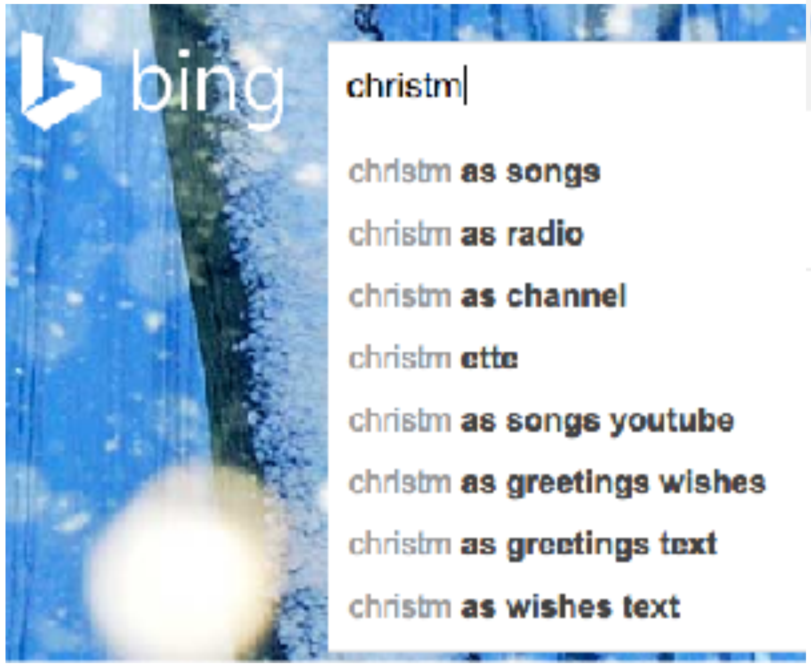
Query Modelling

Autocompletions, Temporal profiling

Query Modelling

- Query modelling is used to better capture the users information need
- Bridges the vocabulary gap between the query and the documents to be retrieved
    - bicycle vs bike, LOTUS vs POTUS vs president of US
    - EOS 1000D vs canon rebel series
- Used in Query expansions, suggestions and auto-completions
- Temporal Profiling for improving result quality

