LG 467 Computers in Linguistics

[1-2021] Topic 5: POS tagging

Sakol Suethanapornkul

Previously...

We can count frequencies of individual items with `FreqDist`:

Code 6.2

```
import nltk

f = open('text1.txt')
txt = f.read()
f.close()

tokens = nltk.word_tokenize(txt)
freq   = nltk.FreqDist(tokens)

freq.most_common(15)
freq.plot()
freq.plot(cumulative = True)
```

Previously...

You can define your own functions to automate tasks. Functions can take multiple parameters plus a docstring:

Code 6.11

```
def ttr(lst, digits):
    """Compute type-token ratio on a list of strings,
    accepts one list and digits to round."""
    result = len(set(lst))/len(lst)
    return round(result, digits)

ttr(text1, 3)
ttr(text2, 4)
help(ttr)
```

Previously...

Language is not random. Things pattern together.

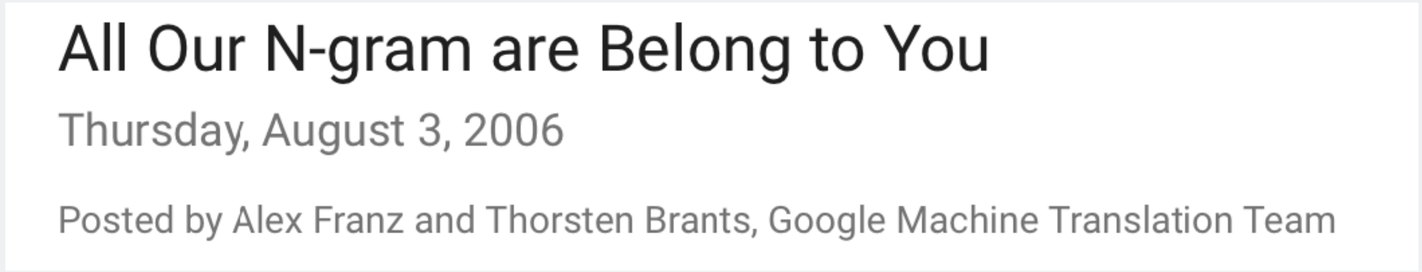
- We can ask what the next word might be given context
- Simple and efficient way of modeling context is using ***n-grams***
- N-grams are units of n sequences
  - Characters: 'custard'
    - (*c*, *u*, *s*, *t*, *a*, *r*, *d*) (*cu*, *us*, *st*, *ta*, *ar*, *rd*) (*cus*, *ust*, *sta*, *tar*, *ard*)
  - Words: 'He is eating fried rice'
    - (*he*, *is*, *eating*, *fried*, *rice*) (*he is*, *is eating*, *eating fried*, *fried rice*)

Previously...

N-grams to model language data

- decide on a useful context size (2, 3, 4, or ?)
- save analyses not of individual words but of words given the previous n words

Check out: Google N-grams and Google Books ngram viewer


All Our N-gram are Belong to You

Thursday, August 3, 2006

Posted by Alex Franz and Thorsten Brants, Google Machine Translation Team

Previously...

We can generate bigram (or any n-gram) counts with NLTK:

Code 6.12

```
import nltk

nltk.bigrams(text1)

list(nltk.bigrams(text1))

nltk.ngrams(text1, 2)
list(nltk.ngrams(text1, 2))

bigrams = list(nltk.ngrams(text1, 2))
bicount = FreqDist(bigrams)
```

Beneath the surface

Our token n-gram models represent transitions between observed characters/words

- We can call them **Visible Markov Models** (**VMMs**)

For things that are overt, we are also interested in the probabilities of **hidden** categories

- We will need **Hidden Markov Models** (**HMMs**)

Beneath the surface

Did I hear hidden categories? What did you mean?

- We may not be interested in a phrase like 'awesome news'
- Instead, we might want to know the likelihood of adjectives followed by nouns (ADJ + NOUN)
- How can we look at categories that are not in the data explicitly?

Parts of speech (POS)

The idea that words can be classified into grammatical categories has a long history

- **part of speech**, word classes, **POS**, **POS tags**

8 parts of speech attributed to Dionysius Thrax of Alexandria (c. 1st C. BCE):

- noun, verb, pronoun, preposition, adverb, conjunction, participle, article
- These categories are relevant for NLP today.

