Outline

- Introduction to topic modelling
- Latent Semantic Analysis
- Latent Dirichlet Allocation
- Gensim
Topic modelling

- organize and understand large collections of documents
- text mining
- discover topical patterns in documents
- topic – group of words representing the information
- applications
  - recommender systems
  - document/book classification
  - bio-informatics (interpret biological data)
  - opinion/sentiment analysis
  - chatbots, topic tracking
  - text categorization
Latent Semantic Analysis

- vector representation of documents
- compare by vector distance
- document = bag of words
- topic = set of words
- applications:
  - data clustering, document classification
  - term relations (synonymy, polysemy)
  - cross language document retrieval
  - word relations in text
  - similarity in multi choice questions
  - prior art in patents
**LSA – step 1**

- **count** term-document **matrix** (word frequency in documents)
- **rows = words, columns = documents**
- **sparse matrix**

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LSA – step 2

- weighting matrix elements
- most popular tf–idf
- term occurring in many documents is not interesting for analysis
LSA – step 3

- Singular Value Decomposition
- matrix factorization (reduce dimensions, throw away noise)
- cluster close vectors (documents and terms)
Latent Dirichlet Allocation

- statistical model
- each document is a mix of topics
- LDA discovers topics and their ratio
- each word in document was generated by one of the topics
- applications:
  - topic relations
  - content recommendation
  - group/community overlapping
  - document topic changes
  - genetics (ancestral populations)
Example

Document 1: I like to eat **broccoli** and **bananas**.
Document 2: I ate a **banana** and spinach smoothie for **breakfast**.
Document 3: **Chinchillas** and **kittens** are **cute**.
Document 4: My sister adopted a **kitten** yesterday.
Document 5: Look at this **cute hamster** **munching** on a piece of **broccoli**.

Example

**Topic A:** 30% broccoli, 15% bananas, 10% breakfast, 10% munching
**Topic B:** 20% chinchillas, 20% kittens, 20% cute, 15% hamster

Example

Document 1 and 2: 100% **Topic A**
Document 3 and 4: 100% **Topic B**
Document 5: 60% **Topic A**, 40% **Topic B**
LDA process

- pick fixed number of topics
- for each document, randomly assign topic to each word
- improve, for each document $d$:
  - for each word $w$ and topic $t$ count:
    - all topic assignments are correct, except for current word
    - $p(topic \ t | document \ d)$ – how many words in document have topic?
    - $p(word \ w | topic \ t)$ – how many assignments to topic for word?
    - new topic: probability $p(topic \ t | document \ d) \times p(word \ w | topic \ t)$
- repeat and reach almost steady state
Gensim

```python
>>> from gensim import corpora, models, similarities

>>> # Load corpus iterator from a Matrix Market file on disk.
>>> corpus = corpora.MmCorpus('/path/to/corpus.mm')

>>> # Initialize Latent Semantic Indexing with 200 dimensions.
>>> lsi = models.LsiModel(corpus, num_topics=200)

>>> # Convert another corpus to the latent space and index it.
>>> index = similarities.MatrixSimilarity(lsi[another_corpus])

>>> # Compute similarity of a query vs. indexed documents
>>> sims = index[query]
```