Query Modelling Applications - Auto-completions



christm

christm as songs

christm as radio

christm as channel

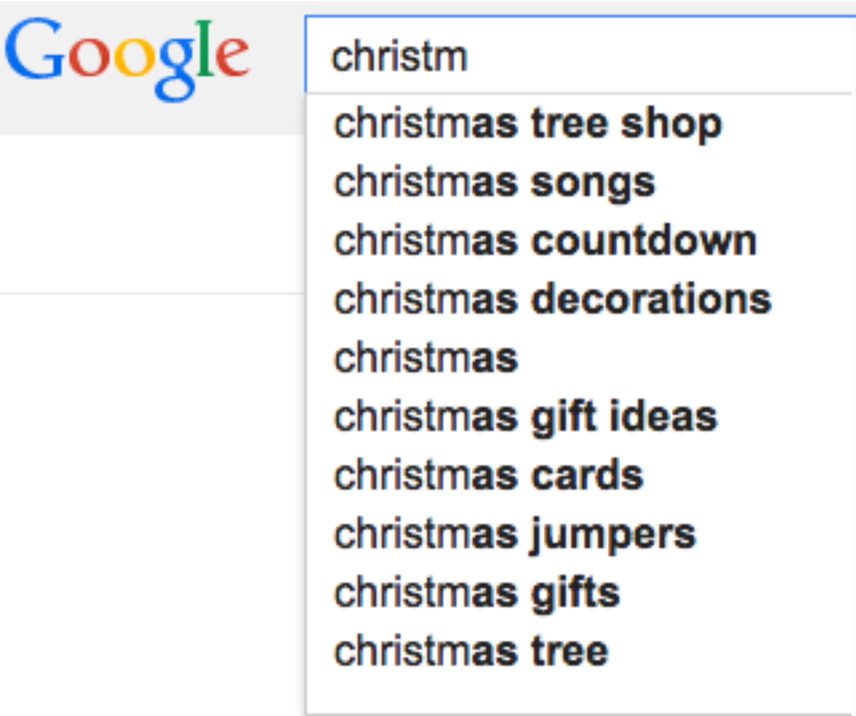
christm ette

christm as songs youtube

christm as greetings wishes

christm as greetings text

christm as wishes text



christm

christmas tree shop

christmas songs

christmas countdown

christmas decorations

christmas

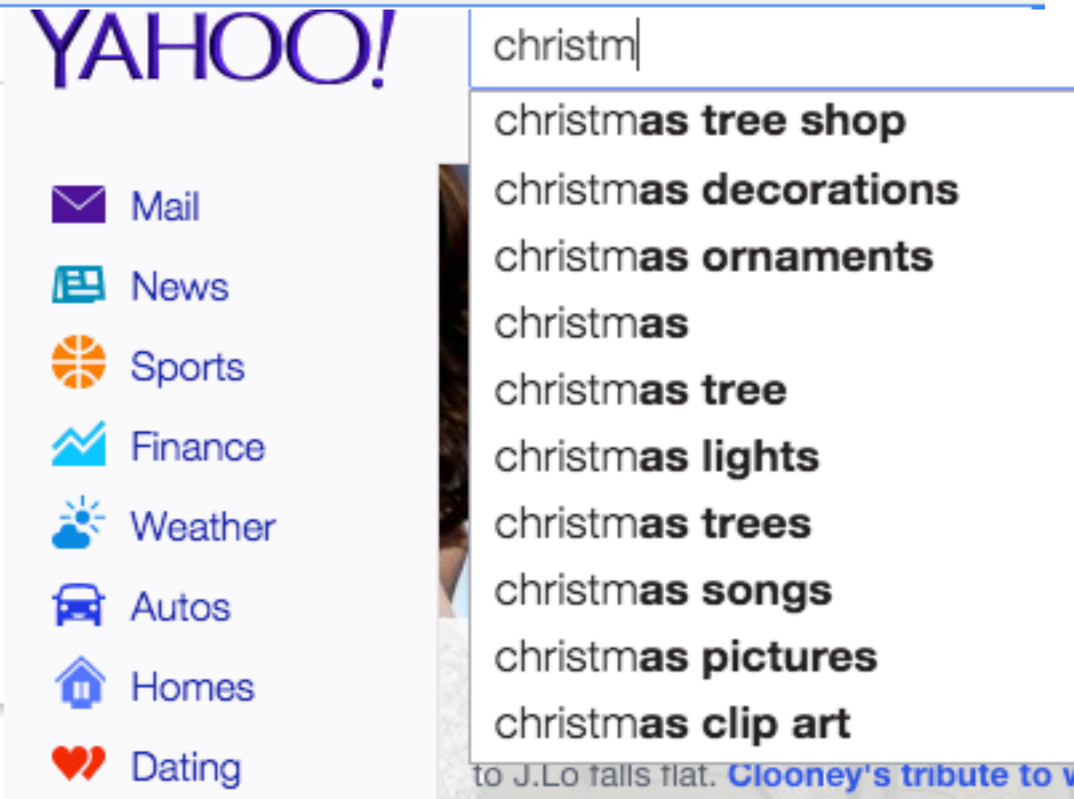
christmas gift ideas

christmas cards

christmas jumpers

christmas gifts

christmas tree



christm

christmas tree shop

christmas decorations

christmas ornaments

christmas

christmas tree

christmas lights

christmas trees

christmas songs

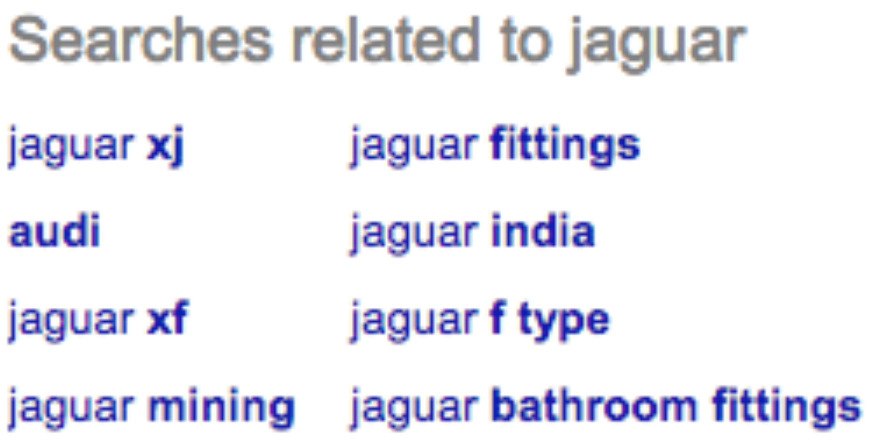
christmas pictures

christmas clip art

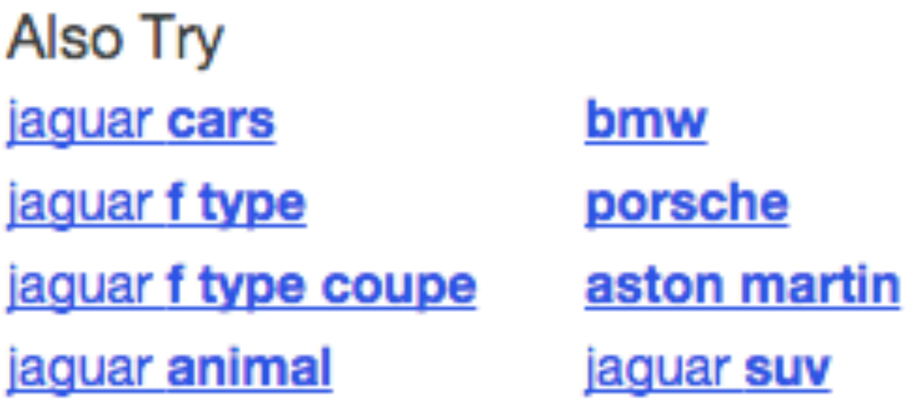
to J.Lo falls flat. Clooney's tribute to v

- Query Auto-completions : Given a prefix text suggest the most probable queries
- Better auto-completions are based on better modelling user intents

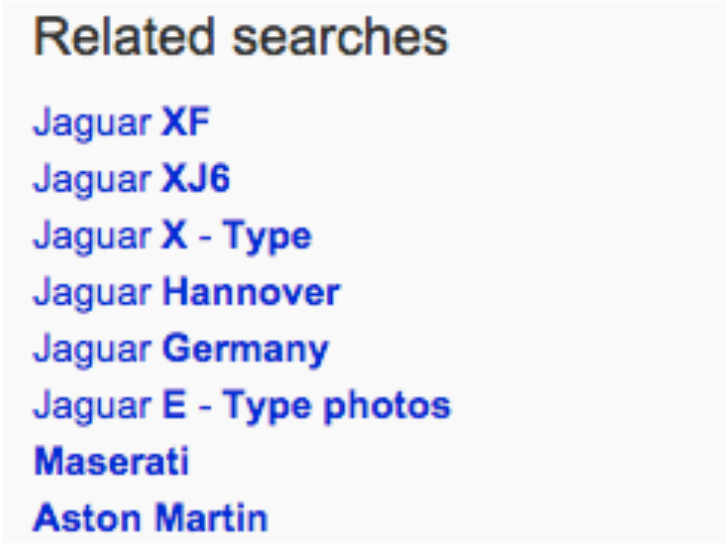
Query Modelling Applications - Suggestions


Searches related to jaguar

jaguar **xj**
audi
jaguar **xf**
jaguar **mining**
jaguar **fittings**
jaguar **india**
jaguar **f type**
jaguar **bathroom fittings**


Also Try

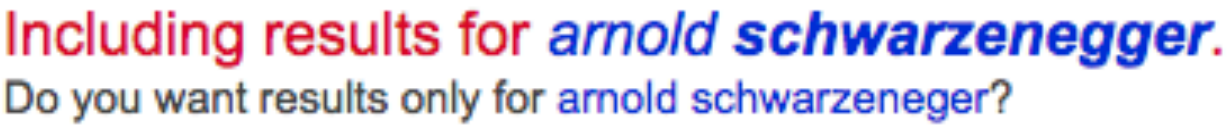
jaguar **cars**
jaguar **f type**
jaguar **f type coupe**
jaguar **animal**
bmw
porsche
aston martin
jaguar **suv**


Related searches

Jaguar **XF**
Jaguar **XJ6**
Jaguar **X - Type**
Jaguar **Hannover**
Jaguar **Germany**
Jaguar **E - Type photos**
Maserati
Aston Martin

- Query Suggestions : Given the complete query, try to guess related queries or what the user might be interested in

- spelling corrections are a subset of it


Including results for *arnold **schwarzenegger***.
Do you want results only for arnold schwarzeneger?