Adapted from: Jurafsky & Martin's chapter 8 PPT

Two classes of words: Open and closed

1. Closed class words
   - Relatively fixed membership
   - Usually function words: short, frequent words with grammatical function
     - determiners: *a*, *an*, *the*
     - pronouns: *she*, *he*, *I*
     - prepositions: *on*, *under*, *over*, *near*, *by*, ...

Adapted from: Jurafsky & Martin's chapter 8 PPT

Two classes of words: Open and closed

2. Open class words

- Usually content words: Nouns, Verbs, Adjectives, Adverbs
  - Plus interjections: *oh*, *ouch*, *uh-huh*, *yes*, *hello*
- New nouns and verbs like *iPhone*, *facebook*, *mansplain*, *google*

Adapted from: Jurafsky & Martin's chapter 8 PPT

Open class ("content") words

Nouns

Proper

Janet
Italy

Common

cat, cats
mango

Verbs

Main

eat
went

Auxiliary

can
had

Adjectives *old green tasty*

Adverbs *slowly yesterday*

Numbers

122,312
one

Interjections *Ow hello*

… more

Closed class ("function")

Determiners *the some*

Conjunctions *and or*

Pronouns *they its*

Prepositions *to with*

Particles *off up*

… more

Adapted from: Jurafsky & Martin's chapter 8 PPT

Part-of-speech (POS) tagging

POS tagging = assigning a part-of-speech to each word in a text

If we know the POS tags of a text, we could create n-gram models describing them:

- V N ART N → double object dative (e.g., *baked me a cake*)
- N N → compound nouns (e.g., *friend zone*)

Part-of-speech (POS) tagging

Words often have more than one POS. The goal is to find the correct tag for the situation (= solving ambiguity)

Case 1: 'book'

- VERB: (Book that flight)
- NOUN: (Hand me that book)

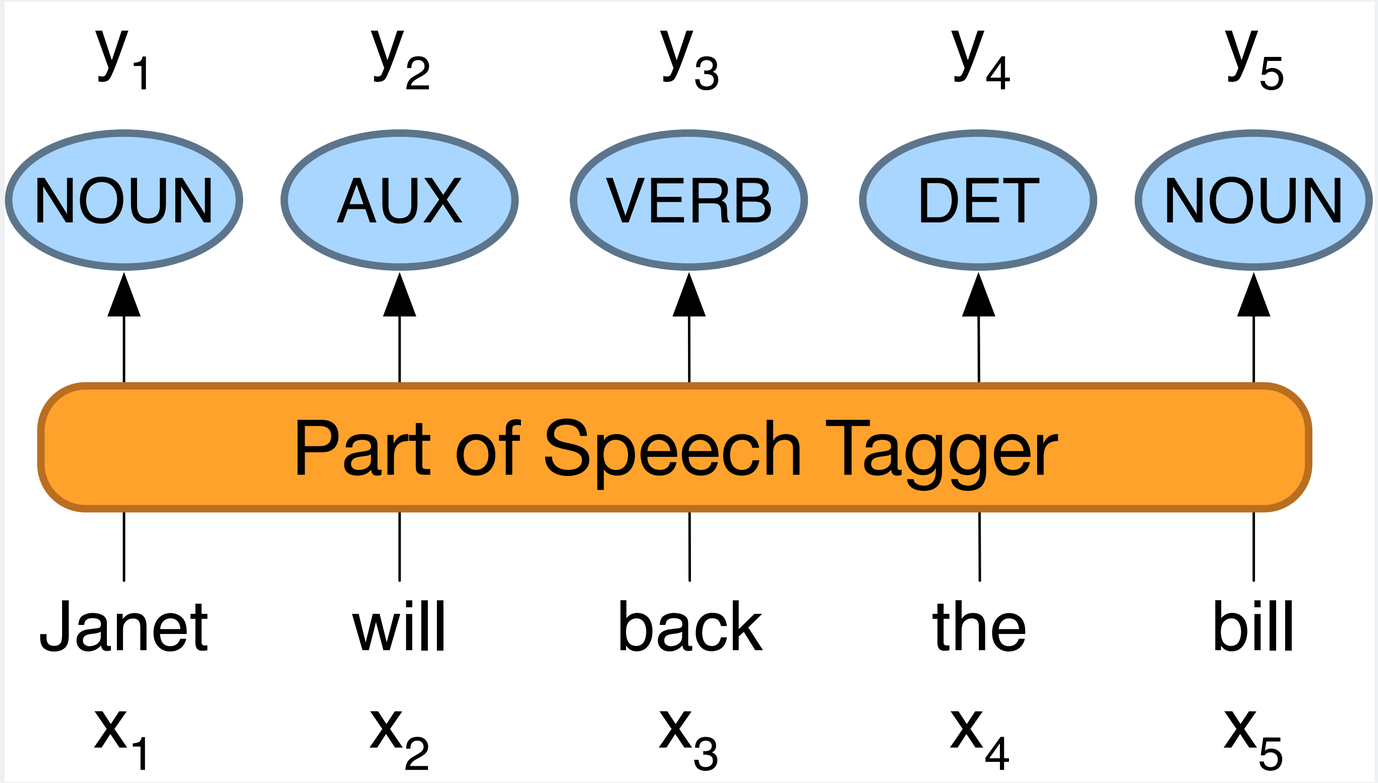
Case 2: 'tired'

