Word counts with bag-of-words

INTRODUCTION TO NATURAL LANGUAGE PROCESSING IN PYTHON

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Bag-of-words

- Basic method for finding topics in a text
- Need to first create tokens using tokenization
- ... and then count up all the tokens
- The more frequent a word, the more important it might be
- Can be a great way to determine the significant words in a text

Bag-of-words example

- Text: "The cat is in the box. The cat likes the box. The box is over the cat."
- Bag of words (stripped punctuation):
  - "The": 3, "box": 3
  - "cat": 3, "the": 3
  - "is": 2
  - "in": 1, "likes": 1, "over": 1

Bag-of-words in Python

```
from nltk.tokenize import word_tokenize
from collections import Counter
Counter(word_tokenize("""The cat is in the box. The cat likes the box.
                  The box is over the cat."""))
```

```
Counter({'.': 3,
         'The': 3,
         'box': 3,
         'cat': 3,
         'in': 1,
         ...
         'the': 3})
```

```
counter.most_common(2)
```

```
[('The', 3), ('box', 3)]
```

Let's practice!

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Simple text preprocessing

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Why preprocess?

- Helps make for better input data
  - When performing machine learning or other statistical methods
- Examples:
  - Tokenization to create a bag of words
  - Lowercasing words
- Lemmatization/Stemming
  - Shorten words to their root stems
- Removing stop words, punctuation, or unwanted tokens
- Good to experiment with different approaches

Preprocessing example

- Input text: Cats, dogs and birds are common pets. So are fish.
- Output tokens: cat, dog, bird, common, pet, fish

Text preprocessing with Python

```
from nltk.corpus import stopwords
text = """The cat is in the box. The cat likes the box.
                  The box is over the cat."""
tokens = [w for w in word_tokenize(text.lower())
                  if w.isalpha()]
 no_stops = [t for t in tokens
                    if t not in stopwords.words('english')]
Counter(no_stops).most_common(2)
```

```
[('cat', 3), ('box', 3)]
```

Let's practice!

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Introduction to gensim

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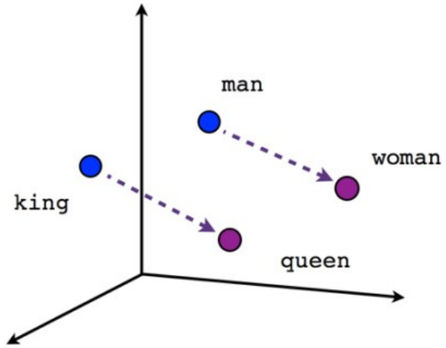
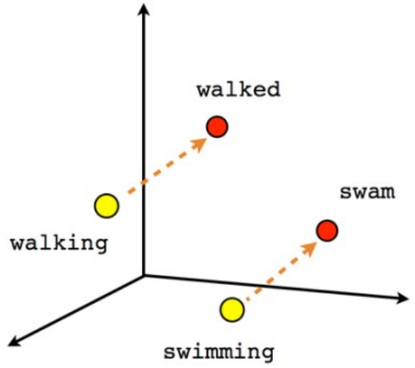
What is gensim?

- Popular open-source NLP library
- Uses top academic models to perform complex tasks
  - Building document or word vectors
  - Performing topic identification and document comparison

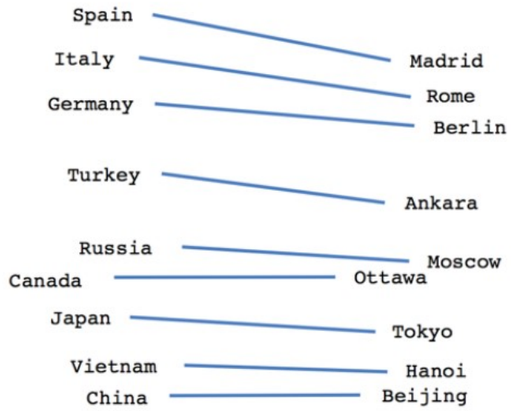
What is a word vector?