Query Modelling Applications - Expansions

- Autocompletions and suggestions are explicit
- To improve the quality of results the search engines implicitly enrich or expand queries
  - Input query: bike prices
  - Expanded query: bike prices OR bicycle price OR bicycle cost OR two-wheeler cost OR …

How can queries be modelled ?

How to use temporal information to better model queries?

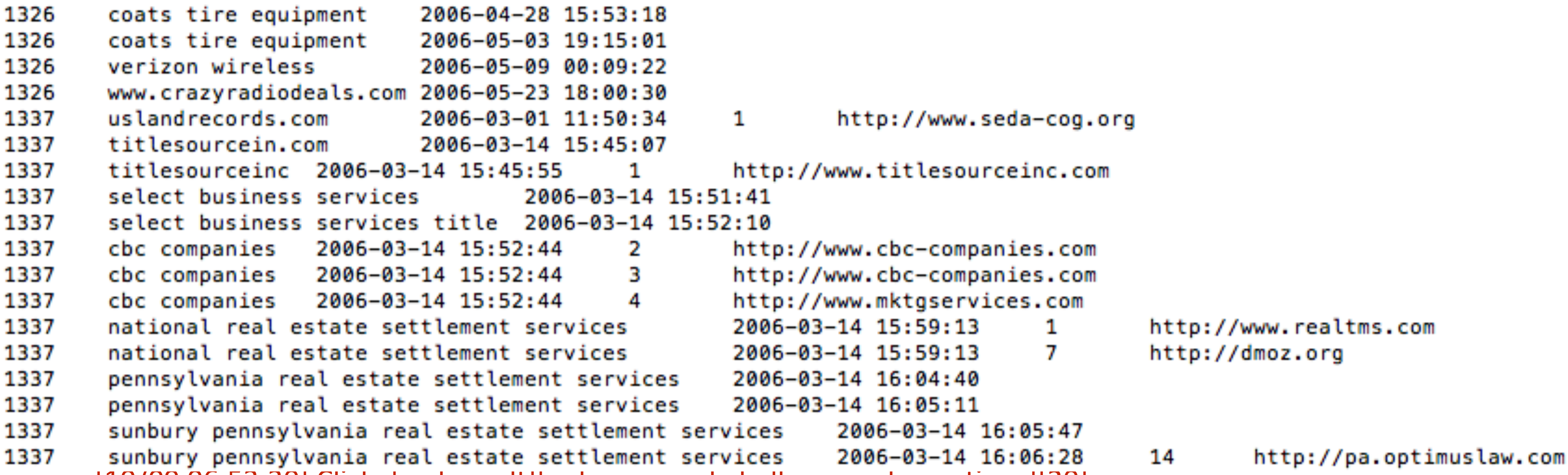
Query Modelling - Ingredients

- **Query log mining:** Usage of query logs and behavioral statistics while interacting with the search engines
- Query logs are not always available especially query logs for a long duration of time
- Information about new and emerging topics are unavailable even in query logs
- **Pseudo-relevance feedback:** Assuming top documents retrieved by the search engine to be relevant

Query Logs

- **Query log mining:** Usage of query logs and behavioral statistics while interacting with the search engines

- Example of query logs and usage logs :



```
1326    coats tire equipment    2006-04-28 15:53:18
1326    coats tire equipment    2006-05-03 19:15:01
1326    verizon wireless        2006-05-09 00:09:22
1326    www.crazyradiodeals.com 2006-05-23 18:00:30
1337    uslandrecords.com       2006-03-01 11:50:34     1       http://www.seda-cog.org
1337    titlesourcein.com       2006-03-14 15:45:07
1337    titlesourceinc  2006-03-14 15:45:55     1       http://www.titlesourceinc.com
1337    select business services        2006-03-14 15:51:41
1337    select business services title  2006-03-14 15:52:10
1337    cbc companies   2006-03-14 15:52:44     2       http://www.cbc-companies.com
1337    cbc companies   2006-03-14 15:52:44     3       http://www.cbc-companies.com
1337    cbc companies   2006-03-14 15:52:44     4       http://www.mktgservices.com
1337    national real estate settlement services        2006-03-14 15:59:13     1       http://www.realtms.com
1337    national real estate settlement services        2006-03-14 15:59:13     7       http://dmoz.org
1337    pennsylvania real estate settlement services    2006-03-14 16:04:40
1337    pennsylvania real estate settlement services    2006-03-14 16:05:11
1337    sunbury pennsylvania real estate settlement services    2006-03-14 16:05:47
1337    sunbury pennsylvania real estate settlement services    2006-03-14 16:06:28     14      http://pa.optimuslaw.com
```

[10/09 06:53:30] Click: [webresult][q=home made halloween decorations][20] http://www.halloween-magazine.com/

Query Auto-completions

- Candidate set generation for a given prefix p
- Candidates are ranked according to the *most popular completion* to the given prefix and top-k are presented as most promising
- A weight w(q) for each candidate **q** is estimated from the document collection of query log
- How are weights computed ?
    - Most popular query — based on query frequency or how many times has the query been issues

$$MPC(p) = arg \max_{q \in \mathcal{C}_p} w(q), \quad w(q) = \frac{f(q)}{\sum_{i \in \mathcal{Q}} f(i)}$$

Query Auto-completions

- Choose the top-k promising candidates

query frequency

$$MPC(p) = arg \max_{q \in \mathcal{C}_p} w(q), \quad w(q) = \frac{f(q)}{\sum_{i \in \mathcal{Q}} f(i)}$$

