

# Seminar 4

# Probabilistic Topic Model

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# Topic modeling

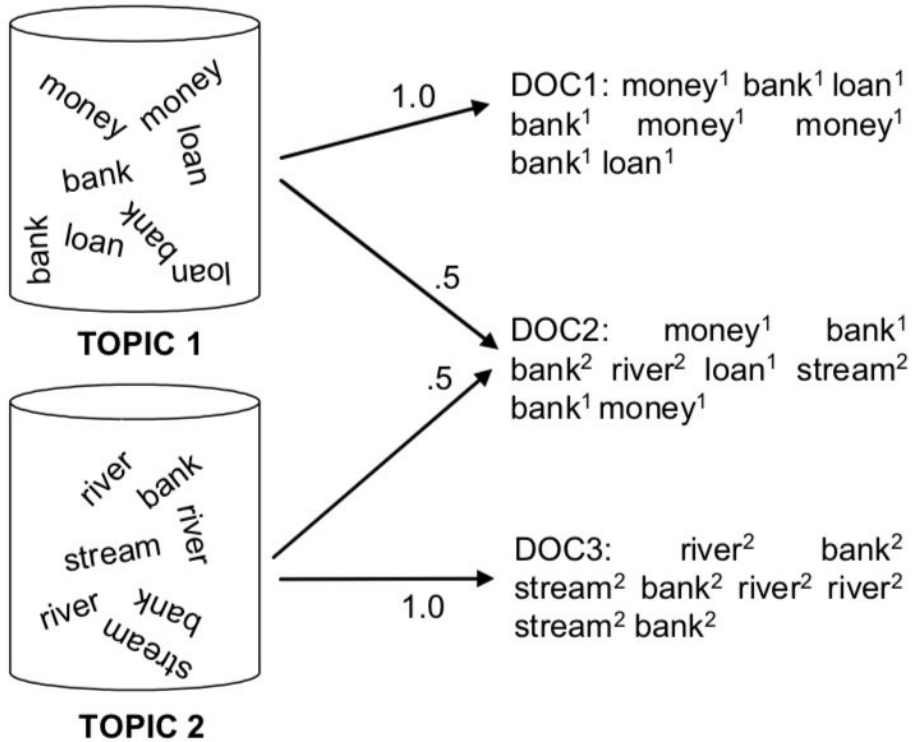
- Models of a collection of composites
- Composites are documents
- Parts are words (or phrases, n-grams)
- Two outputs:
  - chance of selecting a particular part when sampling a particular topic
  - chance of selecting a particular topic when sampling a particular document or composite

# Assumptions

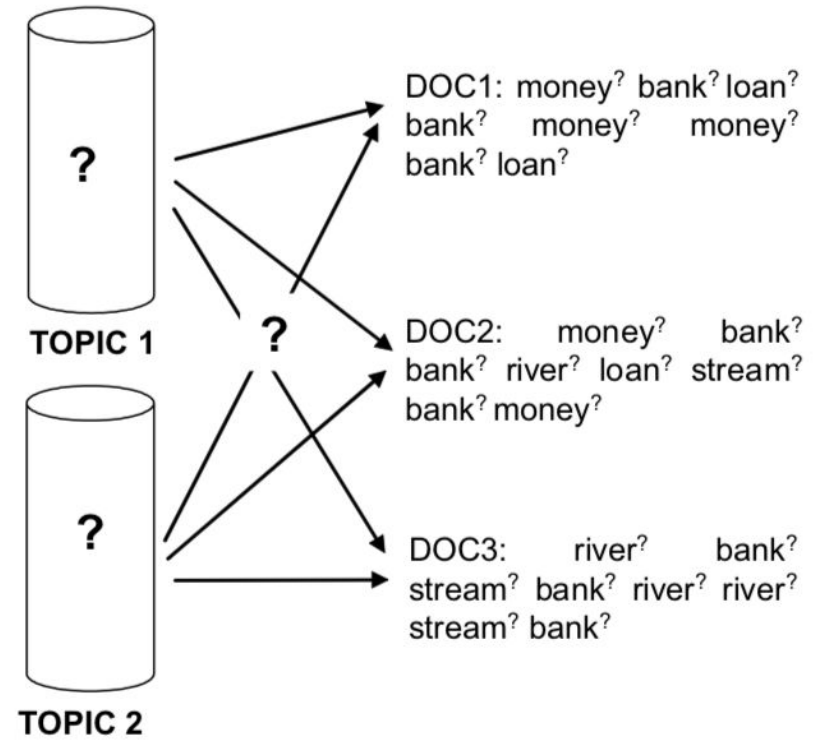
- semantic information can be derived from a word-document co-occurrence matrix;
- topic is a probability distribution over words
- to make a new document, one chooses a distribution over topics
- for each word in that document, one chooses a topic at random according to this distribution, and draws a word from that topic.
- Resulting document is a mixture of topics

