

School of Computing and Information Systems  
The University of Melbourne  
COMP90042  
NATURAL LANGUAGE PROCESSING (Semester 1, 2021)

Workshop exercises: Week 6

### Discussion

1. Give illustrative examples that show the difference between:
  - (a) **Synonyms** and **hypernyms**
  - (b) **Hyponyms** and **meronyms**
2. Using some Wordnet visualisation tool, for example, <http://wordnetweb.princeton.edu/perl/webwn> and the Wu & Palmer definition of **word similarity**, check whether the word *information* is more similar to the word *retrieval* or the word *science* (choose the sense which minimises the distance). Does this mesh with your intuition?
3. What is **word sense disambiguation**?
4. For the following term co-occurrence matrix (suitably interpreted):

	cup	not (cup)
world	55	225
not (world)	315	1405

  - (a) Find the Point-wise Mutual Information (PMI) between these two terms in this collection.
  - (b) What does the value from (a) tell us about **distributional similarity**?
5. In the 09-distributional-semantics iPython notebook, a term-document matrix is built to learn word vectors.
  - (a) What is the Singular Value Decomposition (SVD) method used for here? Why is this helpful?
6. What is a **word embedding** and how does it relate to **distributional similarity**?
  - (a) What is the difference between a **skip-gram** model and a **CBOW** model?
  - (b) How are the above models trained?

### Programming

1. Consider the iPython notebook 08-lexical-semantics. Repeat the exercise about word similarity from the Discussion problems above (Q2); confirm that you get the same answer. Now try the Lin similarity — do you get the same result? Why or why not?
2. Use the 09-distributional-semantics iPython notebook to find some interesting collocations, using PMI.
  - (a) Write a wrapper function which finds the 10 collocations with the greatest PMI, amongst all of bi-grams in the collection. (Note that you might want to be careful about your strategy for doing this in a very large collection!)

- (b) NLTK has an in-built method `collocations()` (of a `Text` object) — does it come up with the same collocations as PMI? Why do you think this is the case?

### Catch-up

- What is **information**, with respect to **entropy**? How might we calculate the information of a word in a corpus? How might we calculate the information of a (textual) message with respect to the information in a corpus? (There are many different ways!)
- What is **WordNet**? What is a **synset**?
- What is the **cosine similarity** and how is it calculated?
- What is **entropy** and how is it calculated? What is entropy attempting to measure?
- What is a **term–document matrix**? How is it different to an **inverted index**?
- What is a TF-IDF model? What are its intuitions and how do they appear in a typical model (formula)?

### Get ahead

- Choose an individual word and consider its different synsets in Wordnet.
  - Find a number of instances of that word in a corpus. Assign each token to its sense. Is one sense more frequent than the other senses?
- Build a system which attempts to use the **Lesk** strategy of WSD based on the Wordnet bindings in NLTK. Choose some word(s) in some sentence(s) and observe its output — does the correct sense get returned? Why or why not?
- In the notebook `09-distributional-semantics`:
  - Try doing the same calculations on the collection without the SVD method. How much time does the truncation step save?
  - Try different values for truncating the decomposition; at what point do the results seem to become noticeably worse?
  - How important is the TF-IDF step? Try the retrieval without it; do the results change? What if you omit it from only the document matrix, or only the query vector?
  - Try to find some queries where the results are different with and without the TF-IDF transformation.