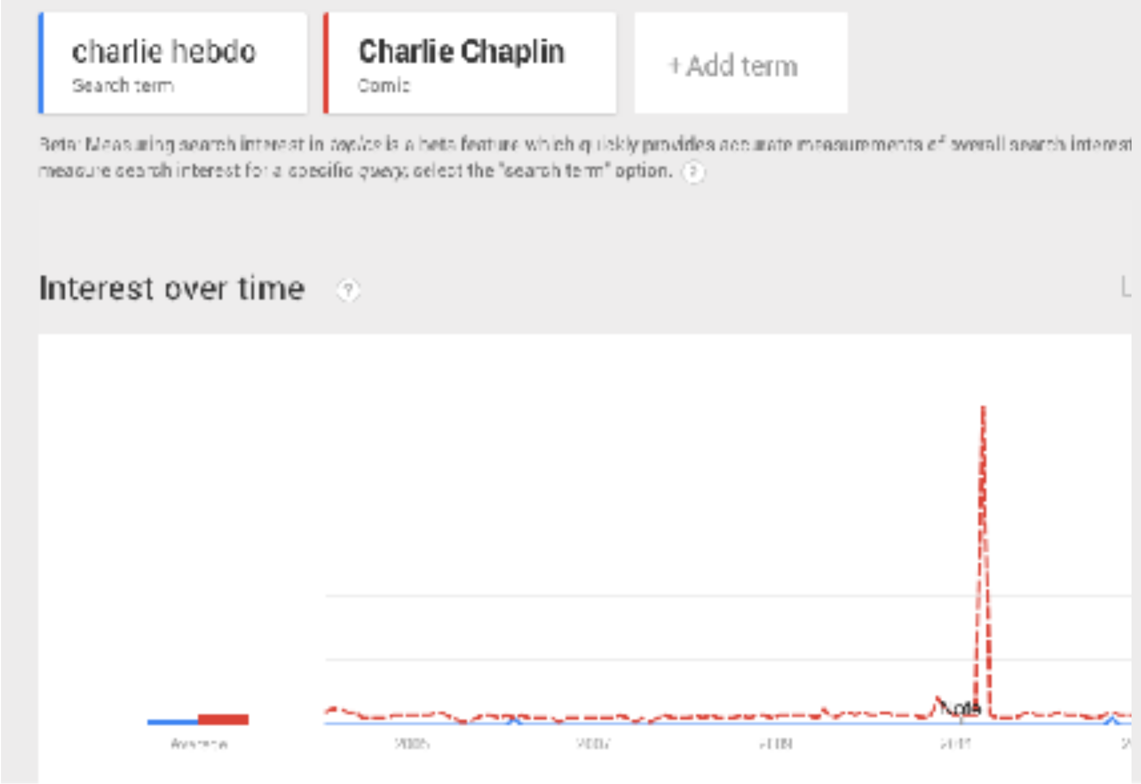
candidate weight

candidates for prefix p

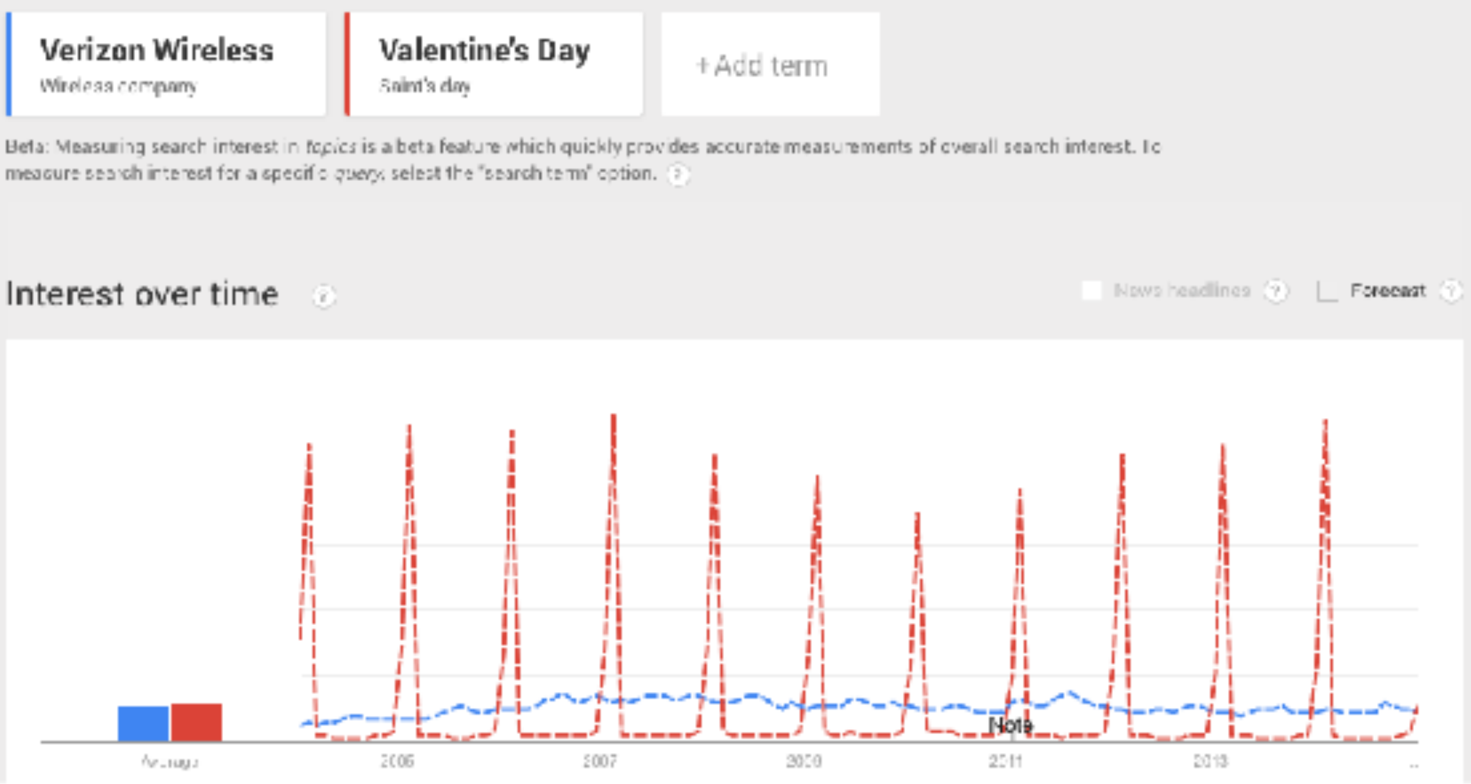
query log

What is missed in such kind of a modelling approach ?

