Introduction to Text Mining

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What is "Text Mining"?

- *"Text mining, also referred to as **text data mining**, roughly equivalent to text analytics, refers to the process of deriving high-quality information from text."* - wikipedia
- *"Another way to view text data mining is as a process of **exploratory** data analysis that leads to **heretofore unknown** information, or to answers for questions for which the answer is not currently known."* - Hearst, 1999

Two different definitions of mining

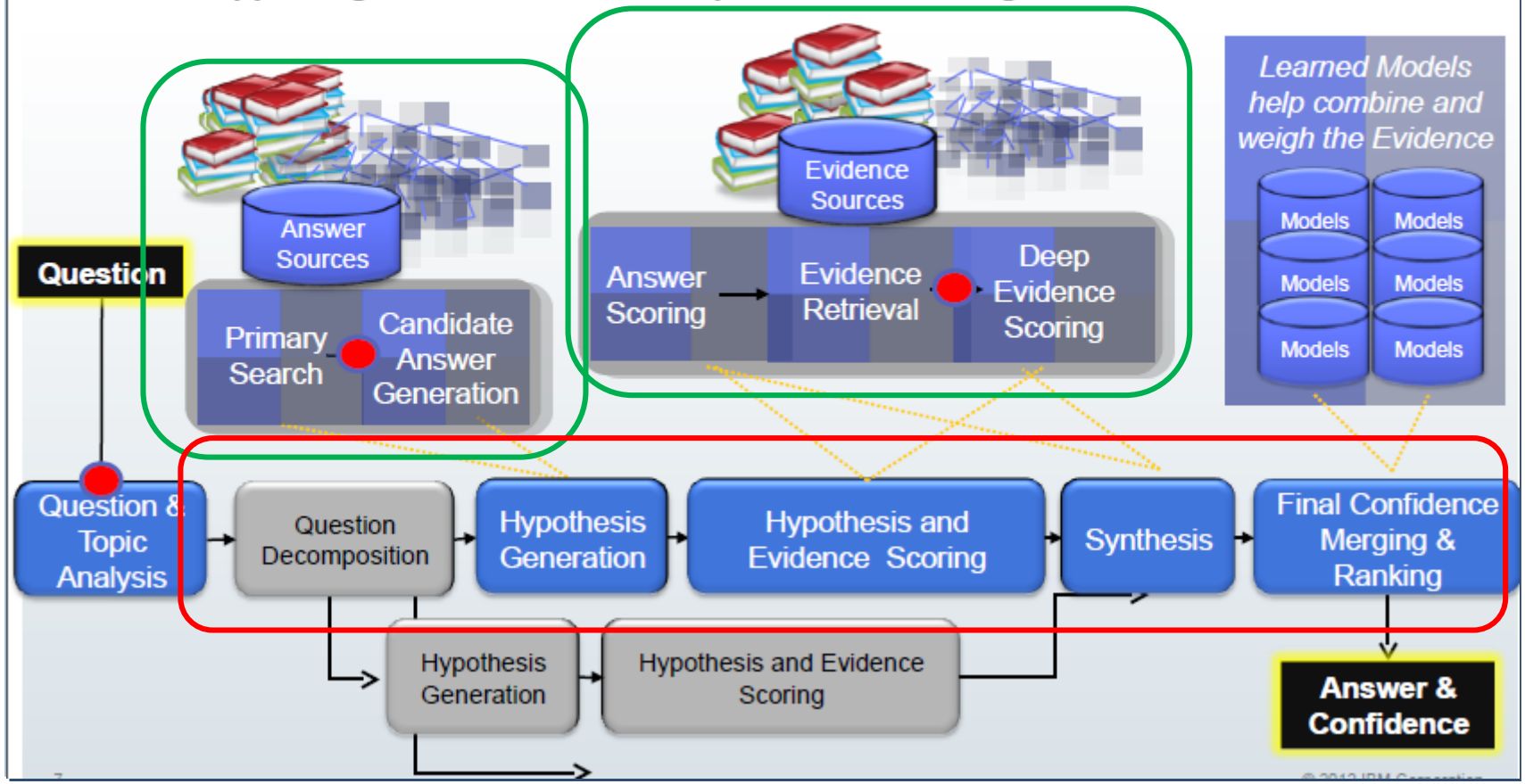
- Goal-oriented (effectiveness driven)
  - Any process that generates useful results that are non-obvious is called “mining”.
  - Keywords: “**useful**” + “**non-obvious**”
  - Data isn’t necessarily massive
- Method-oriented (efficiency driven)
  - Any process that involves extracting information from massive data is called “mining”
  - Keywords: “**massive**” + “**pattern**”
  - Patterns aren’t necessarily useful

Knowledge discovery from text data

- IBM's Watson wins at Jeopardy! - 2011

An overview of Watson

- On questions, at the start of question analysis
- On primary search results, before candidate answer generation
- On supporting evidence, before deep evidence scoring



What is inside Watson?

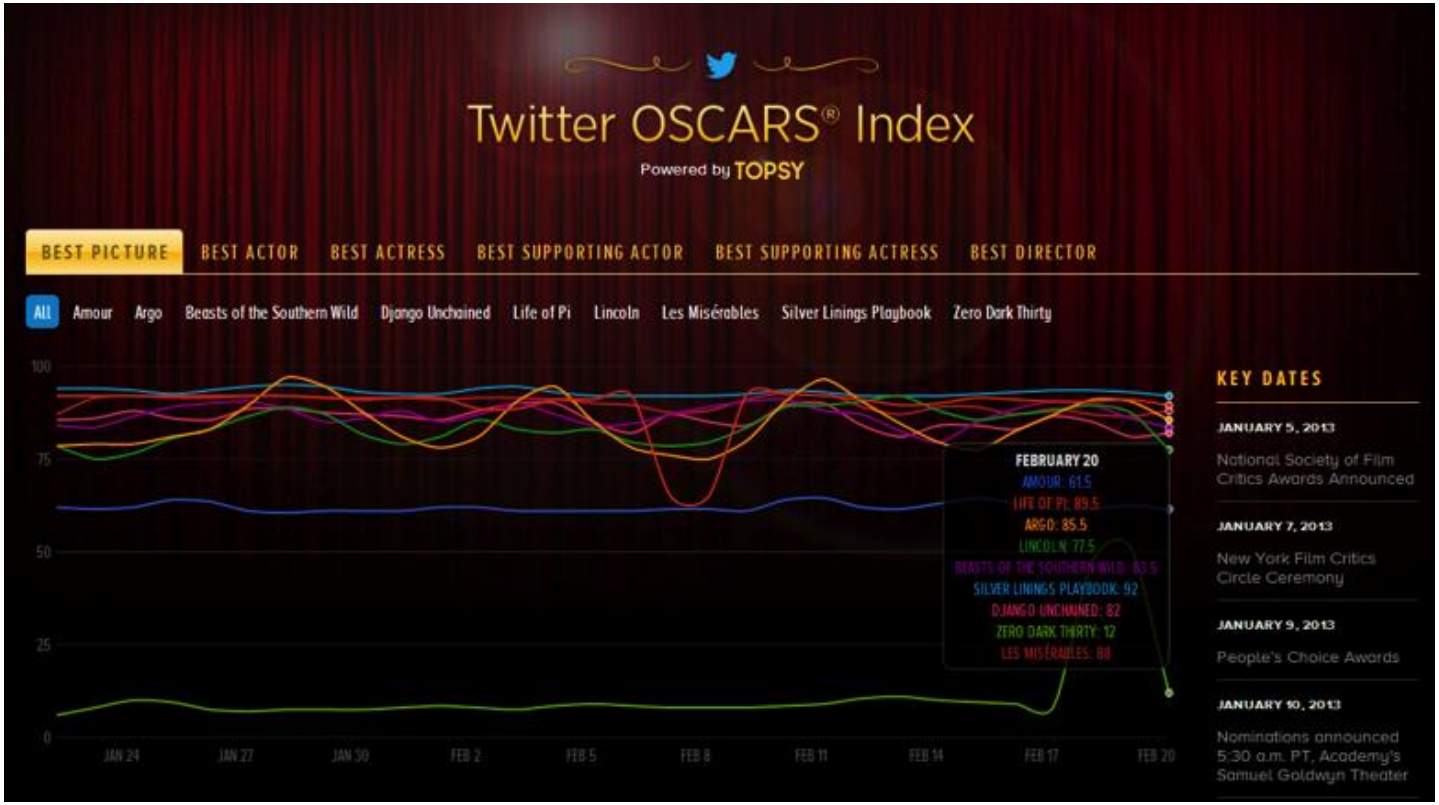
- *"Watson had access to <u>200 million pages</u> of structured and unstructured content consuming four terabytes of disk storage including the full text of Wikipedia" – PC World*
- *"The sources of information for Watson include encyclopedias, dictionaries, thesauri, newswire articles, and literary works. Watson also used databases, taxonomies, and ontologies. Specifically, DBPedia, WordNet, and Yago were used." – AI Magazine*

What is inside Watson?

