile in glob.glob( os.path.join('spam/','*.txt') ):
    text_file = open(infile, "r")
    spamtexts.append(text_file.read())
    text_file.close()
```

"Spambot.py" (continued)

label each item with the appropriate label and store them as a list of tuples

```
mixedemails =  ([(email,'spam') for email in spamtexts]
mixedemails +=  [(email,'ham') for email in hamtexts])
```

From this list of random but labeled emails, we will defined a "**feature extractor**" which outputs a feature set that our program can use to statistically compare spam and ham.

```
random.shuffle(mixedemails)
```

lets give them a nice shuffle

```
def email_features(sent):
    features = {}
    wordtokens = [wordlemmatizer.lemmatize(word.lower()) for word
in word_tokenize(sent)]
    for word in wordtokens:
        if word not in commonwords:
            features[word] =  True
    return features
```

Normalize words

If the word is not a stop-word then lets consider it a "feature"

Let's run each email through the feature extractor and collect it in a "featureset" list

```
featuresets = [(email_features(n), g) for (n,g) in mixedemails]
```

- The features you select must be binary features such as the existence of words or part of speech tags (True or False).

- To use features that are non-binary such as number values, you must convert it to a binary feature. This process is called **“binning”.**

  - If the feature is the number 12 the feature is: (“11<x<13”, True)

"Spambot.py" (continued)

Lets grab a sampling of our featureset. Changing this number will affect the accuracy of the classifier. It will be a different number for every classifier, find the most effective threshold for your dataset through experimentation.

```
size = int(len(featuresets) * 0.7)
```

Using this threshold grab the first ***n*** elements of our featureset and the last ***n*** elements to populate our "training" and "test" featuresets

```
train_set, test_set = featuresets[size:], featuresets[:size]
```

Here we start training the classifier using NLTK's built in Naïve Bayes classifier

```
classifier = NaiveBayesClassifier.train(train_set)
```

```
print classifier.labels()
```

This will output the labels that our classifier will use to tag new data

```
['ham', 'spam']
```

The purpose of create a "training set" and a "test set" is to test the accuracy of our classifier on a separate sample from the same data source.

```
print classify.accuracy(classifier,test_set)
```

```
0.983589566419
```

```
classifier.show_most_informative_features(20)
```

Ham			Spam		
ect	ham	46:1	**2004**	spam	43.5:1
cc	ham	40.2:1	**removed**	spam	42.9:1
kitchen	ham	39.1:1	**thousand**	spam	38.2:1
wednesday	ham	29.8:1	**prescription**	spam	34.2:1
shirley	ham	29.1:1	**doctor**	spam	28.9:1
meeting	ham	26.8:1	**super**	spam	26.9:1
houston	ham	24.3:1	**quality**	spam	26.9:1
thursday	ham	23.9:1	**drug**	spam	26.9:1
2001	ham	19.1:1	**remove**	spam	26.1:1
mary	ham	19.1:1	**cheap**	spam	24.9:1

“Spambot.py” (continued)