Temporal Query Auto-completions



Beta: Measuring search interest in topics is a beta feature which quickly provides accurate measurements of overall search interest. To measure search interest for a specific query, select the "search term" option.



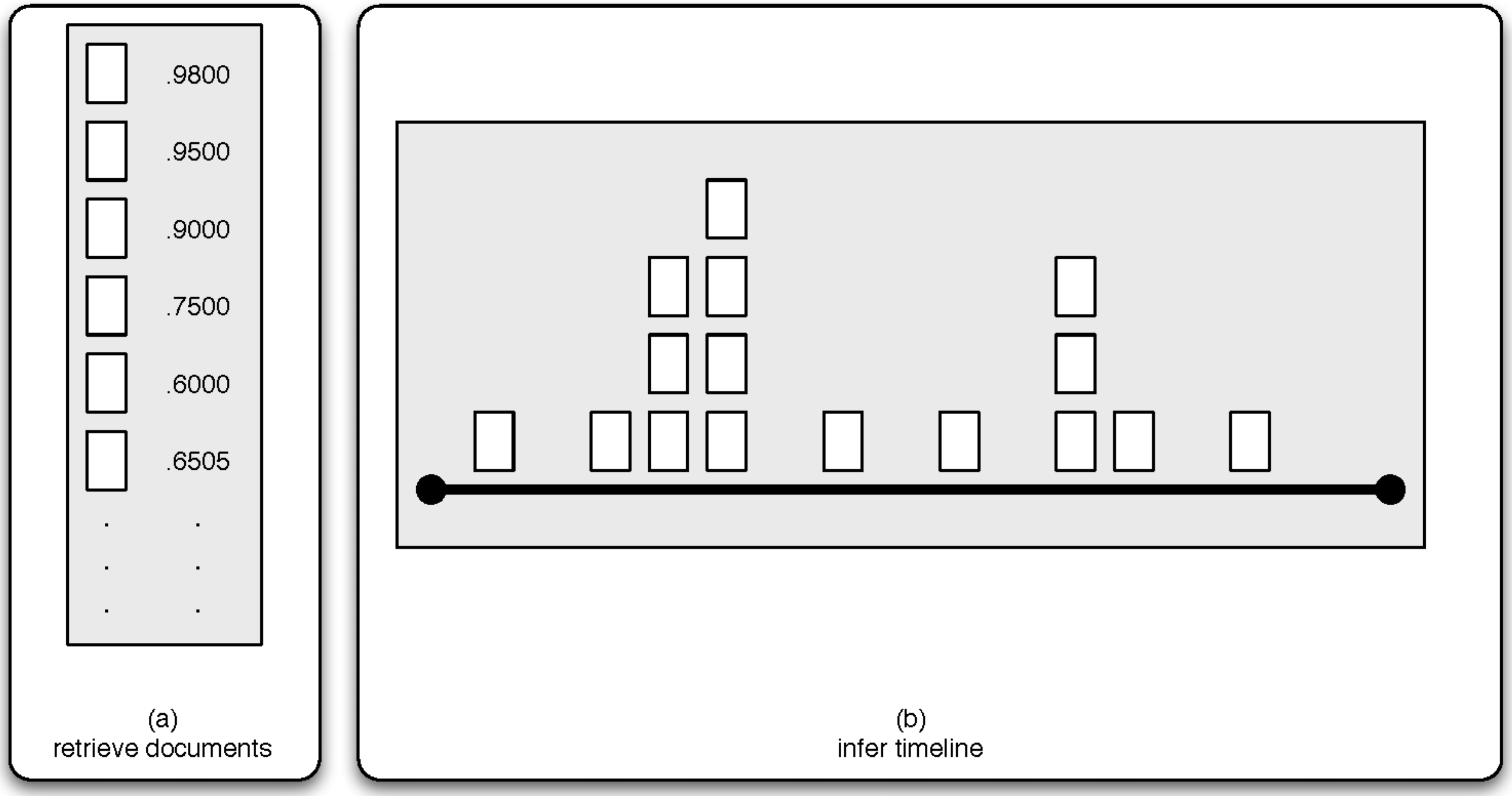
Beta: Measuring search interest in topics is a beta feature which quickly provides accurate measurements of overall search interest. To measure search interest for a specific query, select the "search term" option.

- Temporal aspect of popularity not taken into account
- Historically popular candidates might overpower recent trends
- Periodically popular queries might not be represented

Temporal Query Auto-completions

- Weights assigned to candidates should not only take into account absolute historical frequencies but also
  - Trends
  - periodicities
  - bursts
- Time series analysis techniques can be used to determine the forecast the popularity weight
  - Trends - double exponential smoothing
  - periodicities - triple exponential smoothing
  - burst - burst detection techniques