-
-

Adapted from: Jurafsky & Martin's chapter 8 PPT

Part-of-speech (POS) tagging

Map from sequence $x_1,\ldots,x_n$ of words to $y_1,\ldots,y_n$ of POS tags



Adapted from: Jurafsky & Martin's chapter 8 PPT

Tagsets for English

Common in the US:

- Penn Treebank Tagset (PTB) 45 tags
- Brown Tagset 87 tags

Common in the UK:

- CLAWS 5 (or C5) 61 tags

CLAWS = Constituent Likelihood Automatic Word-tagging System (for BNC)

Penn Treebank Tags

Tag	Description	Example	Tag	Description	Example	Tag	Description	Example
CC	coord. conj.	*and, but, or*	NNP	proper noun, sing.	*IBM*	TO	"to"	*to*
CD	cardinal number	*one, two*	NNPS	proper noun, plu.	*Carolinas*	UH	interjection	*ah, oops*
DT	determiner	*a, the*	NNS	noun, plural	*llamas*	VB	verb base	*eat*
EX	existential 'there'	*there*	PDT	predeterminer	*all, both*	VBD	verb past tense	*ate*
FW	foreign word	*mea culpa*	POS	possessive ending	*'s*	VBG	verb gerund	*eating*
IN	preposition/ subordin-conj	*of, in, by*	PRP	personal pronoun	*I, you, he*	VBN	verb past participle	*eaten*
JJ	adjective	*yellow*	PRP$	possess. pronoun	*your, one's*	VBP	verb non-3sg-pr	*eat*
JJR	comparative adj	*bigger*	RB	adverb	*quickly*	VBZ	verb 3sg pres	*eats*
JJS	superlative adj	*wildest*	RBR	comparative adv	*faster*	WDT	wh-determ.	*which, that*
LS	list item marker	*1, 2, One*	RBS	superlatv. adv	*fastest*	WP	wh-pronoun	*what, who*
MD	modal	*can, should*	RP	particle	*up, off*	WP$	wh-possess.	*whose*
NN	sing or mass noun	*llama*	SYM	symbol	*+,%, &*	WRB	wh-adverb	*how, where*

Source: J & M Chapter 8 (3rd edition)

Practice

Try tagging the following sentences with the PTB tags:

1. The/ grand/ jury/ commented/ on/ a/ number/ of/ other/ topics/ ./

2. Although/ preliminary/ findings/ were/ reported/ more/ than/ a/ year/ ago/ ,/ the/ latest/ results/ appear/ in/ today/ 's/ New/ England/ Journal/ of/ Medicine/ ./

Practice

Try tagging the following sentences with the PTB tags:

1. The/**DT** grand/**JJ** jury/**NN** commented/**VBD** on/**IN** a/**DT** number/**NN** of/**IN** other/**JJ** topics/**NNS** ./**.**

2. Although/**IN** preliminary/**JJ** findings/**NNS** were/**VBD** reported/**VBN** more/**RBR** than/**IN** a/**DT** year/**NN** ago/**IN** ,/**,** the/**DT** latest/**JJS** results/**NNS** appear/**VBP** in/**IN** today/**NN** ’s/**POS** New/**NNP** England/**NNP** Journal/**NNP** of/**IN** Medicine/**NNP** ./**.**