```
While True:
    featset = email_features(raw_input("Enter text to classify: "))
    print classifier.classify(featset)
```

We can now directly input new email and have it classified as either Spam or Ham

A few notes:

-The quality of your input data will affect the accuracy of your classifier.

- The threshold value that determines the sample size of the feature set will need to be refined until it reaches its maximum accuracy. This will need to be adjusted if training data is added, changed or removed.

A few notes:

- The accuracy of this dataset can be misleading; In fact our spambot has an accuracy of 98% - but this only applies to Enron emails. This is known as “over-fitting” .

- Try classifying your own emails using this trained classifier and you will notice a sharp decline in accuracy.

Chunking

Complete sentences are composed of two or more “phrases”.

- Noun phrase:
  - **Jack and Jill** went up the hill
- Prepositional phrase:
  - Contains a noun, preposition and in most cases an adjective
  - **The NLTK book is on the table** but perhaps it is best kept in a bookshelf
- Gerund Phrase:
  - Phrases that contain “–ing” verbs
  - Jack fell down and broke his crown and **Jill came tumbling after**

Take the following sentence …..

Jack and Jill *went* up **the hill**

Noun phrase

Noun Phrase

Chunkers will get us this far:

[Jack and Jill] went up **[the hill]**

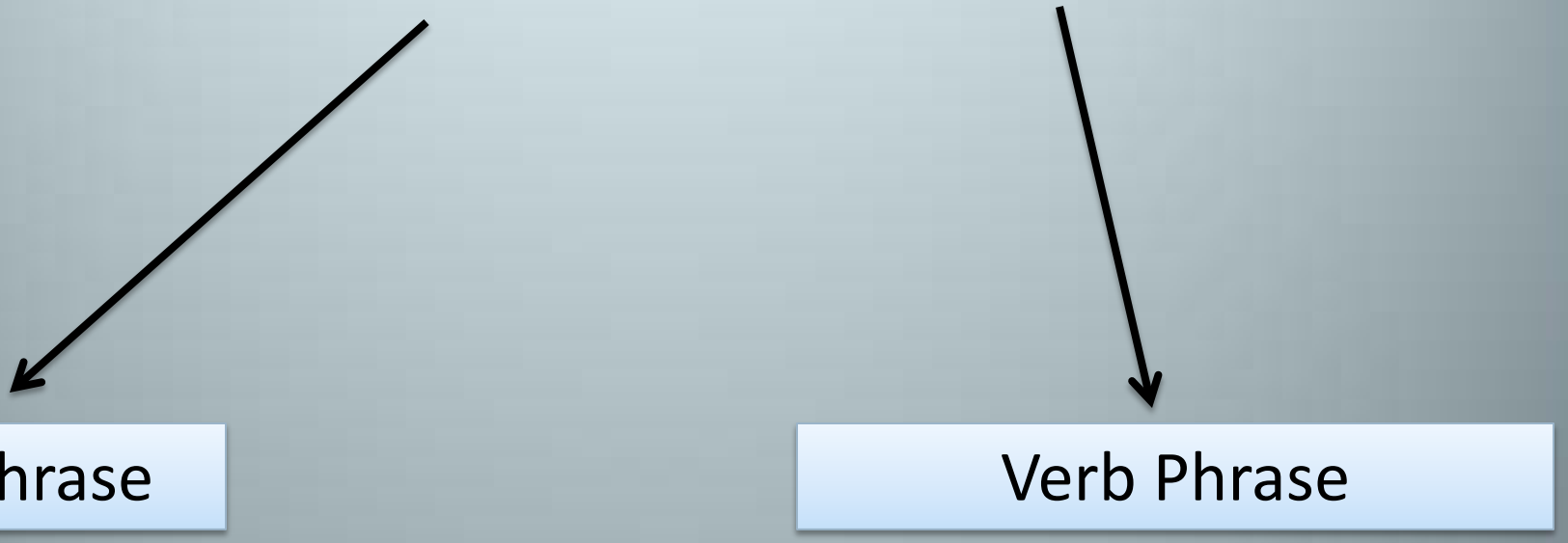
Chunk tokens are non-recursive – meaning, there is no overlap when chunking

The recursive form for the same sentence is:

(Jack and Jill went up **(the hill))**

Verb phrase chunking

Jack and Jill **went up the hill** to **fetch a pail of water**

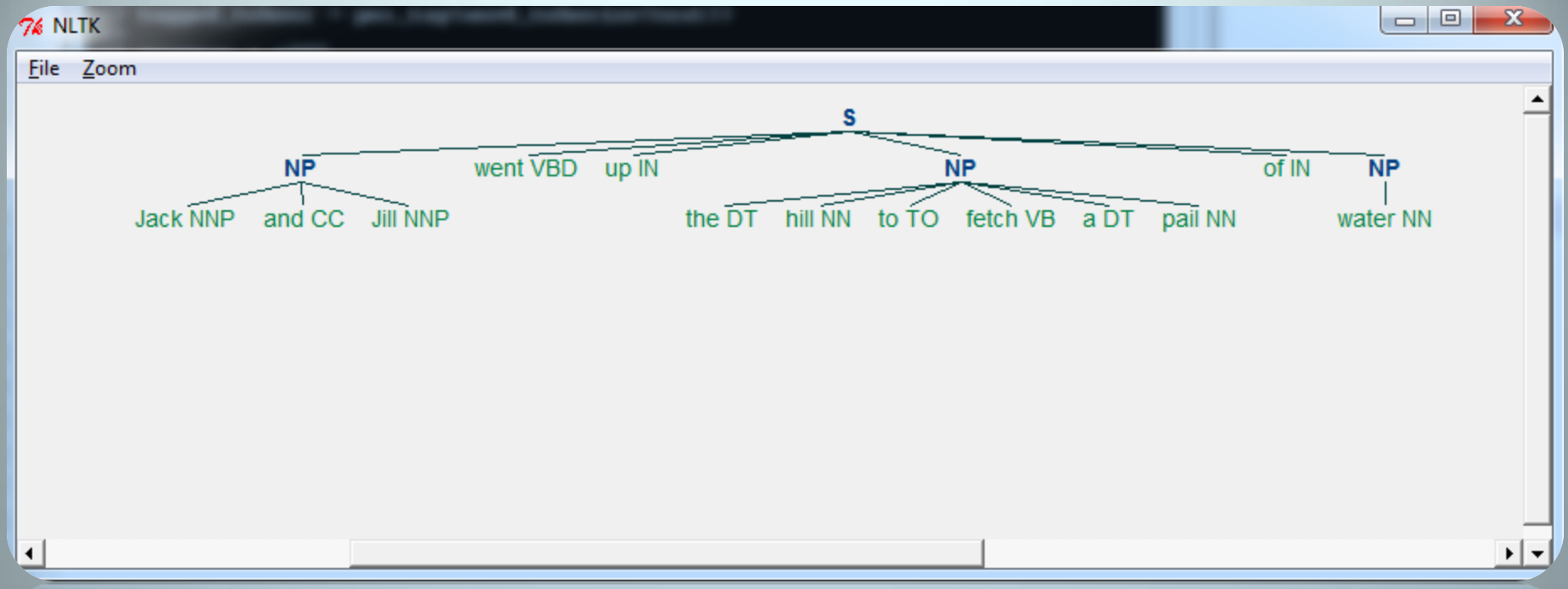