# Generative model

PROBABILISTIC GENERATIVE PROCESS



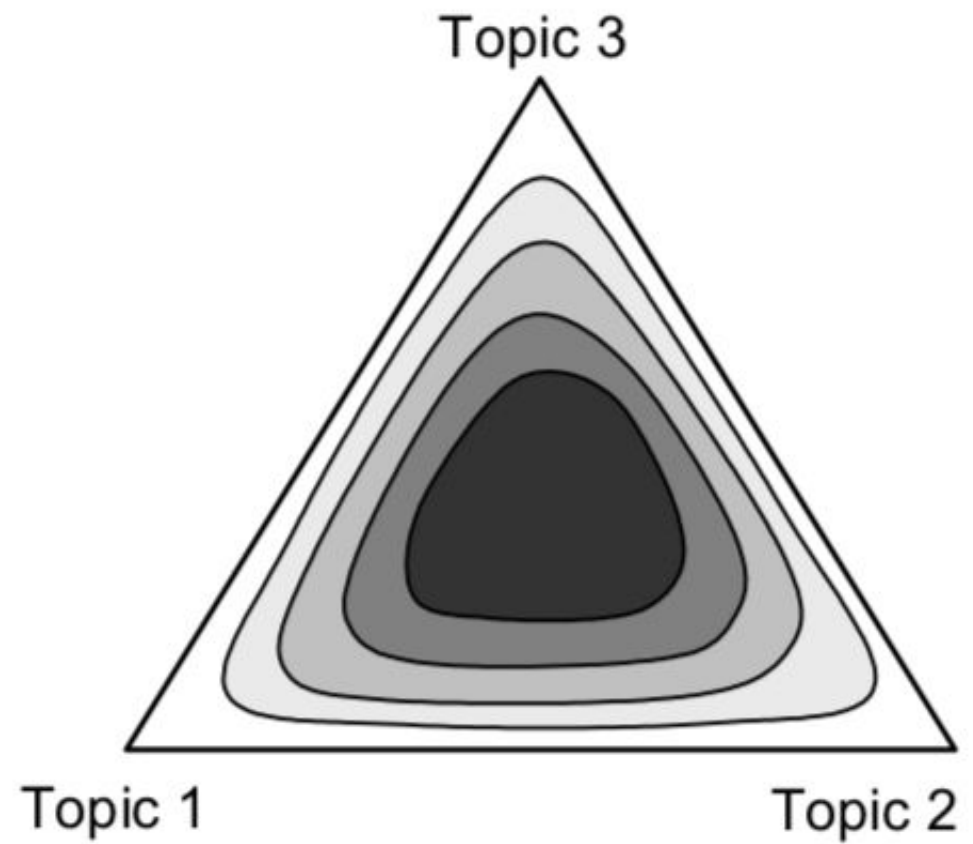
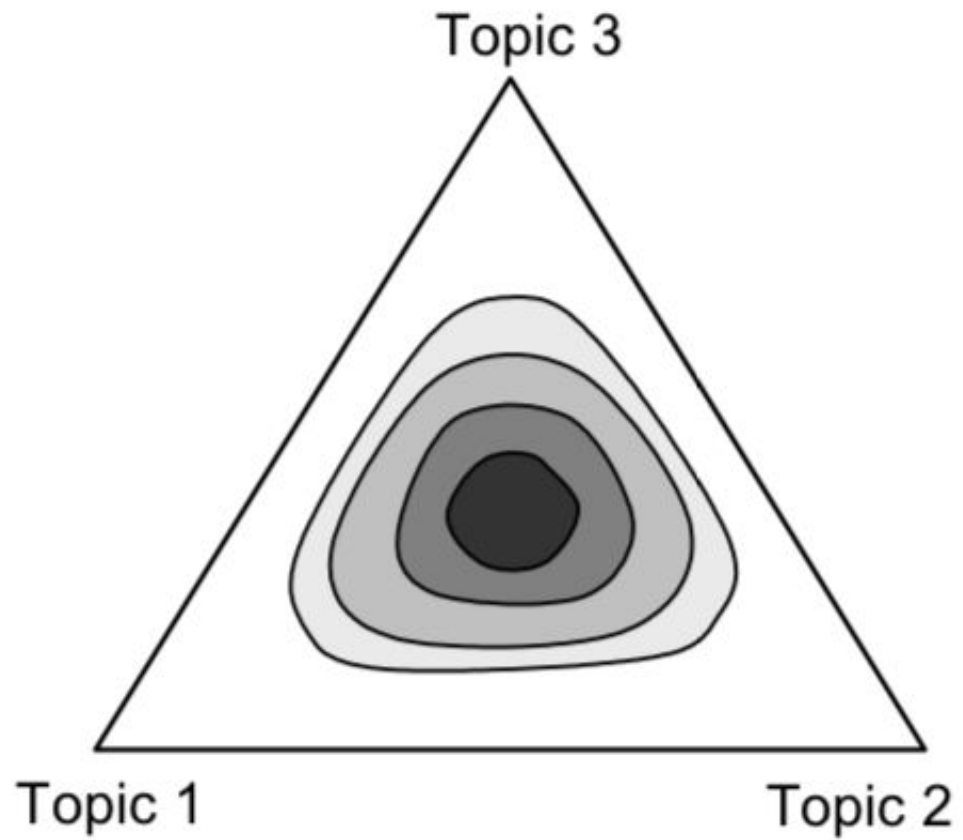
STATISTICAL INFERENCE