Universal Dependencies Tagset

	Tag	Description	Example
Open Class	**ADJ**	Adjective: noun modifiers describing properties	*red, young, awesome*
	ADV	Adverb: verb modifiers of time, place, manner	*very, slowly, home, yesterday*
	NOUN	words for persons, places, things, etc.	*algorithm, cat, mango, beauty*
	VERB	words for actions and processes	*draw, provide, go*
	PROPN	Proper noun: name of a person, organization, place, etc..	*Regina, IBM, Colorado*
	INTJ	Interjection: exclamation, greeting, yes/no response, etc.	*oh, um, yes, hello*
Closed Class Words	**ADP**	Adposition (Preposition/Postposition): marks a noun's spacial, temporal, or other relation	*in, on, by under*
	AUX	Auxiliary: helping verb marking tense, aspect, mood, etc.,	*can, may, should, are*
	CCONJ	Coordinating Conjunction: joins two phrases/clauses	*and, or, but*
	DET	Determiner: marks noun phrase properties	*a, an, the, this*
	NUM	Numeral	*one, two, first, second*
	PART	Particle: a preposition-like form used together with a verb	*up, down, on, off, in, out, at, by*
	PRON	Pronoun: a shorthand for referring to an entity or event	*she, who, I, others*
	SCONJ	Subordinating Conjunction: joins a main clause with a subordinate clause such as a sentential complement	*that, which*
Other	**PUNCT**	Punctuation	; , ()
	SYM	Symbols like $ or emoji	$, %
	X	Other	asdf, qwfg

Source: J & M Chapter 8 (3rd edition)

Universal Dependencies Tagset for Thai

Abbreviation	Part-of-Speech tag	Examples
ADJ	Adjective	ใหม่, พิเศษ , ก่อน, มาก, สูง
ADP	Adposition	แม้, ว่า, เมื่อ, ของ, สำหรับ
ADV	Adverb	ก่อน, ก็, เล็กน้อย, เลย, สุด
AUX	Auxiliary	เป็น, ใช่, คือ, คล้าย
CCONJ	Coordinating conjunction	แต่, และ, หรือ
DET	Determiner	ที่, นี้, ซึ่ง, ทั้ง, ทุก, หลาย
INTJ	Interjection	อุ้ย, โอ้ย
NOUN	Noun	กำมือ, พวก, สนาม, กีฬา, บัญชี
NUM	Numeral	5,000, 103.7, 2004, หนึ่ง, ร้อย
PART	Particle	มา ขึ้น ไม่ ได้ เข้า
PRON	Pronoun	เรา, เขา, ตัวเอง, ใคร, เธอ
PROPN	Proper noun	โอบามา, แคปิตอลฮิล, จีโอพี, ไมเคิล
PUNCT	Punctuation	(,), ", ', :
SCONJ	Subordinating conjunction	หาก
VERB	Verb	เปิด, ให้, ใช้, เผชิญ, อ่าน

- Universal Dependencies (UD) is one of the tagsets in PyThaiNLP
- In PyThaiNLP, this tagset is known as Parallel Universal Dependencies (PUD)

Source: PyThaiNLP

Practice

Try tagging the following sentence with the UD tags:

1. There/ are/ 70/ children/ there/ ./

2. Preliminary/ findings/ were/ reported/ in/ today/ 's/ New/ England/ Journal/ of/ Medicine/ ./

Practice

Try tagging the following sentence with the UD tags:

1. There/**PRO** are/**VERB** 70/**NUM** children/**NOUN** there/**ADV** ./**PUNC**

2. Preliminary/**ADJ** findings/**NOUN** were/**AUX** reported/**VERB** in/**ADP** today/**NOUN** 's/**PART** New/**PROPN** England/**PROPN** Journal/**PROPN** of/**ADP** Medicine/**PROPN** ./**PUNC**

POS tagging in NLTK

An off-the-shelf tagger is available for English:

Code 7.1

```
from nltk import pos_tag, word_tokenize

text  = "John's big idea isn't all that bad."
token = word_tokenize(text)
pos   = pos_tag(token)

print(pos)
```

Question: What tagset is this?

POS tagging in NLTK

What can we do with `pos`? We can separate tags from tokens

Code 7.2

```
from nltk import FreqDist

tok = [tok for (tok, tag) in pos]
tag = [tag for (tok, tag) in pos]

# Then, you may choose to count
FreqDist(tok)
FreqDist(tag)
```

Our plan next week...

- Part-of-speech (POS) tagging
  - More tagging!
  - Please install SpaCy
    - Windows:
      - Use Anaconda Prompt to install (Here)
      - Follow the instructions on SpaCy (Here)
    - Mac:
      - Use Terminal