- DeepQA system
  - *"Watson's main innovation was not in the creation of a new algorithm for this operation but rather its ability to **quickly** execute hundreds of proven language analysis algorithms simultaneously to find the correct answer."* – New York Times
  - The DeepQA Research Team

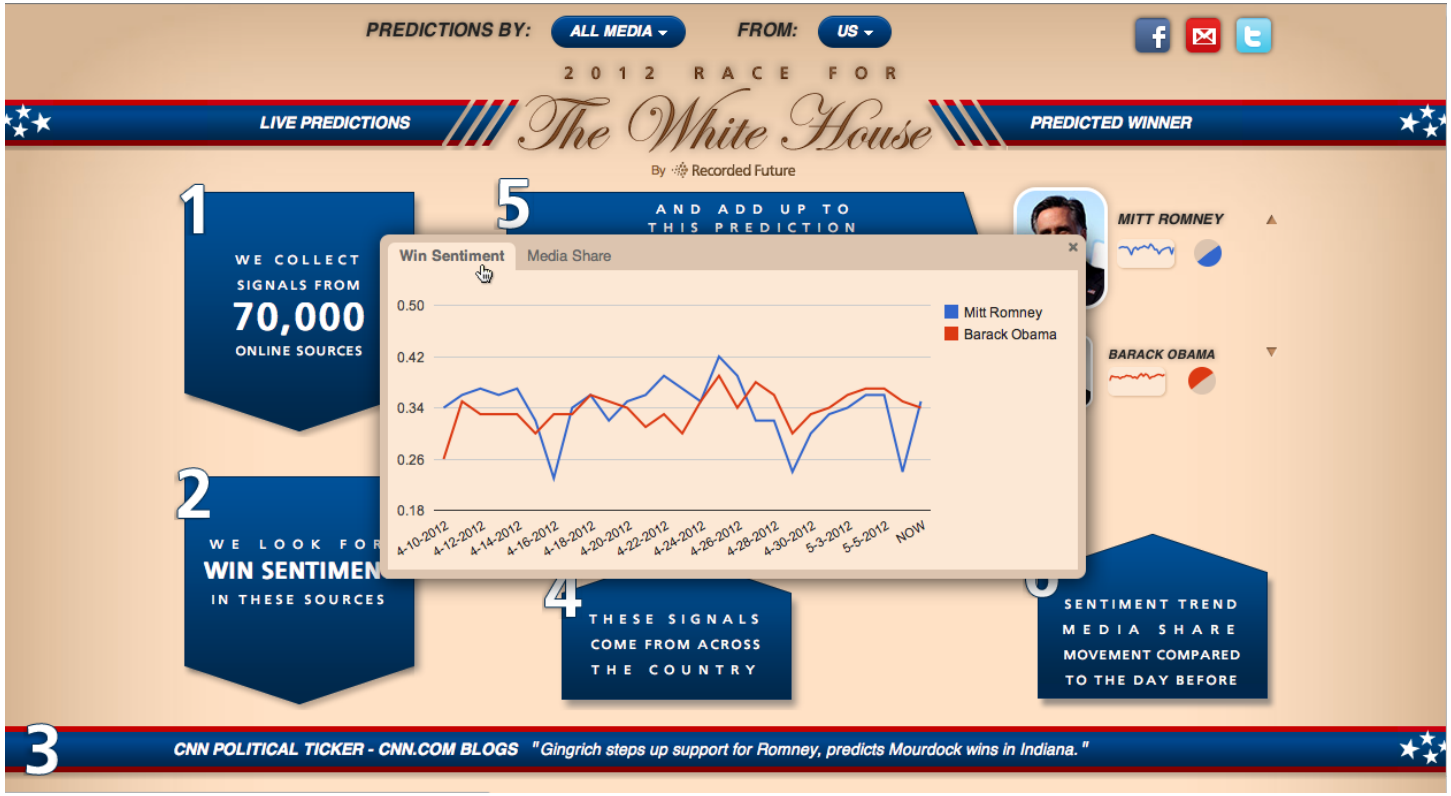
Text mining around us

- Sentiment analysis



Text mining around us

- Sentiment analysis

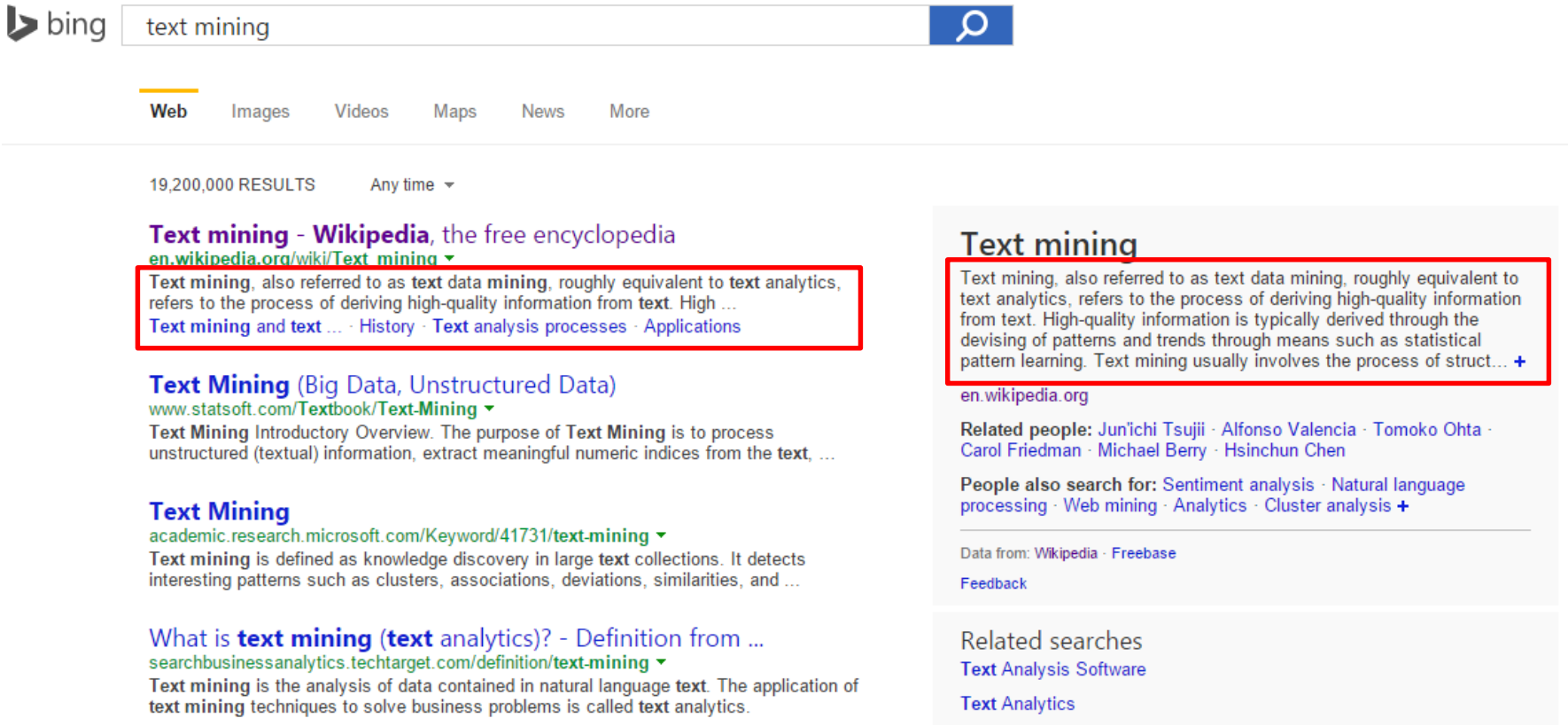


Text mining around us

- Document summarization

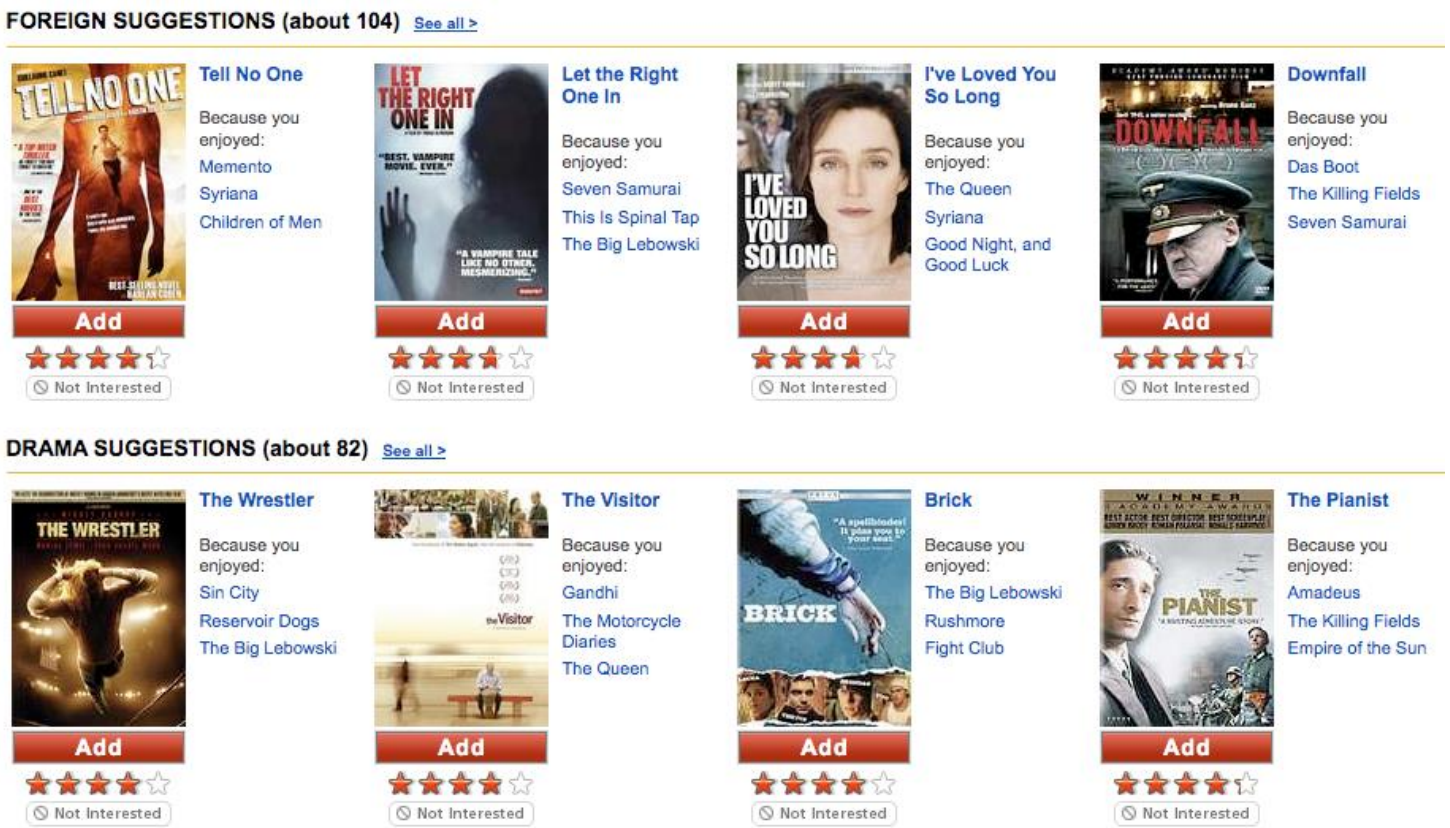
Text mining around us

- Document summarization



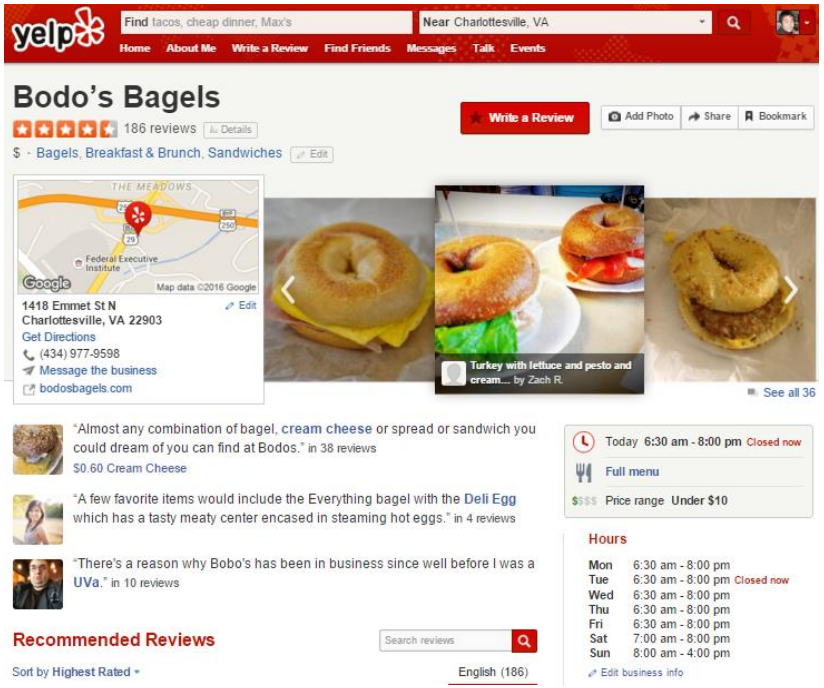
Text mining around us

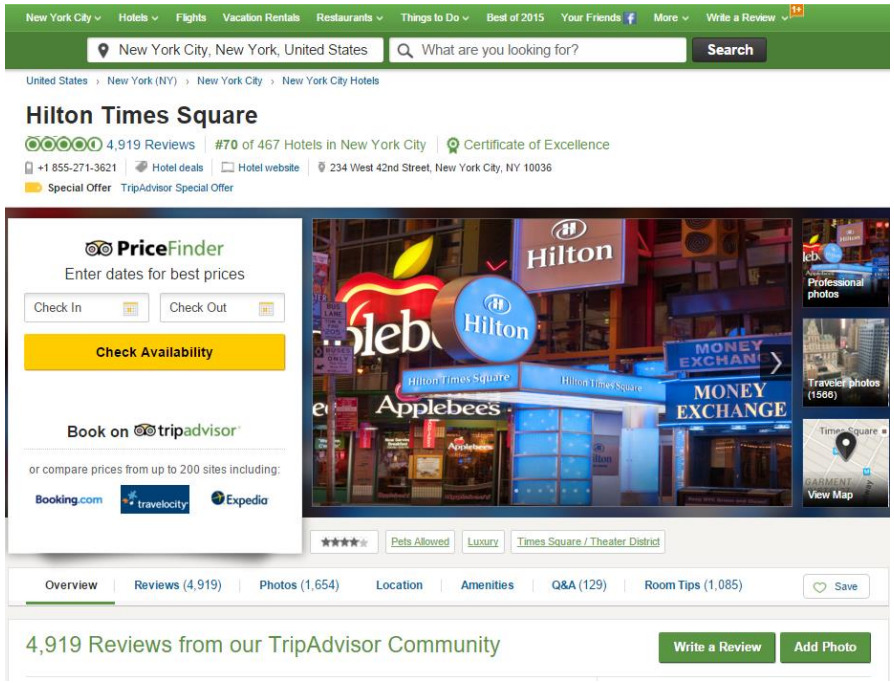
- Movie recommendation



Text mining around us

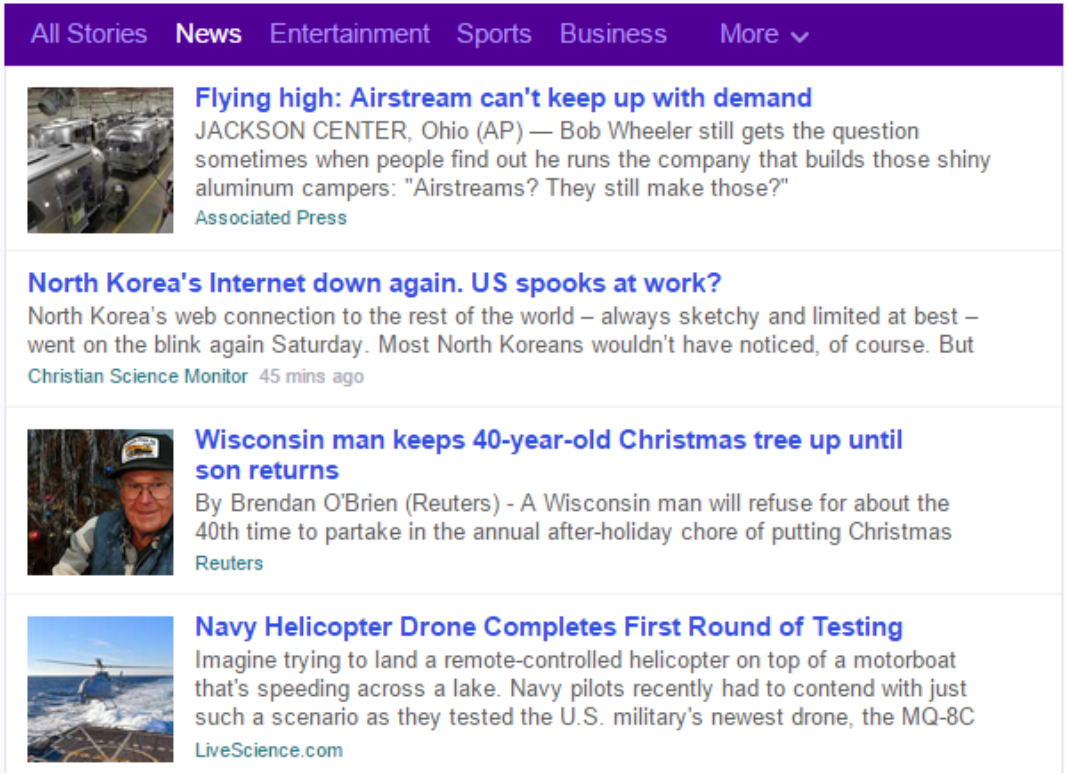
- Restaurant/hotel recommendation





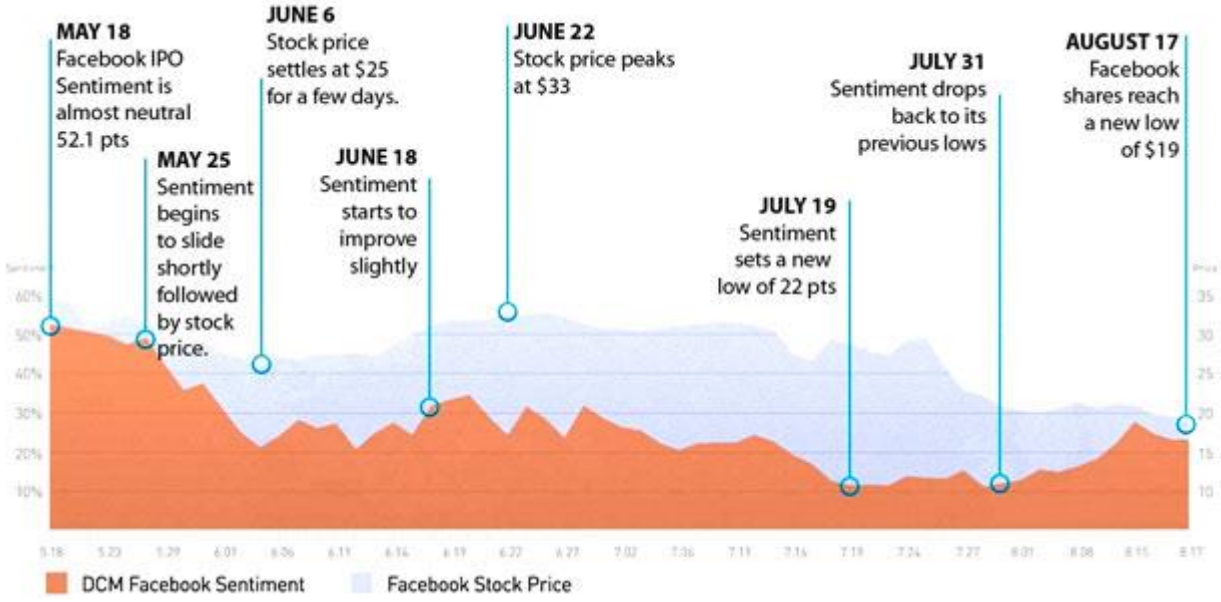
Text mining around us

- News recommendation



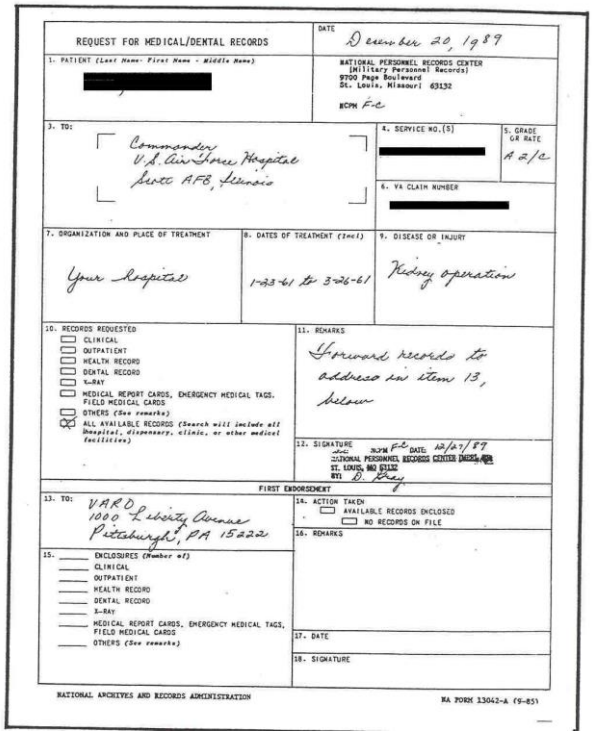
Text mining around us

- Text analytics in financial services



Text mining around us

- Text analytics in healthcare



REQUEST FOR MEDICAL/DENTAL RECORDS

DATE December 20, 1989

1. PATIENT (Last Name - First Name - Middle Name) [redacted]

