Topic Mining and Analysis: Term as Topic

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Formal Definition of Topic Mining and Analysis

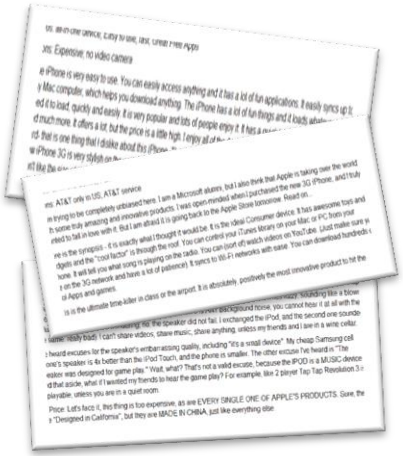
- Input
  - A **collection** of **N** text documents **C={d_1, …, d_N}**
  - **Number of topics**: **k**
- Output
  - **k topics**: **{ θ_1, …, θ_k }**
  - **Coverage of topics in each d_i**: **{ π_{i1}, …, π_{ik} }**
  - π_{ij}=prob. of d_i covering topic θ_j

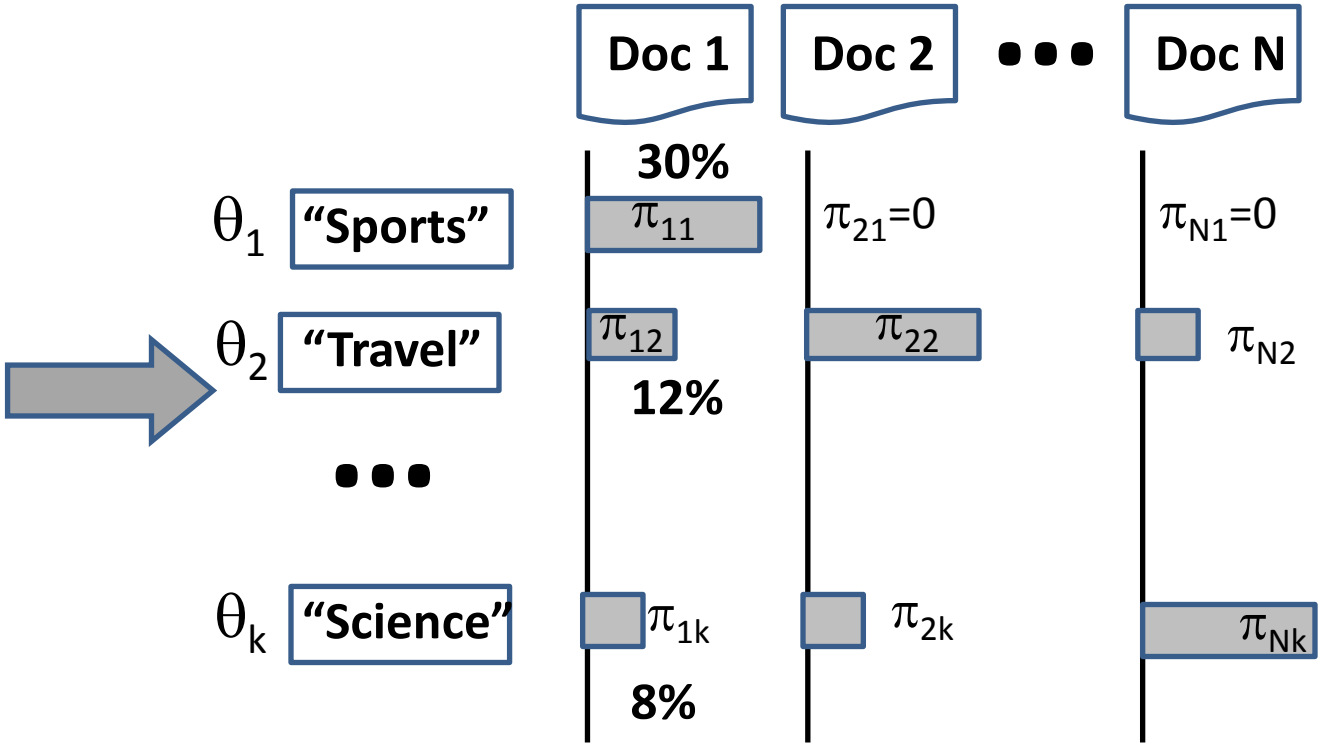
$$\sum_{j=1}^{k} \pi_{ij} = 1$$

How to define θ_i ?

