Introduction to text mining training course

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Table of contents

Table of Contents

Course Logistics

- Instructor: Pham Quang Nhat Minh
  - Emails: minhpqn2@fe.edu.vn, minhpham0902@gmail.com
  - Ph.D. in Information Science (research field: Natural Language Processing)
  - Now researcher at FPT Technology Research Institute (FTRI)
  - **Research Interests**
    - Factoid/Non-factoid Question Answering
    - Semantic Relation Extraction
    - Textual Entailment Recognition (RTE)
    - Contradiction Detection
  - Homepage: `http://ftri.fpt.edu.vn/?page_id=1826`

Course Information

- Short text mining training course (8-day course)
- Learning outcome:
  - Understand and practice some natural language processing techniques for English language.
  - Can use topic modeling methods (LDA) for text mining
  - Get experiences in doing a real text mining project
  - Can do good data visualization
  - Apply Web programming techniques to build a web-based demo for the course's project
    - *Assume that you have knowledge and experiences about that*
  - Apply security knowledge to simulate attacking/defending your website.
    - *Assume that you have knowledge and experience about that*

Course Information

- Course project: **Mining hot tech topics/trends from collections of tech articles**.
  - Focus on **Big Data** and **Internet of Things (IoT)** tech articles
- Lectures in the course will support/toward the goal of the course project.
- Course's github repository: `https://github.com/minhpqn/Text-Mining-Training-Course`
  - Lecture slides
  - Resources (tools, data, etc)
  - Example source codes
  - References

Course Schedule

- **Day 1**
  - Introduce the training course
  - Describe the project's requirements, task list
  - Assign/Discuss tasks for internship students
- **Day 2**
  - Using topic modeling for mining topics/trends in raw text corpora
  - Recommended readings for topic modeling & applications for mining topics
  - Topic modeling tools
- **Day 3**
  - Collecting data for the project (tech news articles about big data and IoT)
  - Using Scrapy (Python package) to crawl data on the internet
  - Introduce some data resources for crawling raw data
  - How to processing crawled text data

Course Schedule

- **Day 4**
  - Using nltk for processing crawled text data
  - Transform text data to the data in the format of LDA tools
- **Day 5**
  - Run LDA to train topic models
  - Observe & analyze output
- **Day 6**
  - Data visualization & Make a simple website
- **Day 7**
  - Review the product
- **Day 8**
  - Project demo & defense

Table of Contents

Course Project: mining hot topics/trends from tech articles

- Objectives:
  - To detect research/technology trends by mining a large collection of articles.
  - Visualize mining results to show:
    - Distribution of topics in the corpus, strength of topics/trends
    - Change of topics/trends overtime
    - **Key phrases** in the corpus
  - Build a web-based demo for the course project
    - Automatically crawl data data given some input keywords about a technology (e.g., Big Data, IoT, etc)
    - Mine topics/**key phrases** and visualize the result

Course project: Motivations

- Keep track the development of ideas/technologies is important in strategic decision making.
  - Which technology should we invest?
- It requires huge efforts to read large amount of tech articles
- Some trends may be obvious but others may be more subtle.
- Good data visualization make us easily to grasp trends/changes of topics overtime.

We need an automatic tool to do the job!

Issues of the project

- What data sources from which we crawl the data?
  - Tech news (Techcrunch, Techmeme, etc) (HTML documents)
  - OR/AND Paper articles (in pdf format)
  - Abstracts of scientific articles (more available)
- How do we crawl data?
- How do we store the data?
- How do we process crawled data?
  - Clean text data
  - Transform to a corpus of the required format
- How do we mine topics/key phrases from the text corpus?
- How do we visualize mined result?

Table of Contents

Related work

- David Hall et al. 2008. Studying the history of ideas using topic models. EMNLP 2008.
  - Apply LDA (Blei et al., 2003) on ACL Reference Corpus of scientific papers related to NLP and computational linguistics.
  - To address the change of topics over years, proposed **empirical probability** to calculate the probability that a document d written in year y was about topic z.

Related work

- David Hall et al. 2008. Studying the history of ideas using topic models. EMNLP 2008.
  - Apply LDA (Blei et al., 2003) on ACL Reference Corpus of scientific papers related to NLP and computational linguistics.

