Hierarchic Topic Models Visualization

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Introduction

Global task

Given large ($10^3 - 10^6$) database of documents. User wants to explore new area. He isn't expert and don't know keywords. We want make this possible and fast.

Idea

Let's group documents by topics!

Problems

Topic model is set of matrix, useless for user. Each document can be member of more then one topics. We want to show all set of documents as interactive picture.

Topic modeling

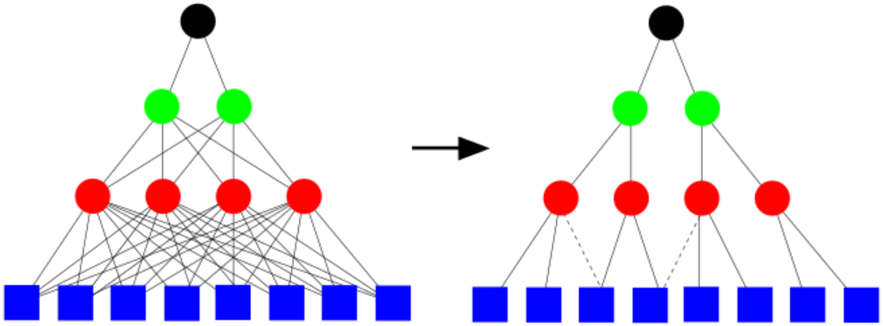
- $F_{w,d}$ — words-documents.
- $\Phi_{w,t}$ — words-topics.
- $\Theta_{t,d}$ — topics-documents.
- $F = \Phi\Theta$.
- $\sum_{d \in D} \sum_{w \in W} |d|_w \ln \sum_{t \in T} \Phi_{w,t}\Theta_{t,d} + R(\Theta, \Phi) \to \max$

Hierarchical tree building

- Nodes: documents, topics, root.
- Extracting tree from matrix:

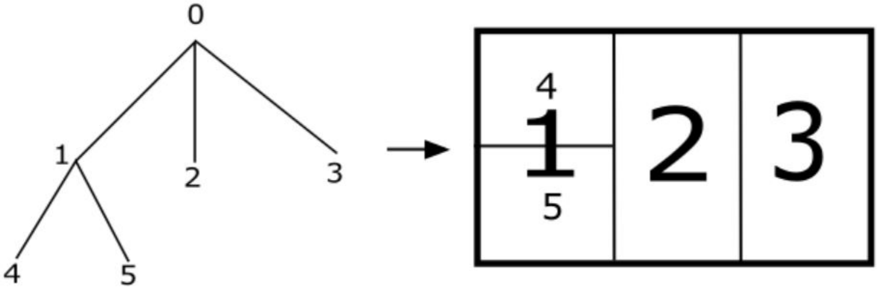
$$Topic(d) = \arg\max_t \Theta_{t,d}$$

$$MultiTopic(d) = \arg\max_t \Theta_{t,d} \cup \{t|\Theta_{t,d} > \varepsilon\}$$

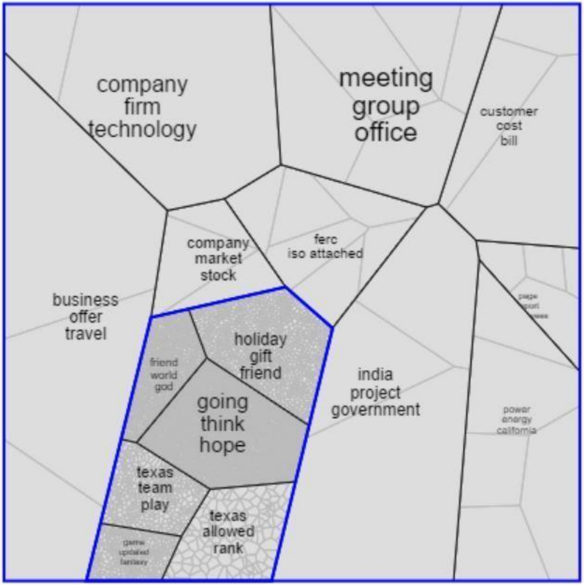


Visualization of hierarchical tree

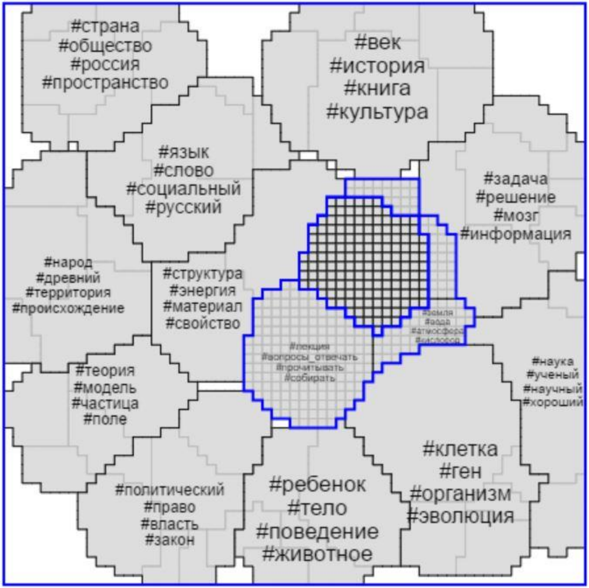
- *"Overview first, zoom and filter, details on demand"*.
- Solution: inserted polygons.



