

COMP90042

Web search and text analysis

Workshop Week 2

Your tutor

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Workshops

- Please post questions to LMS
- Workshop slides:
https://github.com/HanXudong/COMP90042_Workshops
- Review and discussion

Python 3

- Familiarise yourself with Python 3
- <https://trevorcohn.github.io/comp90042/workshops/week1-python-01.pdf>
- Canopy: <https://store.enthought.com/downloads/>
- NLTK: <https://www.nltk.org/install.html>
using Canopy Command Prompt

Web Search & Text Analysis

- Natural Language Processing(NLP)
- Web search
E.g. Information retrieval(IR)
- Text analysis
E.g. Structure learning
- Larger tasks:
E.g. Information extraction, question answering,
translation.

```
from nltk.tokenize import word_tokenize
```

```
sentence = "Hello Aswathi How are you doing today"  
sentence_token = word_tokenize(sentence)  
sentence_token
```

```
['Hello', 'Aswathi', 'How', 'are', 'you', 'doing', 'today']
```

Tokenization

<http://blog.xnextcon.com/?p=233>

Tokenization

- A token is an instance of a sequence of characters in some particular document that are grouped together as a useful semantic unit for processing.
- A type is the class of all tokens containing the **same character sequence**.
- E.g. You for me and me for you.

```
from nltk.stem.porter import PorterStemmer  
stem = PorterStemmer()
```

```
word = "mulitplying"  
stem.stem(word)
```

```
'mulitpli'
```

```
from nltk.stem.wordnet import WordNetLemmatizer  
lem = WordNetLemmatizer()
```

```
word = "multiplying"  
lem.lemmatize(word, "v")
```

```
'multiply'
```

Stemming and Lemmatisation

Stemming and Lemmatisation

- <https://semanticsmorphology.weebly.com/inflectional-and-derivational-morphemes.html>
- Inflectional morphology
 - Do **not** really **alter** the meaning
- Derivational morphology
 - **Alter** the meaning
 - One class to another e.g. Verb (teach) -> Noun (teacher)

Stemming and Lemmatisation

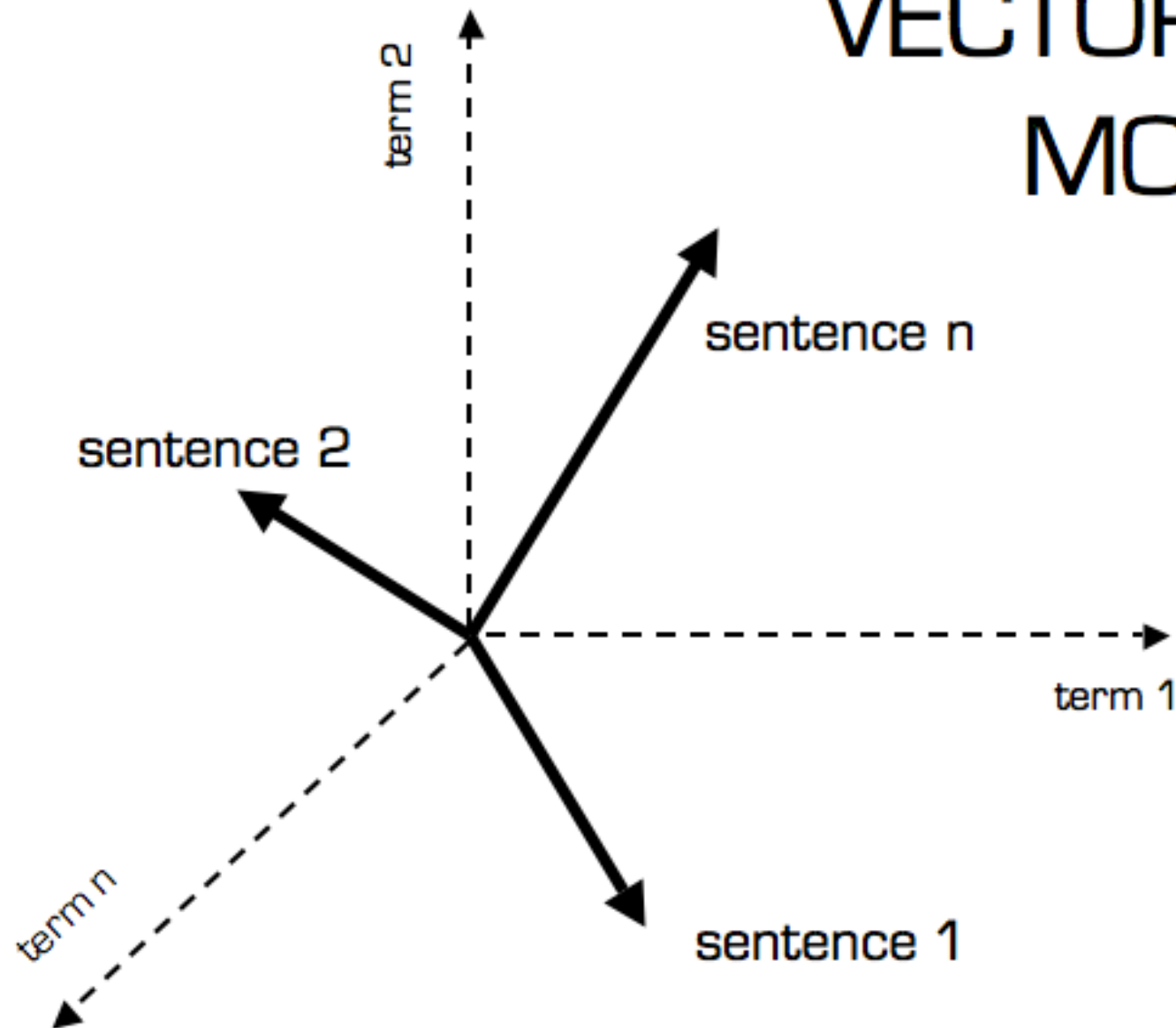
English Inflectional Morphemes		Added to	Examples
-s	plural	Nouns	<i>She has got two guitars.</i>
- 's	possessive	Nouns	<i>Zeynep's hair is long.</i>
-er	comparative	Adjectives	<i>Zeynep has longer hair than Derya.</i>
-est	superlative	Adjectives	<i>Zeynep has the longest hair.</i>
-s	3rd person singular present tense	Verbs	<i>Zeynep plays the guitar.</i>
-ed	past tense	Verbs	<i>She played the guitar at the party.</i>
-ing	progressive	Verbs	<i>She is playing the guitar at the party</i>
-en	past participle	Verbs	<i>She has taken the guitar to the party.</i>