Pseuso-Relevance feedback

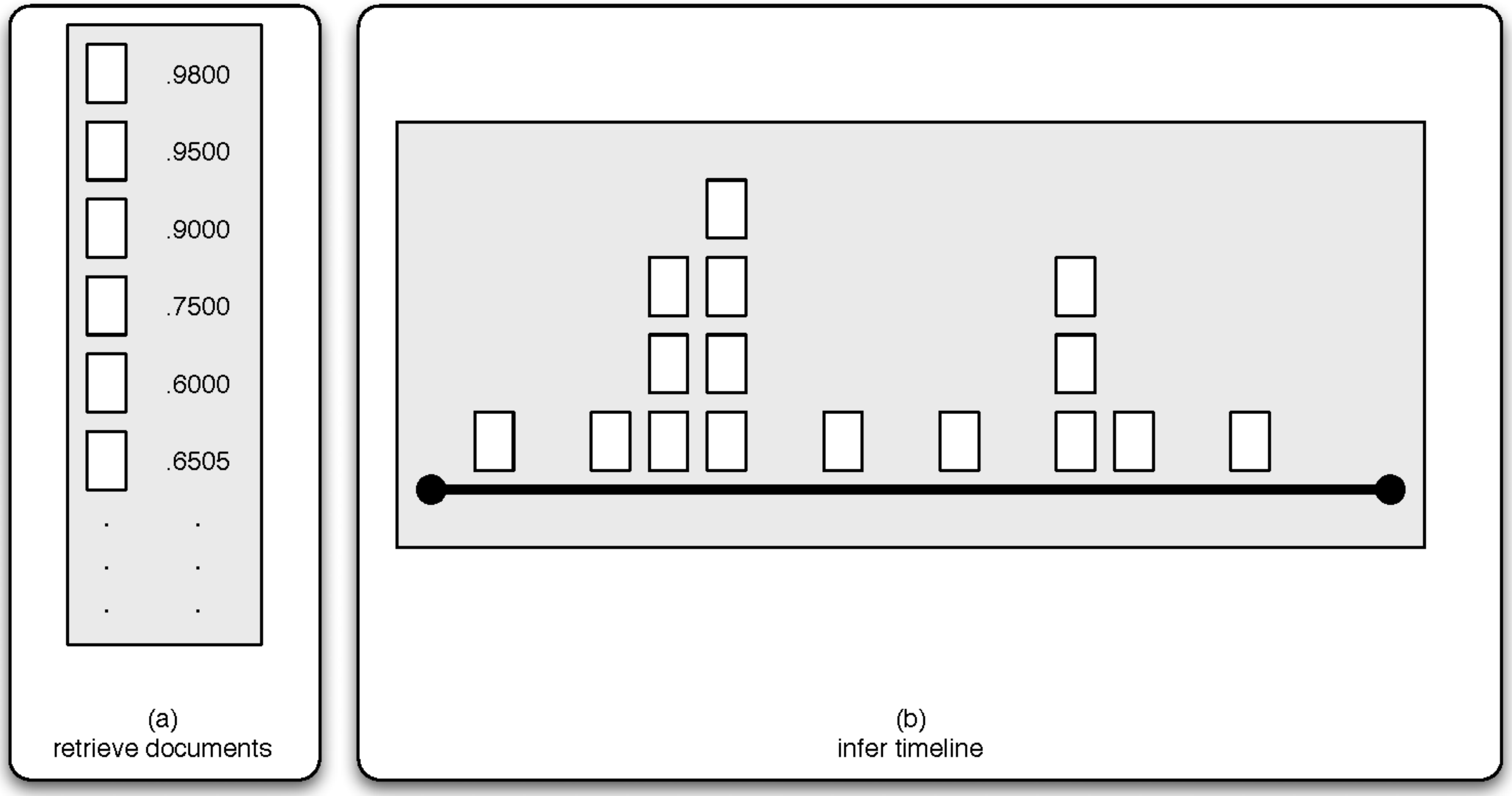


- Assume top-k documents to be relevant
- Use this set for query modelling or retrieval effectiveness

Temporal query profiles

- Temporal profiles are constructed to determine how temporally relevant queries
- Queries can be classified into
    - Atemporal
    - Temporally Ambiguous
    - Temporally unambiguous
- Model the period of time relevant to the query

Temporal query profiles

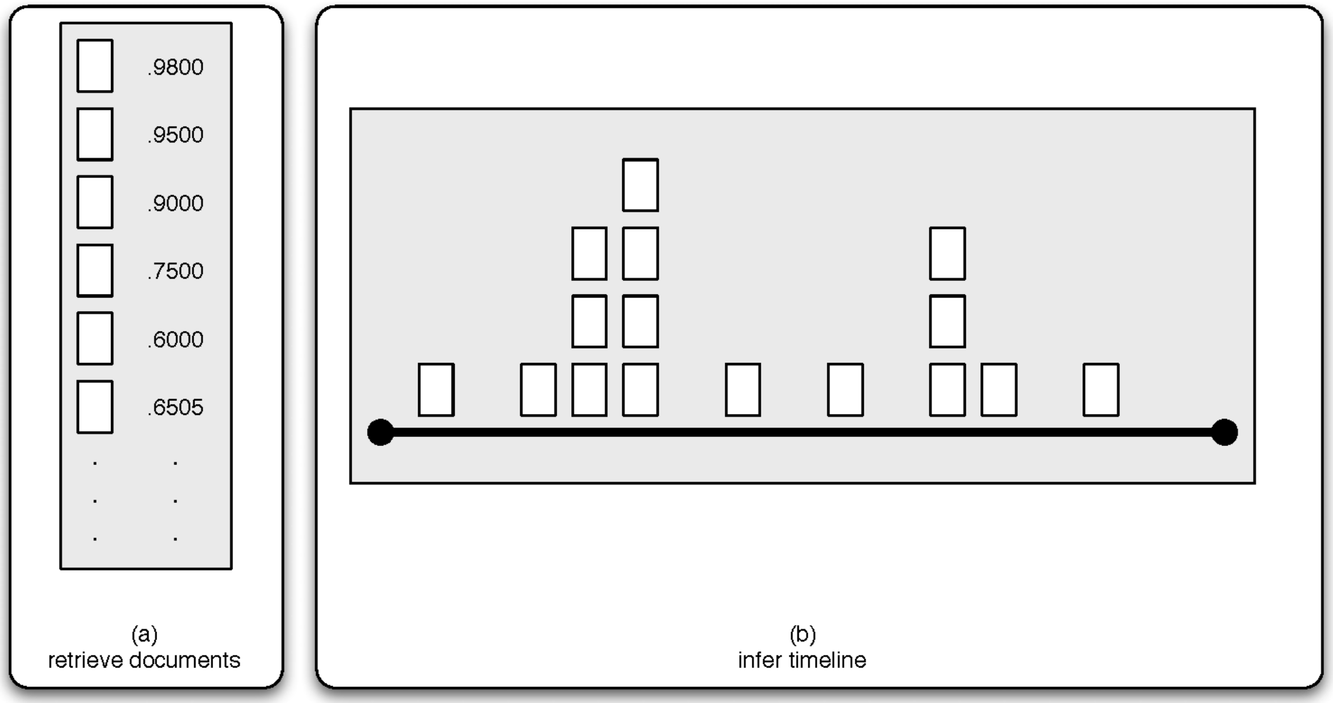


- For a given query rank the documents according to the standard retrieval models (say LM as discussed in the previous lectures)