NATIONAL PERSONNEL RECORDS CENTER (Military Personnel Records) 9700 Page Boulevard St. Louis, Missouri 63132

NCPM F-C

3. TO: Commander V.A. Air Force Hospital Scott AFB, Illinois

4. SERVICE NO. (S) [redacted]

5. GRADE OR RATE A 2/c

6. VA CLAIM NUMBER [redacted]

7. ORGANIZATION AND PLACE OF TREATMENT: Your Hospital

8. DATES OF TREATMENT (Incl) 1-23-61 to 3-26-61

9. DISEASE OR INJURY: Kidney operation

10. RECORDS REQUESTED
- [ ] CLINICAL
- [ ] OUTPATIENT
- [ ] HEALTH RECORD
- [ ] DENTAL RECORD
- [ ] X-RAY
- [ ] MEDICAL REPORT CARDS, EMERGENCY MEDICAL TAGS, FIELD MEDICAL CARDS
- [ ] OTHERS (See remarks)
- [x] ALL AVAILABLE RECORDS (Search will include all hospital, dispensary, clinic, or other medical facilities)

11. REMARKS: Forward records to address in item 13, below

12. SIGNATURE NCPM F-C DATE 12/27/89 NATIONAL PERSONNEL RECORDS CENTER (MPR) ST. LOUIS, MO 63132 BY: D. Gray

FIRST ENDORSEMENT

13. TO: VARO 1000 Liberty Avenue Pittsburgh, PA 15222

14. ACTION TAKEN
- [ ] AVAILABLE RECORDS ENCLOSED
- [ ] NO RECORDS ON FILE

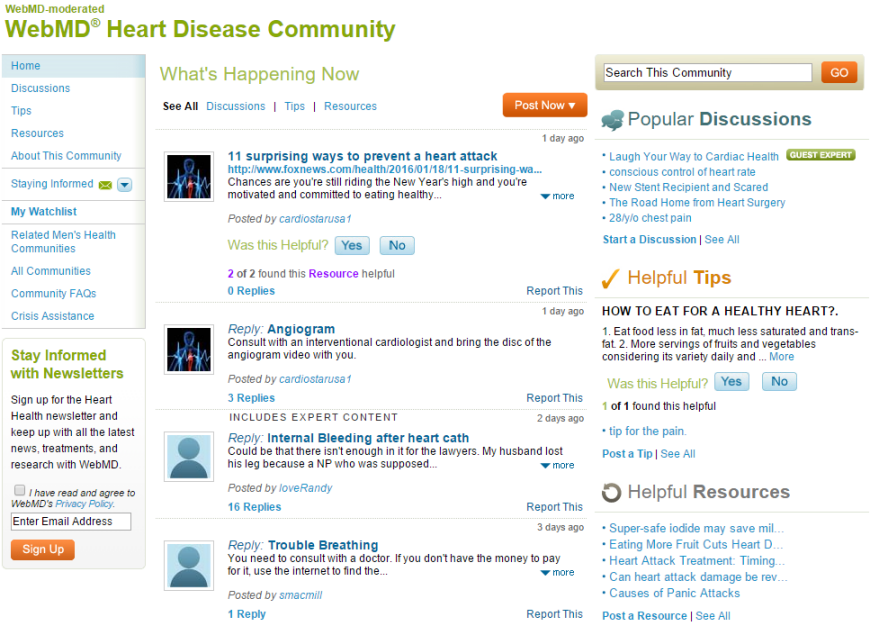
15. ____ ENCLOSURES (Number of)
- ____ CLINICAL
- ____ OUTPATIENT
- ____ HEALTH RECORD
- ____ DENTAL RECORD
- ____ X-RAY
- ____ MEDICAL REPORT CARDS, EMERGENCY MEDICAL TAGS, FIELD MEDICAL CARDS
- ____ OTHERS (See remarks)

16. REMARKS

17. DATE

18. SIGNATURE

NATIONAL ARCHIVES AND RECORDS ADMINISTRATION — NA FORM 13042-A (9-85)



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1 day ago
11 surprising ways to prevent a heart attack
http://www.foxnews.com/health/2016/01/18/11-surprising-wa...
Chances are you're still riding the New Year's high and you're motivated and committed to eating healthy... more
Posted by cardiostarusa1
Was this Helpful? Yes No
2 of 2 found this Resource helpful
0 Replies Report This

1 day ago
Reply: Angiogram
Consult with an interventional cardiologist and bring the disc of the angiogram video with you.
Posted by cardiostarusa1
3 Replies Report This

INCLUDES EXPERT CONTENT 2 days ago
Reply: Internal Bleeding after heart cath
Could be that there isn't enough in it for the lawyers. My husband lost his leg because a NP who was supposed... more
Posted by loveRandy
16 Replies Report This

3 days ago
Reply: Trouble Breathing
You need to consult with a doctor. If you don't have the money to pay for it, use the internet to find the... more
Posted by smacmill
1 Reply Report This

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- 28/y/o chest pain

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1 of 1 found this helpful
- tip for the pain.