```
from nltk.chunk import *
from nltk.chunk.util import *
from nltk.chunk.regexp import *
from nltk import word_tokenize,pos_tag

text = '''
Jack and Jill went up the hill to fetch a pail of water
'''
tokens = pos_tag(word_tokenize(text))

chunk = ChunkRule("<.*>+","Chunk all the text")
chink = ChinkRule("<VBD|IN|\.>",“Verbs/Props")
split = SplitRule("<DT><NN>","<DT><NN>","determiner+noun")

chunker = RegexpChunkParser([chunk, chink, split],chunk_node='NP')
chunked = chunker.parse(tokens)
chunked.draw()
```



Chunkers and Parsers ignore the words and instead use part of speech tags to create chunks.

Chunking and Named Entity Recognition

```
from nltk import ne_chunk,pos_tag
from nltk.tokenize.punkt import PunktSentenceTokenizer
from nltk.tokenize.treebank import TreebankWordTokenizer

TreeBankTokenizer = TreebankWordTokenizer()
PunktTokenizer = PunktSentenceTokenizer()

text = '''
text on next slide
'''

sentences = PunktTokenizer.tokenize(text)
tokens = [TreeBankTokenizer.tokenize(sentence) for sentence in sentences]
tagged = [pos_tag(token) for token in tokens]
chunked = [ne_chunk(taggedToken) for taggedToken in tagged]
```

text = '''

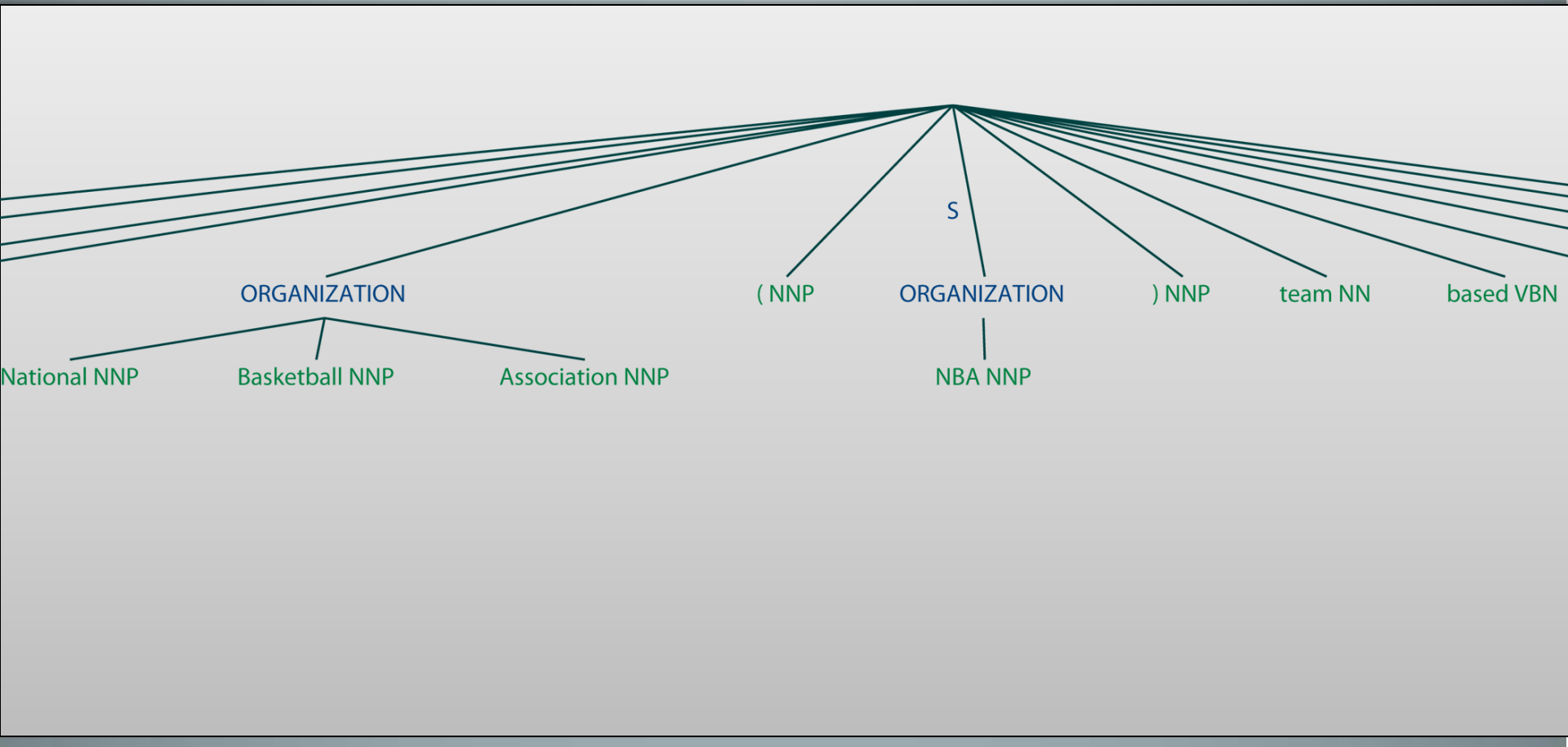
The Boston Celtics are a National Basketball Association (NBA) team based in Boston, MA. They play in the Atlantic Division of the Eastern Conference. Founded in 1946, the team is currently owned by Boston Basketball Partners LLC. The Celtics play their home games at the TD Garden, which they share with the Boston Blazers (NLL), and the Boston Bruins of the NHL. The