Initial Idea: Topic = Term

Text Data

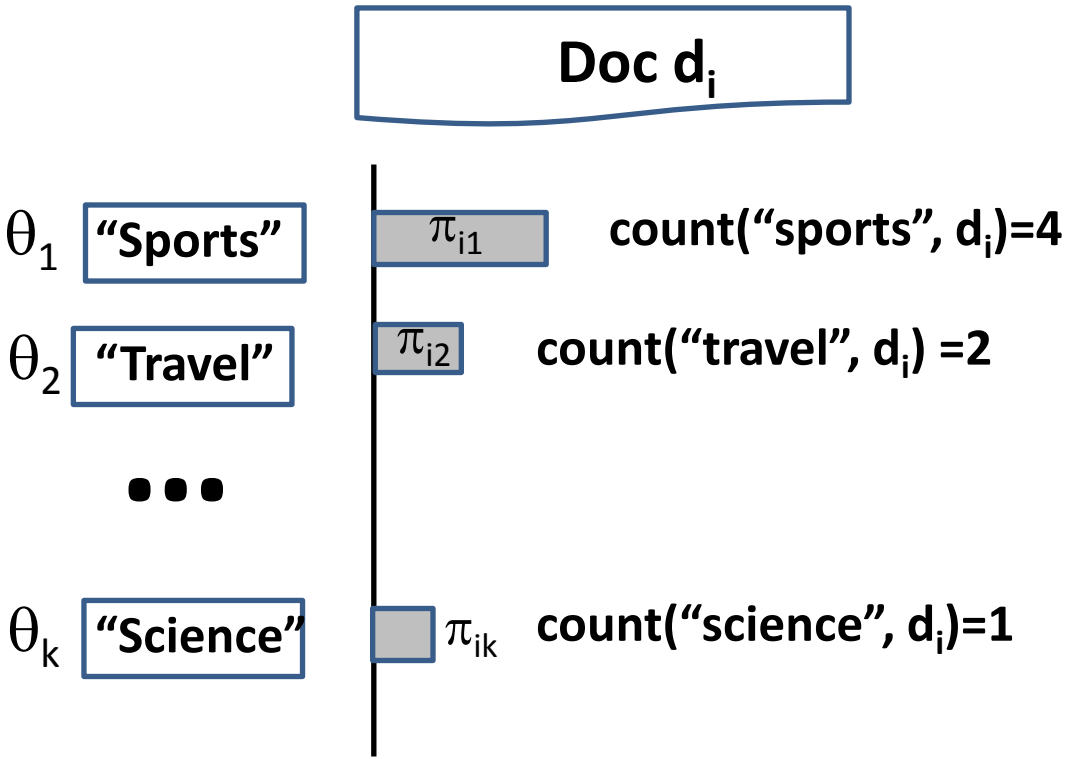




Mining k Topical Terms from Collection C

- Parse text in C to obtain candidate terms (e.g., term = word).
- Design a scoring function to measure how good each term is as a topic.
  - Favor a representative term (high frequency is favored)
  - Avoid words that are too frequent (e.g., “the”, “a”).
  - TF-IDF weighting from retrieval can be very useful.
  - Domain-specific heuristics are possible (e.g., favor title words, hashtags in tweets).
- Pick k terms with the highest scores but try to minimize redundancy.
  - If multiple terms are very similar or closely related, pick only one of them and ignore others.

Computing Topic Coverage: π_{ij}



$$\pi_{ij} = \frac{count(\theta_j, d_i)}{\sum_{L=1}^{k} count(\theta_L, d_i)}$$

How Well Does This Approach Work?

Doc d_i

Cavaliers vs. Golden State Warriors: NBA playoff finals … basketball game … travel to Cleveland … star …

θ_1 **"Sports"** $\pi_{i1} \propto c("sports", d_i) = 0$

θ_2 **"Travel"** $\pi_{i2} \propto c("travel", d_i) = 1 > 0$

…

θ_k **"Science"** $\pi_{ik} \propto c("science", d_i) = 0$

1. Need to count related words also!

2. "Star" can be ambiguous (e.g., star in the sky).

3. Mine complicated topics?

Problems with “Term as Topic”

- Lack of expressive power
  - Can only represent simple/general topics
  - Can’t represent complicated topics
- Incompleteness in vocabulary coverage
  - Can’t capture variations of vocabulary (e.g., related words)
- Word sense ambiguity
  - A topical term or related term can be ambiguous (e.g., basketball star vs. star in the sky)