Stemming and Lemmatisation

Some English derivational affixes

Affix	Change	Examples
Suffixes		
-able	$V \rightarrow A$	fix-able, do-able
-(at)ion	$V \rightarrow N$	realiz-ation
-ing	$V \rightarrow N$	the shoot-ing, the
-ing	$V \rightarrow A$	danc-ing
-ive	$V \rightarrow A$	the sleep-ing giant
-al	$V \rightarrow N$	assert-ive
-ment	$V \rightarrow N$	refusal
-ful	$N \rightarrow A$	treat-ment
		hope-ful

VECTOR SPACE MODEL



Vector Space Model

Term-document matrix(TDM)

doc1	Two	for	tea	and	tea	for	two
doc2	Tea	for	me	and	tea	for	you
doc3	You	for	me	and	me	for	you

	two	tea	me	you
doc1	2	2	0	0
doc2	0	2	1	1
doc3	0	0	2	2

Term-document matrix(TDM)

	two	tea	me	you
doc1	2	2	0	0
doc2	0	2	1	1
doc3	0	0	2	2

- Query 1: Tea me
- Query 2: Two

$$\cos(a, b) = \frac{a \cdot b}{|a| |b|}$$

Term-document matrix(TDM)

	two	tea	me	you
doc1	0.707	0.707	0	0
doc2	0	0.707	0.353	0.353
doc3	0	0	0.707	0.707

Normalisation

All document pre-normalised to **unit length**

- Query 1: Tea me
- Query 2: Two

$$\cos(a, b) = \frac{a \cdot b}{|a| |b|} = a \cdot b$$

Inverted index

	two	tea	me	you
doc1	0.707	0.707	0	0
doc2	0	0.707	0.353	0.353
doc3	0	0	0.707	0.707

- Query 1: Tea me
- Query 2: Two

two	1: 0.707;
tea	1:0.707; 2: 0.707
me	2: 0.353; 3:0.707
you	2: 0.353; 3:0.707

TF*IDF similarity score

$$tf_{d,t} \times idf_t$$

$tf_{d,t}$: term frequency of a document (count of a term t in a document d)

idf_t : inverse document frequency

df_t : document frequency (count of documents that contain the term t)

	two	tea	me	you
doc1	2	2	0	0
doc2	0	2	1	1
doc3	0	0	2	2
idf_t				

$$idf_t = \log \frac{N}{df_t}$$

TF*IDF similarity score

	two	tea	me	you
doc1	2	2	0	0
doc2	0	2	1	1
doc3	0	0	2	2
idf_t	1.58	0.58	0.58	0.58

$$idf_t = \log \frac{N}{df_t}$$

\log_2 **or** \log_e ?

	two	tea	me	you
doc1	3.17	1.16	0	0
doc2	0	1.16	0.58	0.58
doc3	0	0	1.16	1.16

TF*IDF similarity score

Question 4

	apple	ibm	lemo	sun
D1	4	0	1	1
D2	5	0	5	0
D3	2	5	0	0
D4	1	0	1	7
D5	0	1	3	0
idf				

TF*IDF similarity score

	apple	ibm	lemon	sun
D1	4	0	1	1
D2	5	0	5	0
D3	2	5	0	0
D4	1	0	1	7
D5	0	1	3	0
idf				

	apple	ibm	lemon	sun
idf	$\log \frac{5}{4} = 0.22$	$\log \frac{5}{2} = 0.92$	$\log \frac{5}{4} = 0.22$	$\log \frac{5}{2} = 0.92$

TF*IDF similarity score

	apple	ibm	lemo	sun
D1	0.89	0	0.22	0.92
D2	1.12	0	1.12	0
D3	0.45	4.58	0	0
D4	0.22	0	0.22	6.41
D5	0	0.92	0.67	0

Query: apple ibm

skip the document normalisation

$$S_{TF-IDF}(d, Q) = \sum_{t \in Q} tf_{d,t} \times \log \frac{N}{df_t}$$

TF*IDF similarity score

	apple	ibm	lemo	sun
D1	0.89	0	0.22	0.92
D2	1.12	0	1.12	0
D3	0.45	4.58	0	0
D4	0.22	0	0.22	6.41
D5	0	0.92	0.67	0

Query: apple ibm

What if do document
normalisation?

$$S_{TF-IDF}(d, Q) = \sum_{t \in Q} tf_{d,t} \times \log \frac{N}{df_t}$$

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$$w_t = \log \frac{N - df_t + 0.5}{df_t + 0.5} \times \frac{(K_1 + 1)tf_{d,t}}{k_1((1 - b) + b\frac{L_d}{L_{avg}}) + tf_{d,t}} \times \frac{(k_3 + 1)tf_{q,t}}{k_3 + tf_{q,t}}$$

where $0 \leq K_1 \leq \infty$, $0 \leq K_3 \leq \infty$, **and** $0 \leq b \leq 1$