- Each document has a score and a publication time

- Plot the time lines which will then be analysed to find the query classes

Estimating Time Series Values



(a) retrieve documents

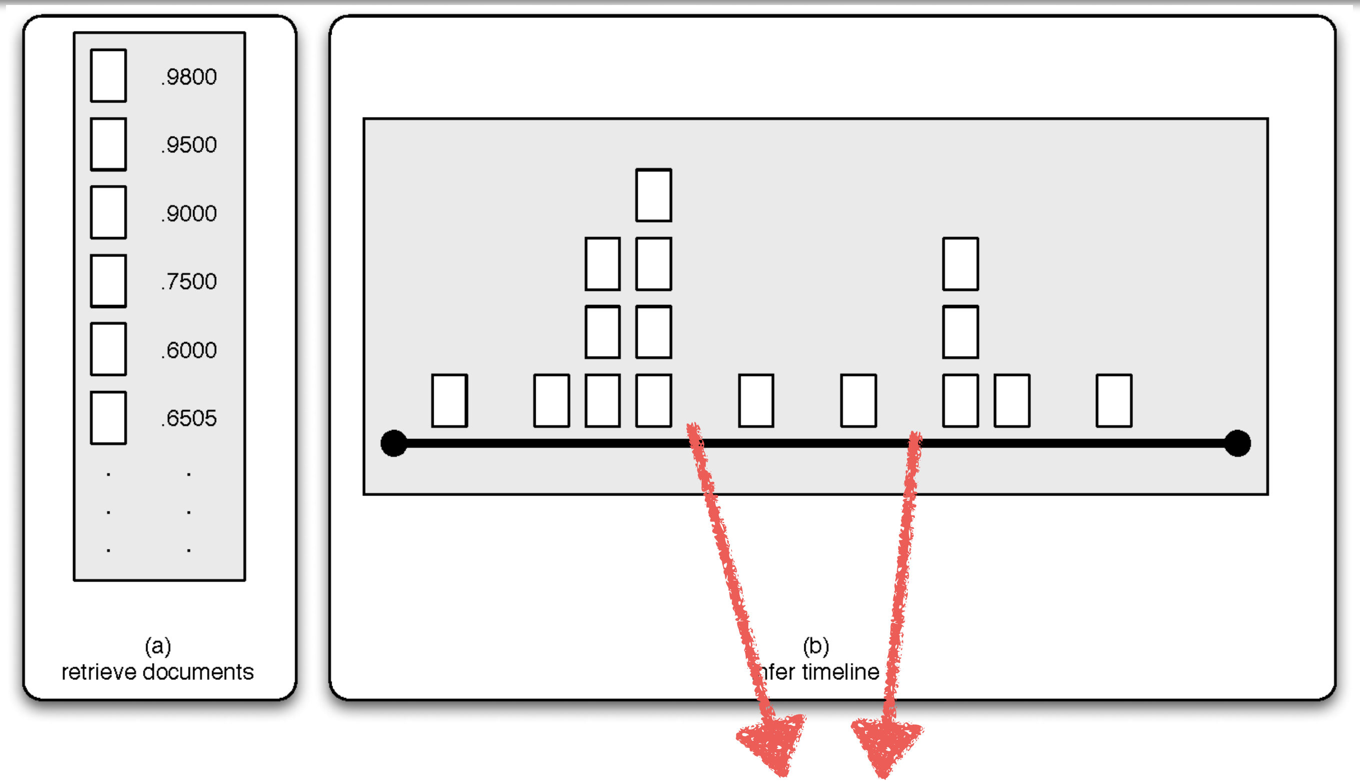
(b) infer timeline

$$P(t|Q) = \sum_{D \in R} P(t|D) \frac{P(Q|D)}{\sum_{D' \in R} P(Q|D')}$$

1 is doc. is published in t, 0 otherwise

- What would be the value at a given time point ?
  - count of documents published at that time point (contribution of each doc same, i.e., 1.0)
  - sum of the scores of the documents (relevance score)
  - Language modelling approach to establish P(t|Q)