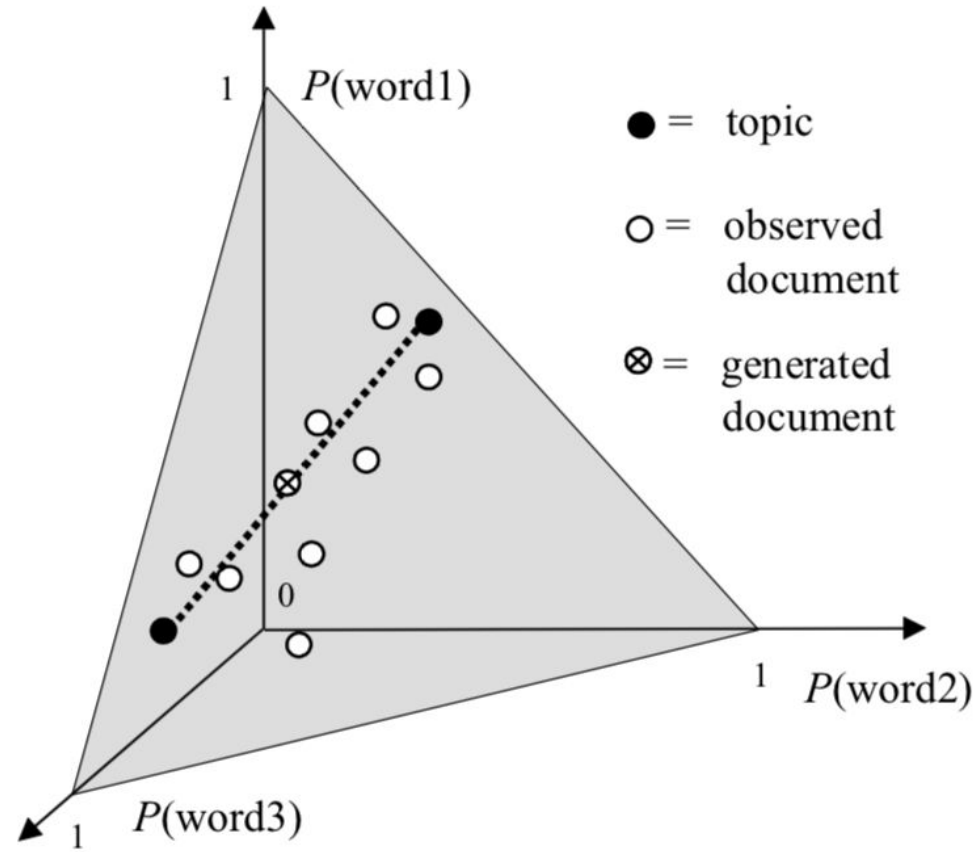
# Probabilistic model

- $P(z)$  – distribution over topics  $z$  in a particular document
- $P(w|z)$  - the probability distribution over words  $w$  given topic  $z$ .
- first sampling a topic from the topic distribution, then choosing a word from the topic-word distribution.
- $P(w_i) = \sum_{j=1}^T P(w_i|z_i = j)P(z_i = j)$
- $T$  – number of topics
- Latent Dirichlet Allocation assumes a particular form of  $P(z)$

# Dirichlet distribution



# Geometric interpretation



# Main goal of the algorithm

- To invert the generative process, inferring the set of topics that were responsible for generating a collection of documents.