Celtics have dominated the league during the late 50's and through the mid 80's, with the help of many Hall of Famers which include Bill Russell, Bob Cousy, John Havlicek, Larry Bird and legendary Celtics coach Red Auerbach, combined for a 795 - 397 record that helped the Celtics win 16 Championships.

print chunked

(S The/DT **(ORGANIZATION Boston/NNP Celtics/NNP)** are/VBP a/DT **(ORGANIZATION National/NNP Basketball/ (/NNP (ORGANIZATION NBA/NNP)**)/NNP team/NN based/VBN in/IN **(GPE Boston/NNP)** ,/, MA./NNP They/NNP play/VBP in/IN the/DT **(ORGANIZATION Atlantic/NNP Division/NN** of/IN the/DT **(LOCATION Eastern/NNP)** Conference./NNP Founded/NNP in/IN 1946/CD ,/, the/DT team/NN is/VBZ currently/RB owned/VBN by/IN **(PERSON Boston/NNP Basketball/NNP) (ORGANIZATION Partners/NNPS)**

which/WDT include/VBP **(PERSON Bill/NNP Russell/NNP)** ,/, (PERSON Bob/NNP Cousy/NNP) ,/, **(PERSON John/NNP Havlicek/NNP)** ,/, (PERSON Larry/NNP Bird/NNP) and/CC legendary/JJ Celtics/NNP coach/NN **(PERSON Red/NNP Auerbach/NNP)**

chunked[0].draw()



Thank you for coming!

Special thanks

Ned Batchelder and Microsoft

My latest creation.
Check out weatherzombie.com on your iphone or android!

Further Resources:

- **This presentation with all the slides can be downloaded from my website**
  - http://www.shankarambady.com
- **“Natural Language Processing with Python” by Steven Bird, Ewan Klein, and Edward Loper**
  - http://www.nltk.org/book
- **API reference :** http://nltk.googlecode.com/svn/trunk/doc/api/index.html
- Great NLTK blog:
  - http://streamhacker.com/