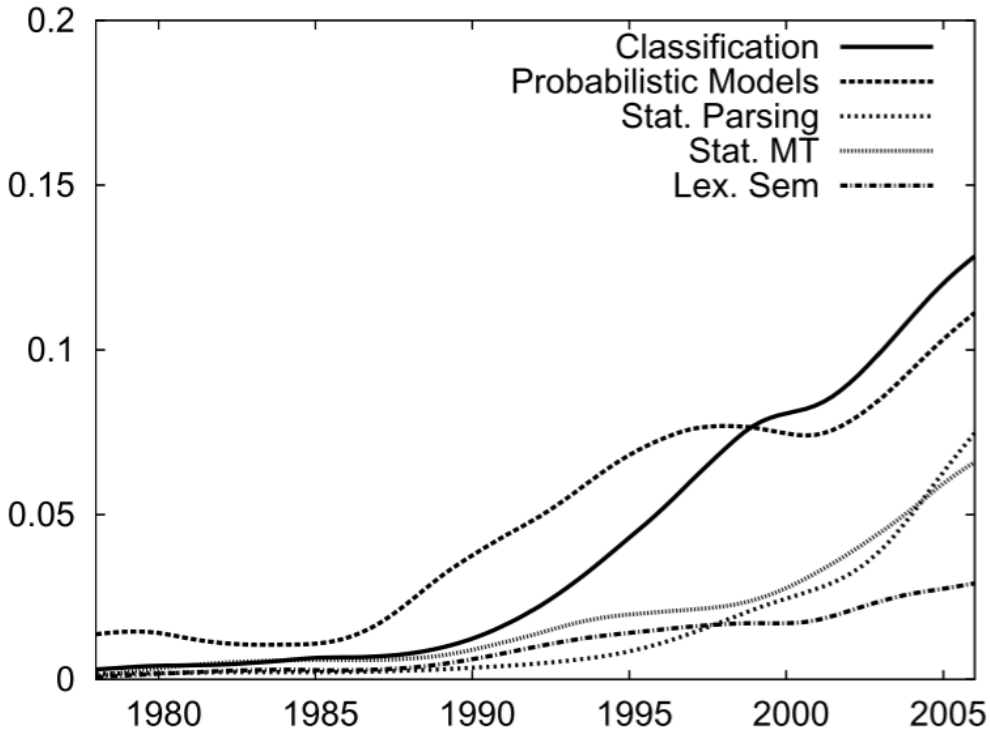


Figure: Topics in the ACL Anthology that show a strong recent increase in strength.

Related work

- Anton Barua et al. 2014. What are developers talking about? An analysis of topics and trends in Stack Overflow. Empirical Softw. Engg. 19, 3 (June 2014), 619-654.
- Paul, Michael J. and Roxana Girju. "Topic Modeling of Research Fields: An Interdisciplinary Perspective." RANLP (2009).

Related work

- Anton Barua et al. 2014. What are developers talking about? An analysis of topics and trends in Stack Overflow. Empirical Softw. Engg. 19, 3 (June 2014), 619-654.
  - Use latent Dirichlet allocation (LDA), to automatically discover the main topics present in developer discussions.
  - Analyse topics, their relationship and trends over time.

Related work

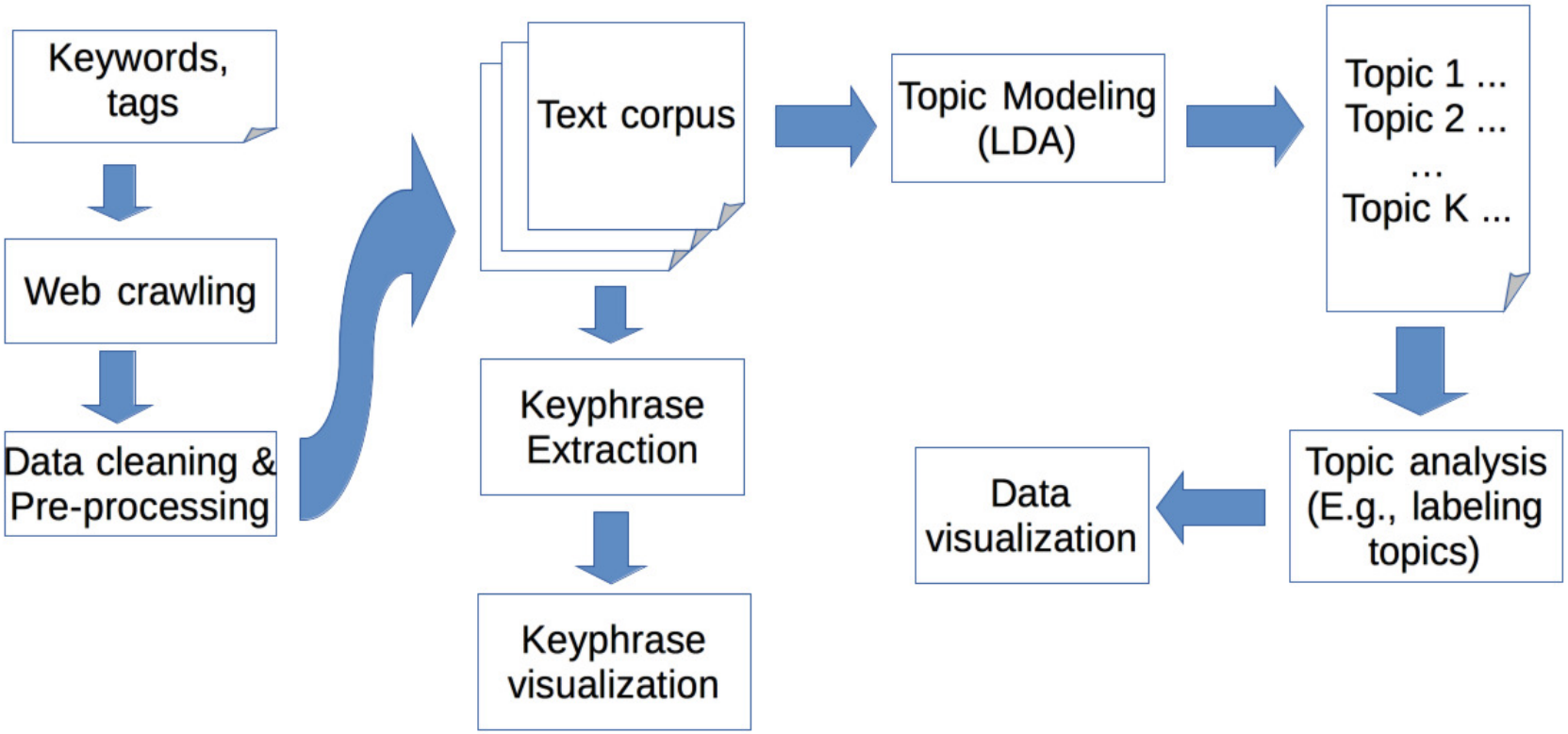
- Gollapalli, Sujatha Das and Xiaoli Li. "EMNLP versus ACL: Analyzing NLP research over time." EMNLP (2015).
  - Compare trends, topics in two NLP conferences
  - Apply LDA on keyphrases extracted from scientific documents
  - Apply a probabilistic distance metric to calculate the difference of papers in two conferences.

