NLP: Text Preparation

Text Representation

- **Bag of Words**: Representing a document as a vector, where values indicate word frequency. "Mary had a little lamb, little lamb, little lamb" becomes

a	had	lamb	little	Mary
1	1	3	3	1

- **N-Grams**: all the combinations of n words. Common examples are bigrams and trigrams. "Mary had a little lamb" in bigrams:

  (Mary had) (had a) (a little) (little lamb)

Text Cleaning

- **Tokenization**: Breaking text down into discrete units, e.g. separating punctuation from words.
- **Stemming**: Finding the stem of the word; "chops off" the end of the word.
- **Lemmatization**: Finds the base form of the word. More computationally expensive than stemming.
- **Stopwords**: Words that are very common and are usually removed. For example, "the" or "and".

TF-IDF

Term Frequency

Term frequency is how often a word appears in a document. It requires a word, and a document that contains the word to calculate.

$$\text{tf}(\text{word}, \text{doc}) = \frac{\#\text{ of times word occurs}}{\text{Total }\#\text{ words in doc}}$$

There are several variations on term frequency:

- **Raw Count**: this is simply the count of the number of occurances of each word.
- **Frequency**: the number of times each word appears divided by the total number of words.
- **Augmented Frequency**: the frequency of each word divided by the maximum frequency. This can help prevent bias towards larger documents.

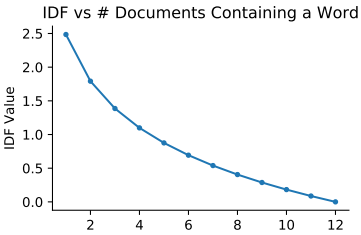
Inverse Document Frequency

IDF tells how much information a word provides[1].

$$\text{idf}(\text{word}, \text{D}) = \log\left(\frac{|\text{D}|}{|\{\text{doc} \in D, \text{word} \in \text{doc}\}|}\right)$$

The calculation for IDF requires a word, and a list of documents, D. The numerator is the length of D. The denominator is the the length of the list of documents that contain the word, for every document in the list of documents.[2]

[1] As the number of documents that a word appears in increases, the IDF value decreases. This can help us identify relatively important words.



TF-IDF

TF-IDF is simply the product of the previous two values:

$$\text{tf-idf}(\text{word, doc, D}) = \text{tf}(\text{word, doc}) \times \text{idf}(\text{word, D})$$

Note that it doesn't make sense to talk about the tf-idf value for a single word without also talking about a specific document, as each combination of word and document will have a seperate tf-idf value.

[2] Some definitions of IDF will add some constant value to the denominator (usually 1) in order to allow for the case where one wishes to calculate the IDF for a word that doesn't appear in *any* of the documents. Without adding this term, the denominator would be 0.