Male-Female

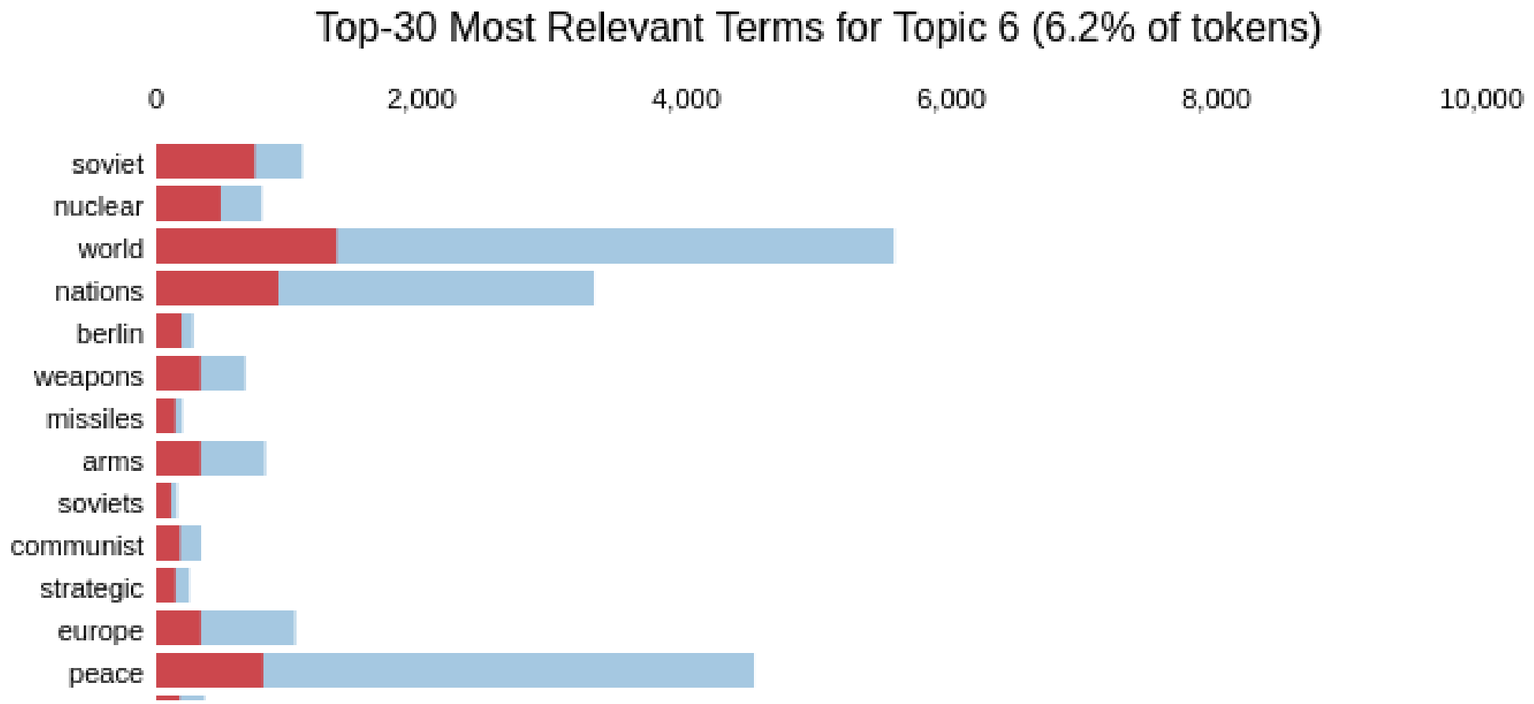


Verb tense



Country-Capital

Gensim example



(Source: **http://tlfvincent.github.io/2015/10/23/presidential-speech-topics**)

```
from gensim.corpora.dictionary import Dictionary
from nltk.tokenize import word_tokenize
my_documents = ['The movie was about a spaceship and aliens.',
                'I really liked the movie!',
                'Awesome action scenes, but boring characters.',
                'The movie was awful! I hate alien films.',
                'Space is cool! I liked the movie.',
                'More space films, please!',]
```

```
tokenized_docs = [word_tokenize(doc.lower())
                  for doc in my_documents]
dictionary = Dictionary(tokenized_docs)
dictionary.token2id
```

```
{'!': 11,
 ',': 17,
 '.': 7,
 'a': 2,
 'about': 4,
...}
```

Creating a gensim corpus

```
corpus = [dictionary.doc2bow(doc) for doc in tokenized_docs]
corpus
```

```
[[(0, 1), (1, 1), (2, 1), (3, 1), (4, 1), (5, 1), (6, 1), (7, 1), (8, 1)],
 [(0, 1), (1, 1), (9, 1), (10, 1), (11, 1), (12, 1)],
...]
```

- `gensim` models can be easily saved, updated, and reused
- Our dictionary can also be updated
- This more advanced and feature rich bag-of-words can be used in future exercises

Let's practice!

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Tf-idf with gensim

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What is tf-idf?

- Term frequency - inverse document frequency
- Allows you to determine the most important words in each document
- Each corpus may have shared words beyond just stopwords
- These words should be down-weighted in importance
- Example from astronomy: "Sky"
- Ensures most common words don't show up as key words
- Keeps document specific frequent words weighted high

Tf-idf formula

$$w_{i,j} = tf_{i,j} * \log(\frac{N}{df_i})$$

$w_{i,j}$ = tf-idf weight for token i in document j

$tf_{i,j}$ = number of occurences of token i in document j

df_i = number of documents that contain token i

N = total number of documents

Tf-idf with gensim

```
from gensim.models.tfidfmodel import TfidfModel
tfidf = TfidfModel(corpus)
tfidf[corpus[1]]
```

```
[(0, 0.1746298276735174),
 (1, 0.1746298276735174),
 (9, 0.2985316622146367 3),
 (10, 0.7716931521027908),
...
]
```

Let's practice!

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