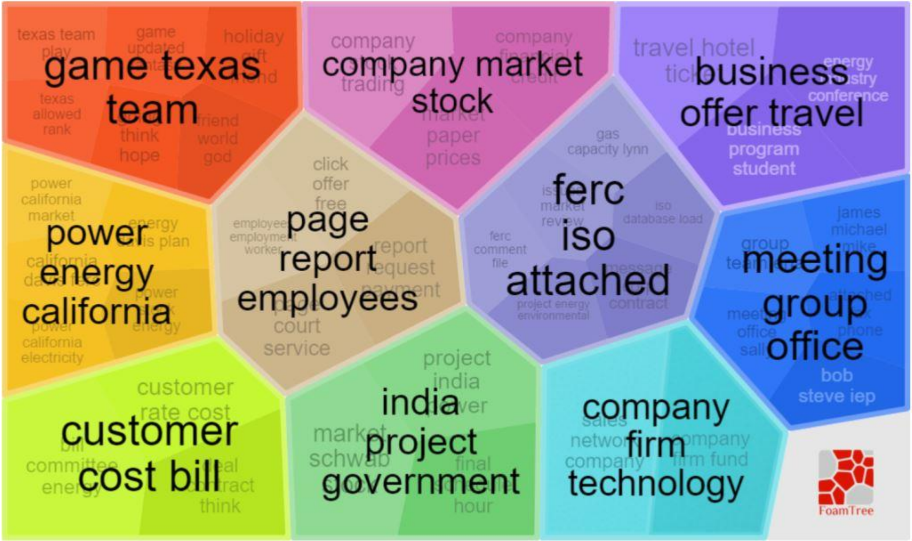
Random Voronoi map



Grid visualization



FoamTree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company firm technology
sales network company
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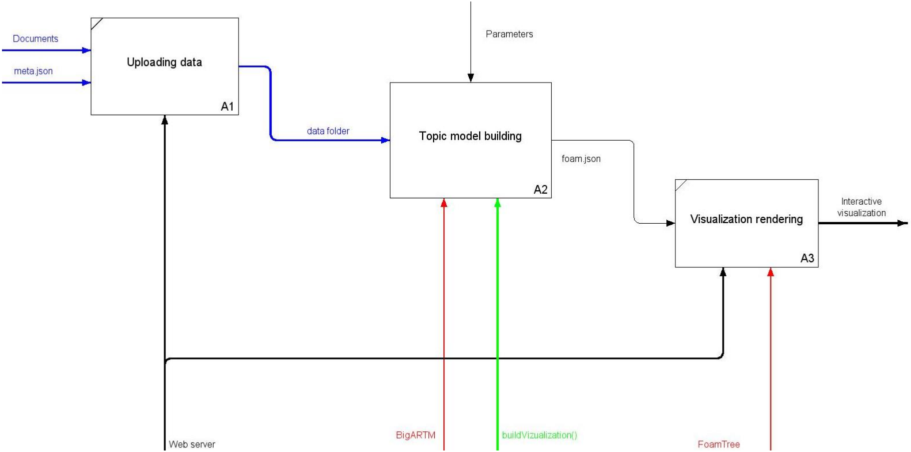
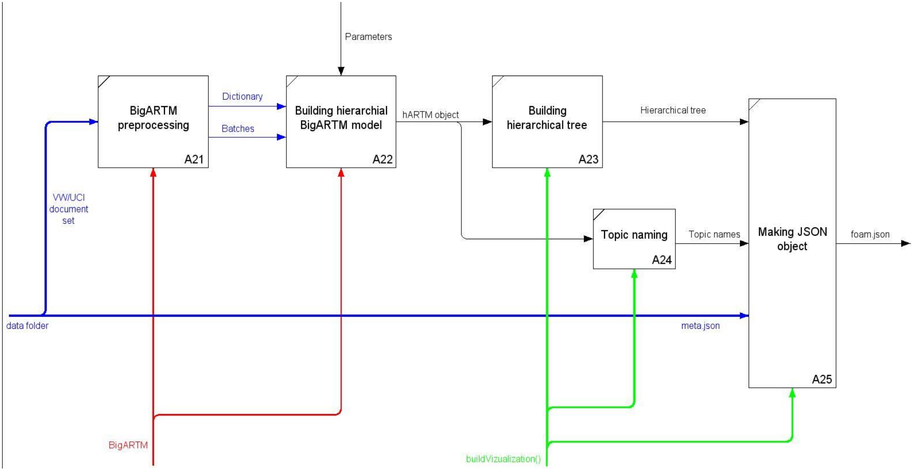
FoamTree

Implementation



Implementation



Quality measurement

- Main goal: make search and exploration **faster**. So, metric should be **time** of search by user.
- Improvement coefficient:

$$\alpha = \frac{t_0}{t}$$

(t_0 — basic system time, t — time with our system)

Conclusion

- Problem of document sets visualization solved using topic models.
- Web service implemented.
- Global goal: generic all-in-one system: preprocessing + topic modeling + visualization.