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- Eating More Fruit Cuts Heart D...
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- Can heart attack damage be rev...
- Causes of Panic Attacks

Post a Resource | See All

How to perform text mining?

- As computer scientists, we view it as
  - Text Mining = Data Mining + Text Data

Applied machine learning
Natural language processing
Information retrieval
Emails
Software documentations
Blogs
Web pages
Tweets
Scientific literature
News articles

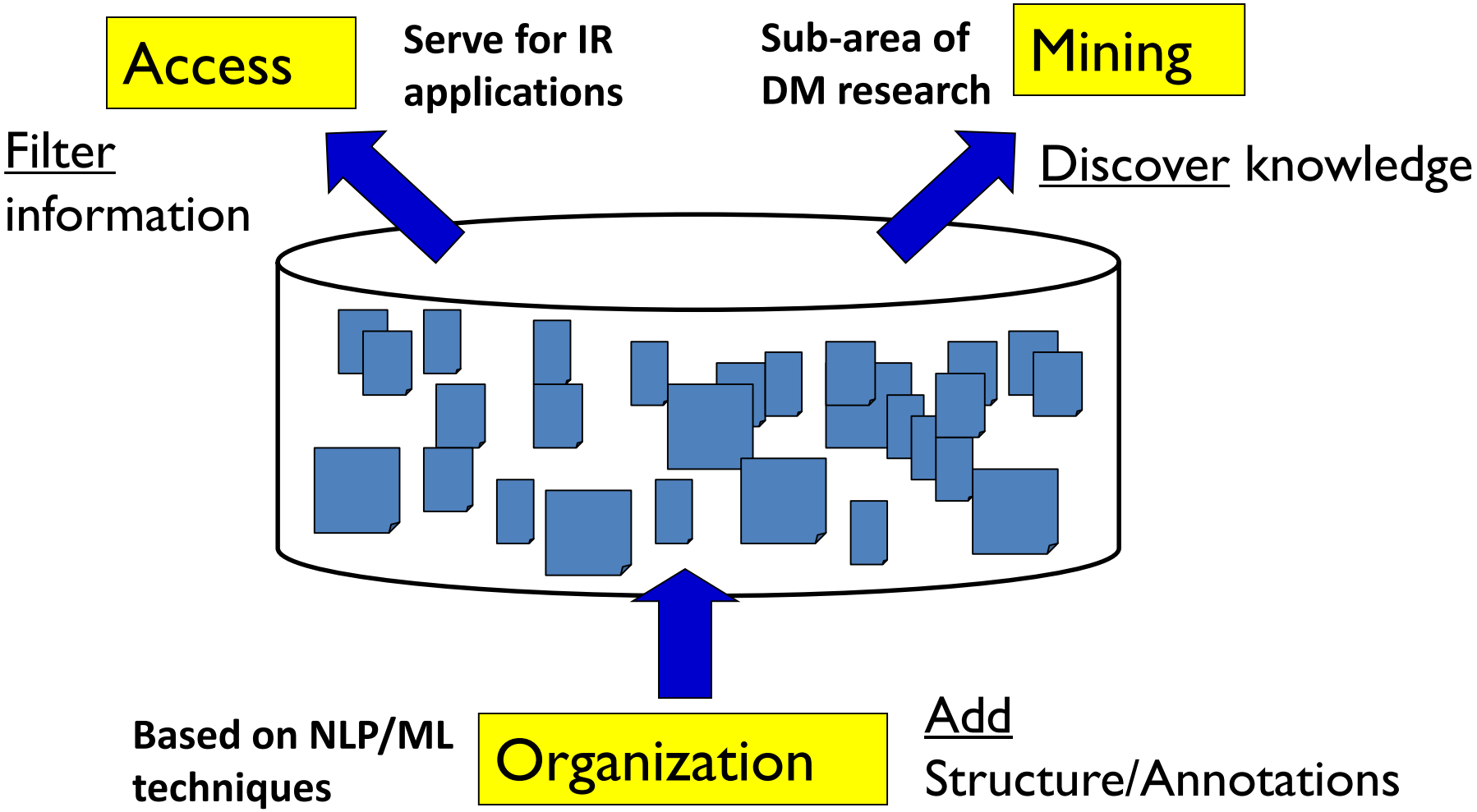
Text mining v.s. NLP, IR, DM…

- How does it relate to data mining in general?
- How does it relate to computational linguistics?
- How does it relate to information retrieval?

	Finding Patterns	Finding "Nuggets"	
		Novel	Non-Novel
Non-textual data	General data-mining	Exploratory	Database queries
Textual data	Comp Ling	ysis	Information retrieval

Text Mining

Text mining in general

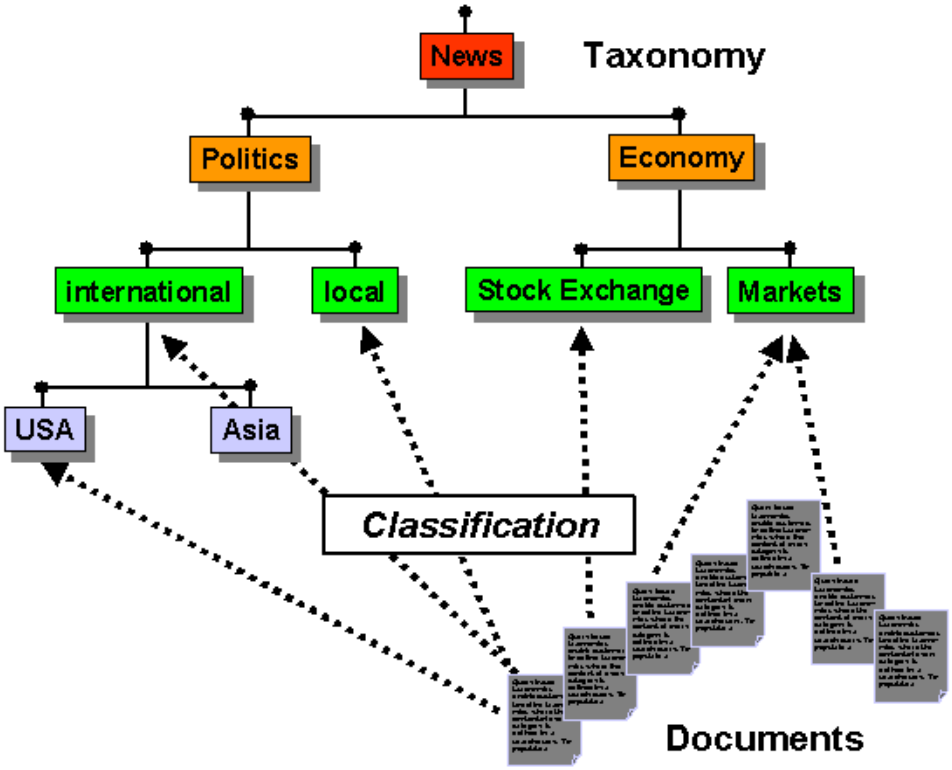


Challenges in text mining

- Data collection is “free text”
  - Data is not well-organized
    - Semi-structured or unstructured
  - Natural language text contains ambiguities on many levels
    - Lexical, syntactic, semantic, and pragmatic
  - Learning techniques for processing text typically need annotated training examples
    - Expensive to acquire at scale
- What to mine?