Related work

- **Keyphrase extraction**
  - Kazi Saidul Hasan and Vincent Ng. 2014. *Automatic keyphrase extraction: Asurvey of the state of the art*. ACL 2014.
  - **ExpandRank**: Xiaojun Wan and Jianguo Xiao. 2008. *Single document keyphrase extraction using neighborhood knowledge*. In AAAI.
- Mihalcea, Rada and Paul Tarau. "TextRank: Bringing Order Into Texts." (2004).
  - Represent text units (words, sentences, documents,...) as vertexes in a graph.
  - Adapt the Pagerank algorithm for ranking text.
    - Can apply for both undirected and directed graphs
    - Allow using weights of edges in graphs

Table of Contents

System Architecture



Topic mining and keyphrase extraction

- Apply Latent Dirichlet allocation
  - D. Blei, A. Ng, and M. Jordan. Latent Dirichlet allocation. Journal of Machine Learning Research, 3:993–1022, January 2003.
- For keyphrase extraction, we apply **TextRank** algorithm
  - Mihalcea, Rada and Paul Tarau. “TextRank: Bringing Order Into Texts.” (2004).

Table of Contents

Task list

#No	Description
1	Choose data sources and crawl text data
2	Clean & process crawled text data
3	Use topic modeling to mine topics in the text corpus
4	Important keyword extraction
5	Interpret mined topics/trends
6	Data visualization
7	Make a website for project demo
8	Prepare presentation for project demo/defence

Plan (1)

- Data sources
  - Tech news articles such as Techcrunch website with tags/topics big data, Internet of Things.
    - E.g., `https://techcrunch.com/tag/big-data/`
    - `https://techcrunch.com/tag/iot/`
    - `https://techcrunch.com/topic/subject/internet-of-things`
  - Paper articles
    - International Conference on the Internet of Things: `http://dblp2.uni-trier.de/db/conf/iot/` (pdf format)
    - Journal of Big data: `http://journalofbigdata.springeropen.com/` (Open access)
    - Big data analytics: `http://bdataanalytics.biomedcentral.com/`

Plan (2)

- Crawling text data: use **Scrapy** (in Python) for web crawling
- Cleaning and process crawled text data: use `nltk` toolkit
  - `nltk.org`
- Mining topics from text corpus
  - **gensim**: `https://radimrehurek.com/gensim/index.html`
- Keyphrase extraction
  - Use **TextRank** algorithm
- Data visualization: use `matplotlib`, `seaborn`
- Make website for the project demo
  - Use LAMP: Linux, Apache, MyQSL, PHP
  - You can use your favorite web technologies

Table of Contents

Task Assignment

- I have made a tentative assignment on:
  `http://bit.ly/2fTotat`

Exercises

- Install Python & libraries for scientific computing
  - Recommended package: `Anaconda` `https://www.continuum.io/downloads`
- Install `nltk` data
  - Large size ($\approx$ 2.5 GB)
  - You can copy from my laptop.
- Install Git tool
- Clone repository of the course

  git clone

  https://github.com/minhpqn/Text-Mining-Training-Course
- Get update from repository (I will update more lecture slides and resources)
  - `git pull`

Table of Contents

QA & Discussion

Any Questions?

Next Lecture

- Practice with nltk toolkit
- Topic modeling (LDA)
- Practice using topic modeling tools for mining topics from text corpora