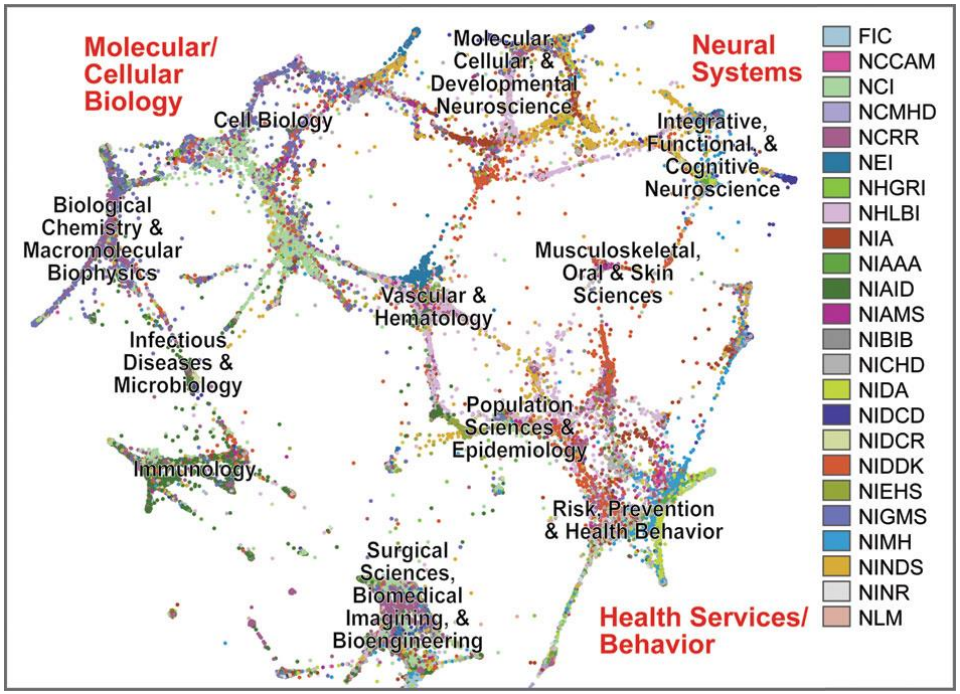
Text mining problems we will solve

- Document categorization
  - Adding structures to the text corpus



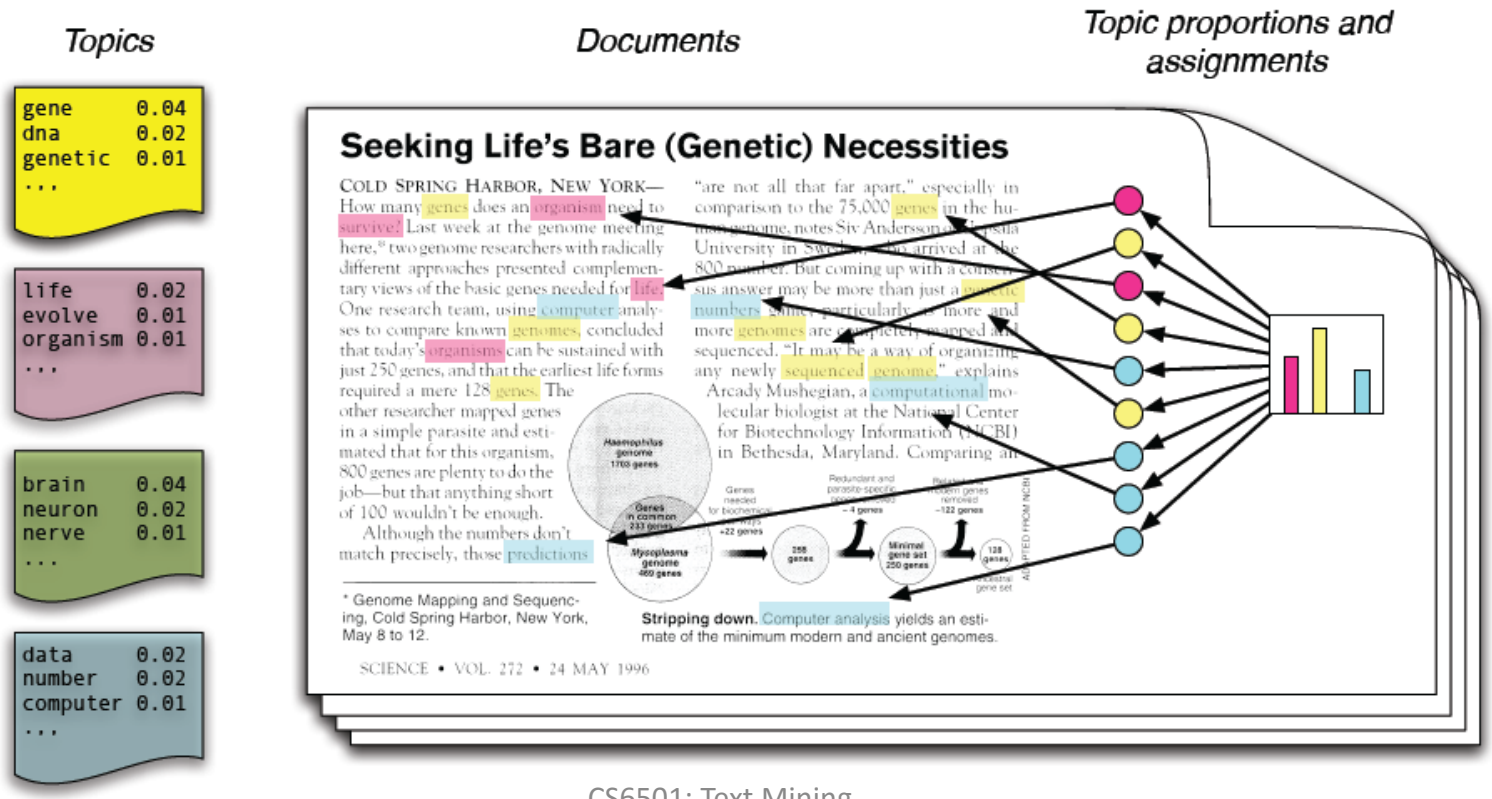
Text mining problems we will solve

- Text clustering
  - Identifying structures in the text corpus



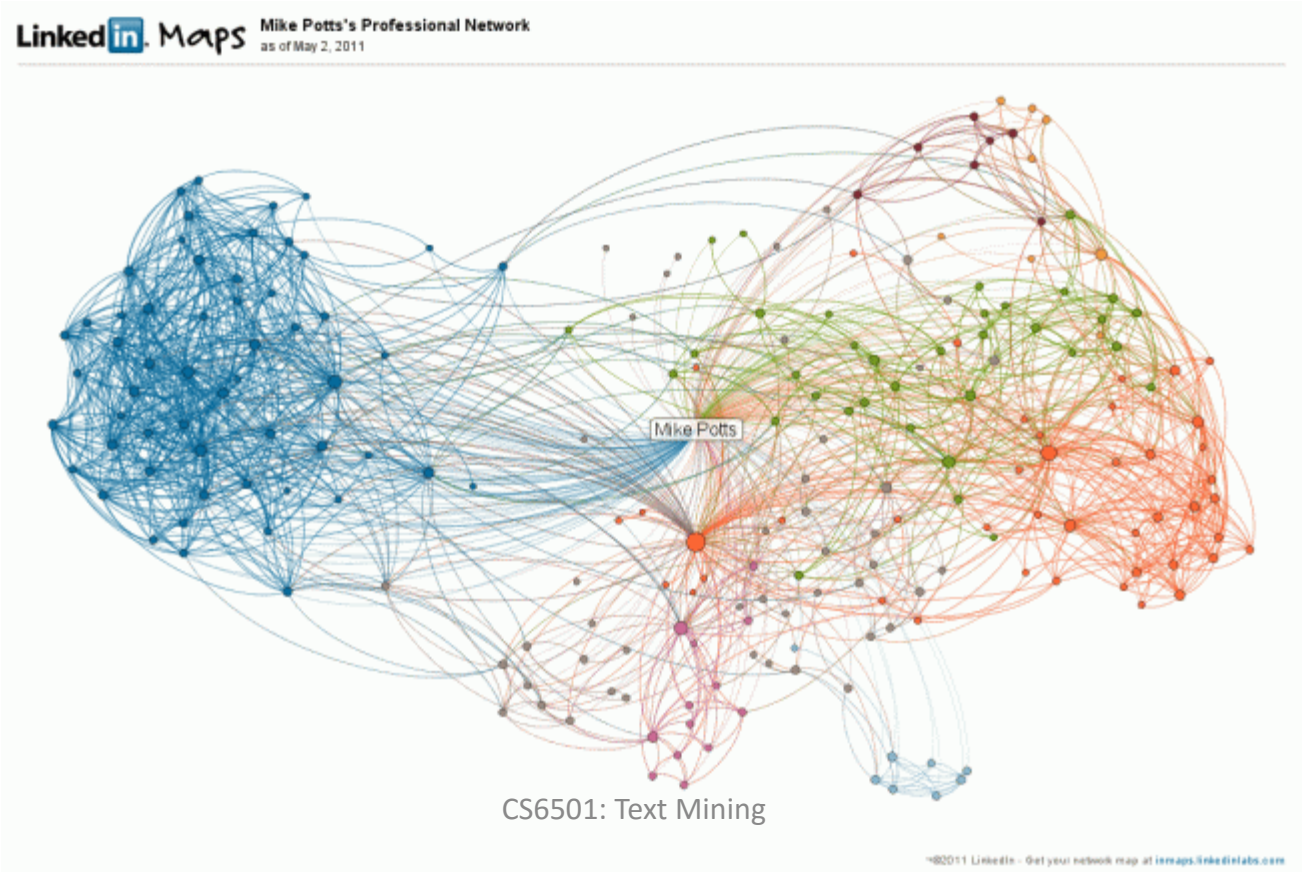
Text mining problems we will solve

- Topic modeling
  - Identifying structures in the text corpus

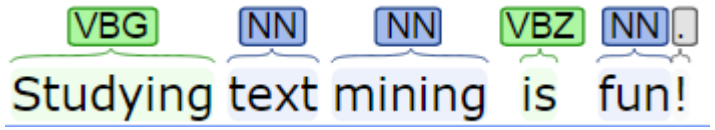


Text mining problems we will solve

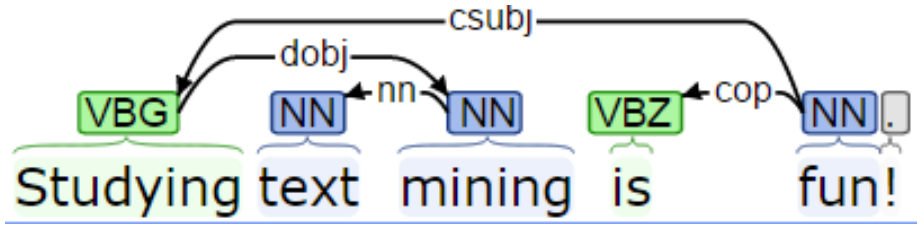
- Social media and network analysis
  - Exploring additional structure in the text corpus



We will also briefly cover

- Natural language processing pipeline
  - Tokenization
    - "Studying text mining is fun!" -> "studying" + "text" + "mining" + "is" + "fun" + "!"
  - Part-of-speech tagging
    - "Studying text mining is fun!" -> 

  - Dependency parsing
    - "Studying text mining is fun!" ->



We will also briefly cover

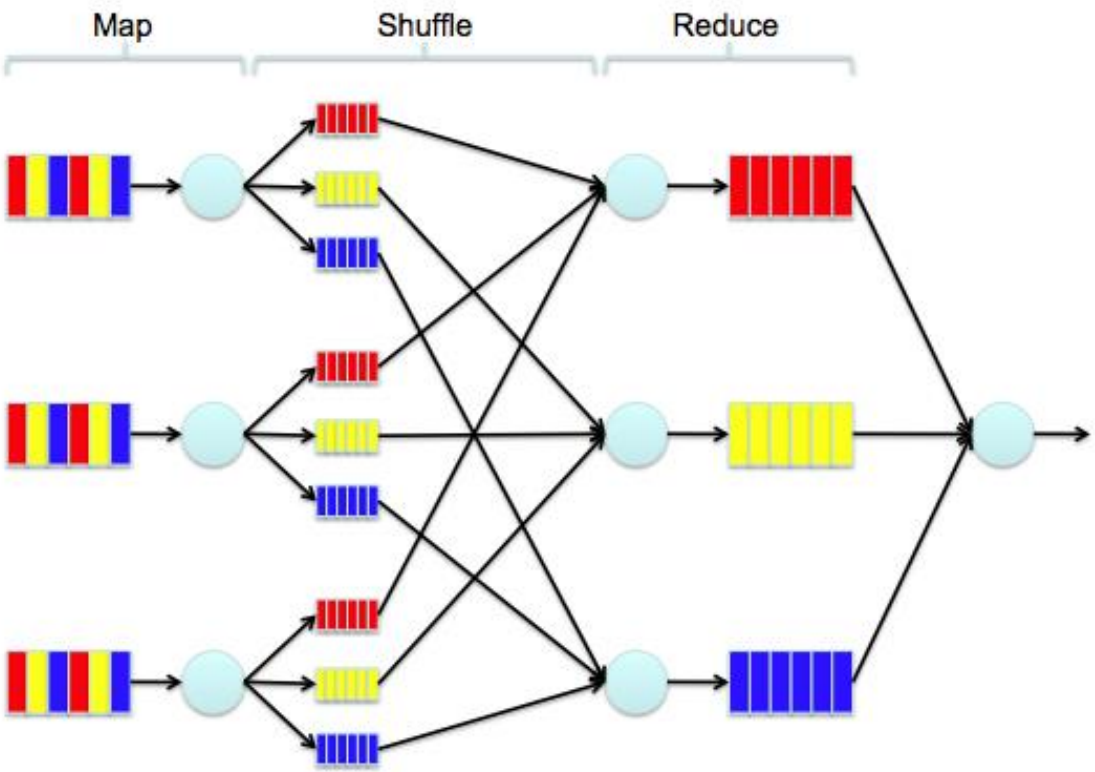
- Machine learning techniques
  - Supervised methods
    - Naïve Bayes, k Nearest Neighbors, Logistic Regression
  - Unsupervised methods
    - K-Means, hierarchical clustering, topic models
  - Semi-supervised methods
    - Expectation Maximization

Text mining in the era of Big Data

- Huge in size
  - Google processes 5.13B queries/day (2013)
  - Twitter receives 340M tweets/day (2012)
  - Facebook has 2.5 PB of user data + 15 TB/day (4/2009)
  - eBay has 6.5 PB of user data + 50 TB/da
- 80% data is unstructured (IBM, 2010)

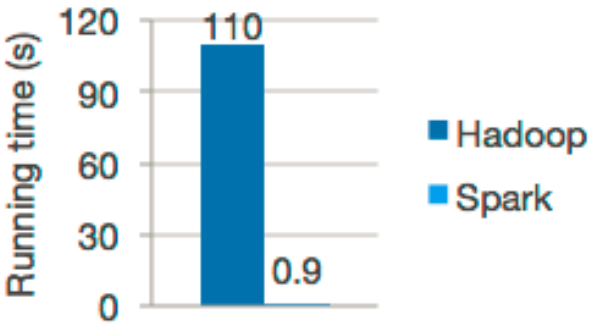
Scalability is crucial

- Large scale text processing techniques
  - MapReduce framework



State-of-the-art solutions

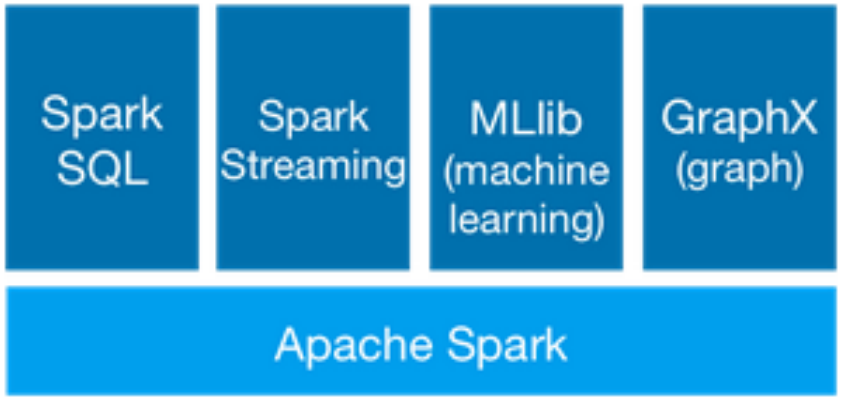
- Apache Spark (spark.apache.org)
  - In-memory MapReduce
    - Specialized for machine learning algorithms
  - Speed
    - 100x faster than Hadoop MapReduce in memory, or 10x faster on disk.



Logistic regression in Hadoop and Spark

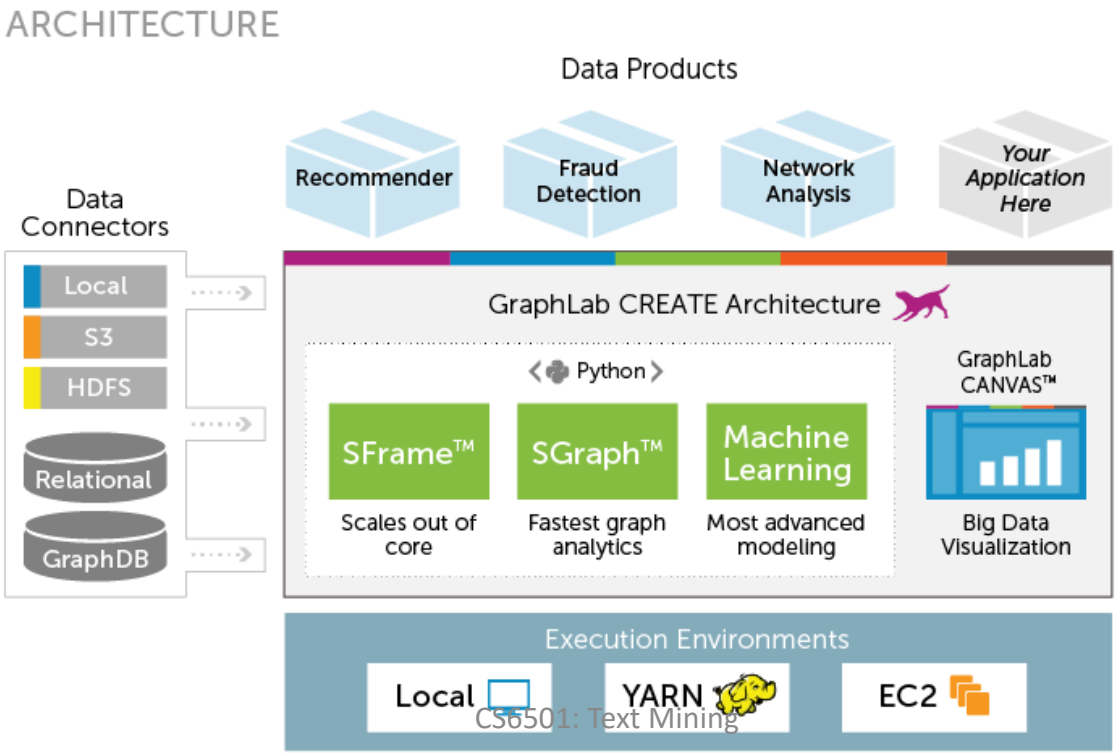
State-of-the-art solutions

- Apache Spark (spark.apache.org)
  - In-memory MapReduce
    - Specialized for machine learning algorithms
  - Generality
    - Combine SQL, streaming, and complex analytics



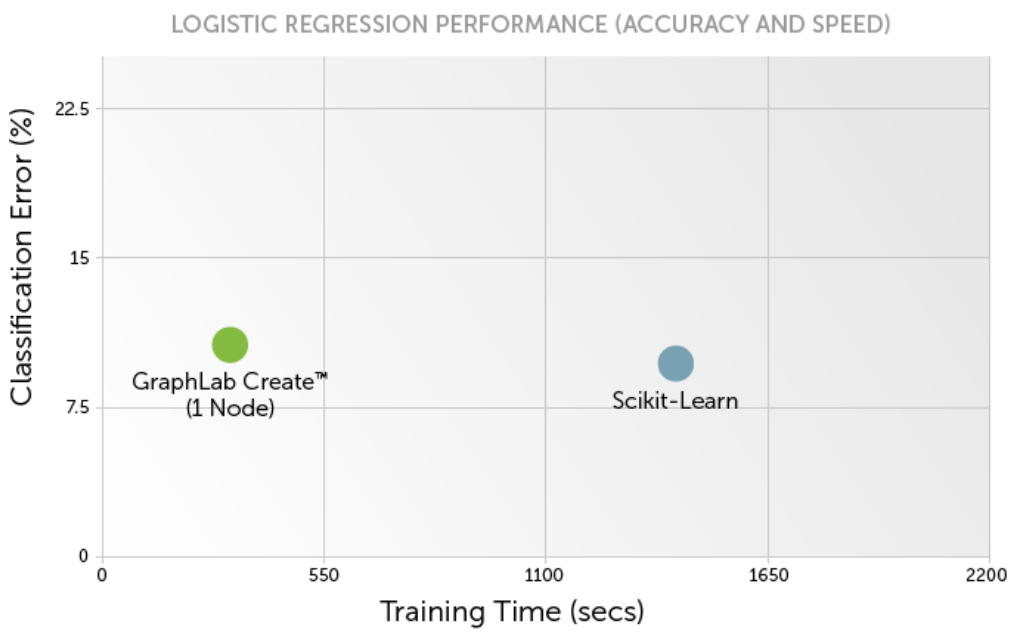
State-of-the-art solutions

- GraphLab (graphlab.com)
  - Graph-based, high performance, distributed computation framework



State-of-the-art solutions

- GraphLab (graphlab.com)
  - Specialized for sparse data with local dependencies for iterative algorithms



Text mining in the era of Big Data

Knowledge service system

Knowledge Discovery

Human-generated data

Text data

Behavior data

Decision Support

Human: big data producer and consumer

Data Generation Modeling

As knowledge consumer

Challenges:

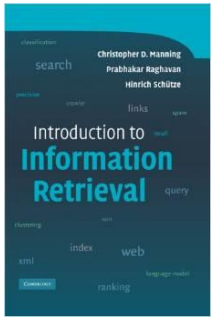
1. **Implicit feedback**
2. **Diverse and dynamic**

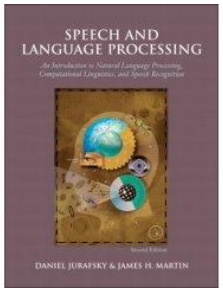
As data producer

Challenges:

1. **Unstructured data**
2. **Rich semantic**

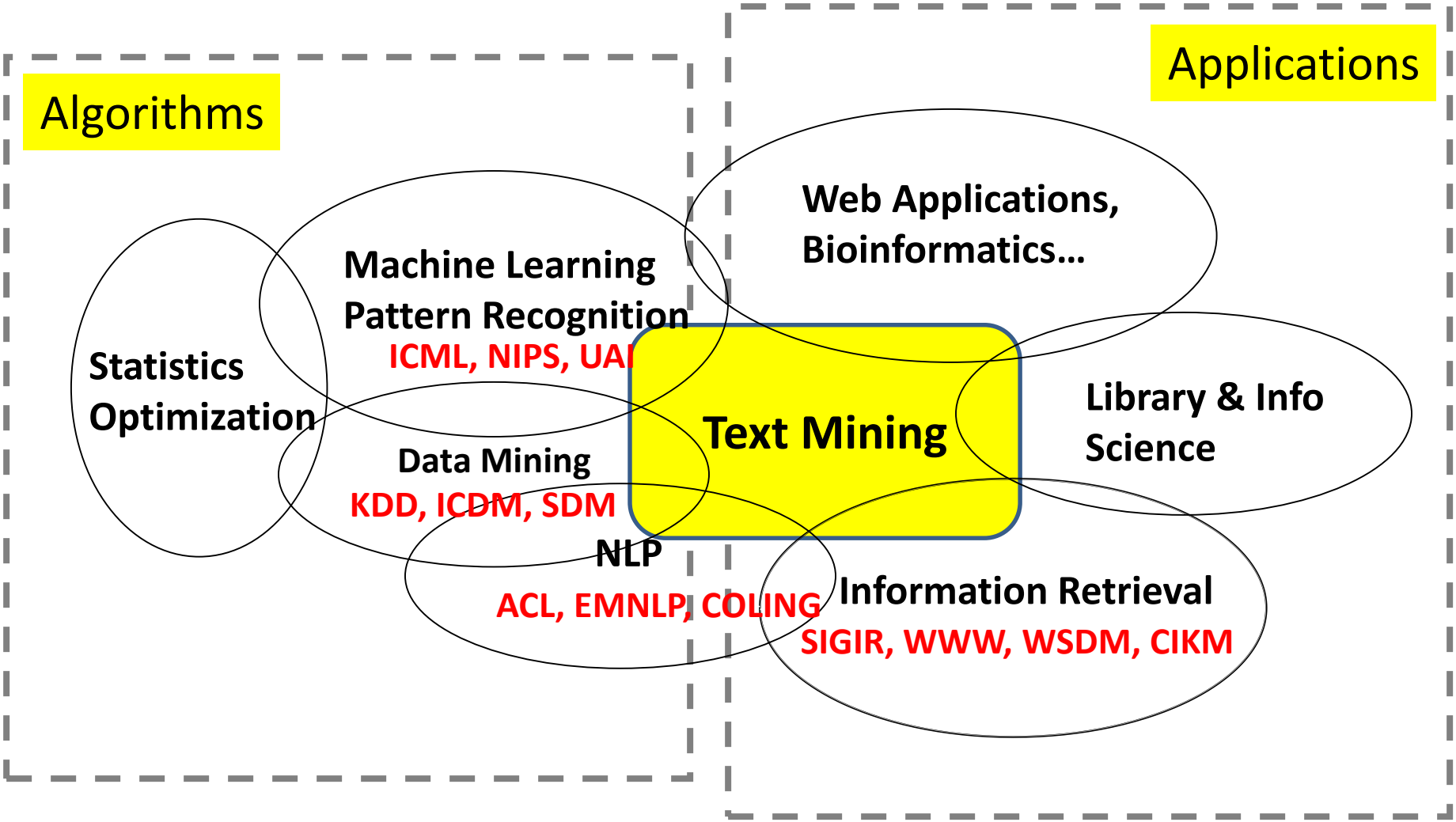
Text books





- ***Introduction to Information Retrieval***. Christopher D. Manning, Prabhakar Raghavan, and Hinrich Schuetze, Cambridge University Press, 2007.
- ***Speech and Language Processing***. Daniel Jurafsky and James H. Martin, Pearson Education, 2000.
- ***Mining Text Data***. Charu C. Aggarwal and ChengXiang Zhai, Springer, 2012.

What to read?



- Find more on course website for resource

Welcome to the class of “Text Mining”!