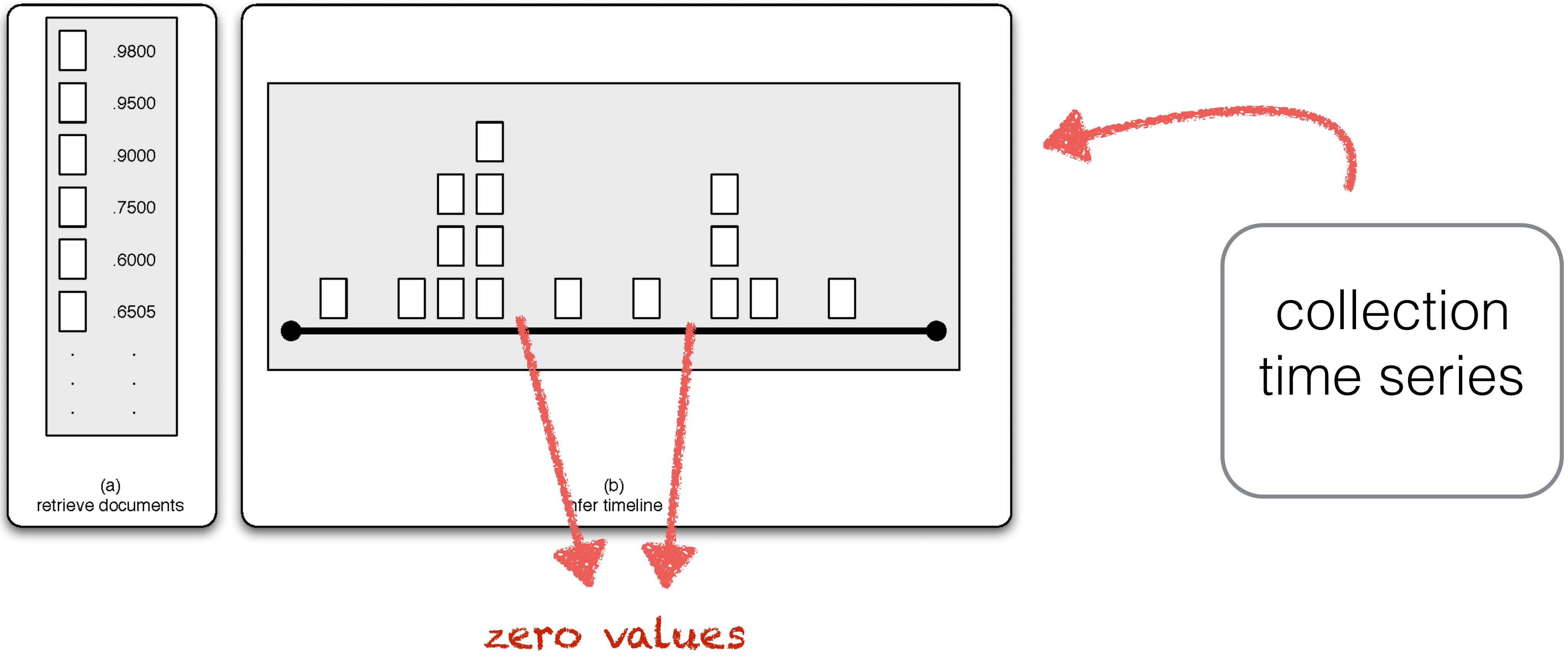
Smoothing the time series



zero values

- What about the time points with no documents published ?
  - Distribution of documents containing the query term irregular (vocabulary gap)
  - Neighbouring time points having high values increases the probability of have a non-zero value for a time point

Smoothing using Background Model



collection time series

zero values

- Smoothing using language model
  - Take the distribution of the entire collection P(t | C)
  - What is the concentration of documents in the underlying distribution at t

Smoothing using Background Model

smoothing parameter

$$P'(t|Q) = \lambda P(t|Q) + (1 - \lambda) P(t|c)$$

original score at t

collection score at t

$$P(t|Q) = \sum_{D \in R} P(t|D) \frac{P(Q|D)}{\sum_{D' \in R} P(Q|D')}$$

How do we incorporate information from neighbouring time points ?

- Use time series prediction methods like exponential smoothing

Features of Temporal Profiles

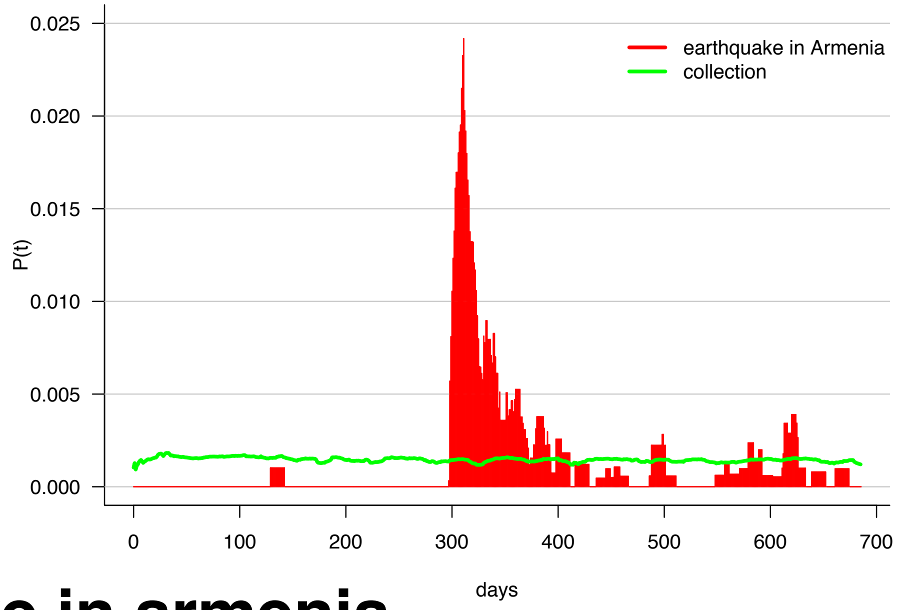
- How do we compare time series ?
- **Clarity** - Based on KL divergence between collection and query distribution
  - KL divergence is used to compare two distribution
  - The more the divergence the more clear the query is
- **Periodicity -** detect if the query time-series so obtained is periodic
  - Use auto-correlation or similar methods (discussed in lecture before)

Features of Temporal Profiles - II

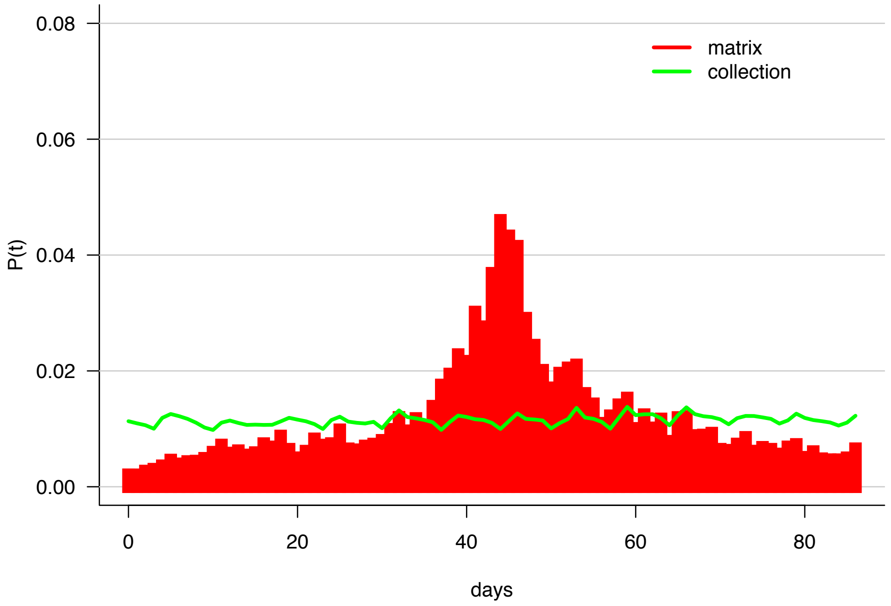
- **Statistics of Rank order**
  - How much of the power of the distribution contained in the peaks ?
  - To focus on peaks we use rank order of high peaks using the **Kurtosis** measure
- **Burst Model**
  - Identify the burstiness of a distribution using burst detection techniques
- Finally using these features classify the queries into the query classes

Temporal query profiles

Temporal Unambiguous Queries

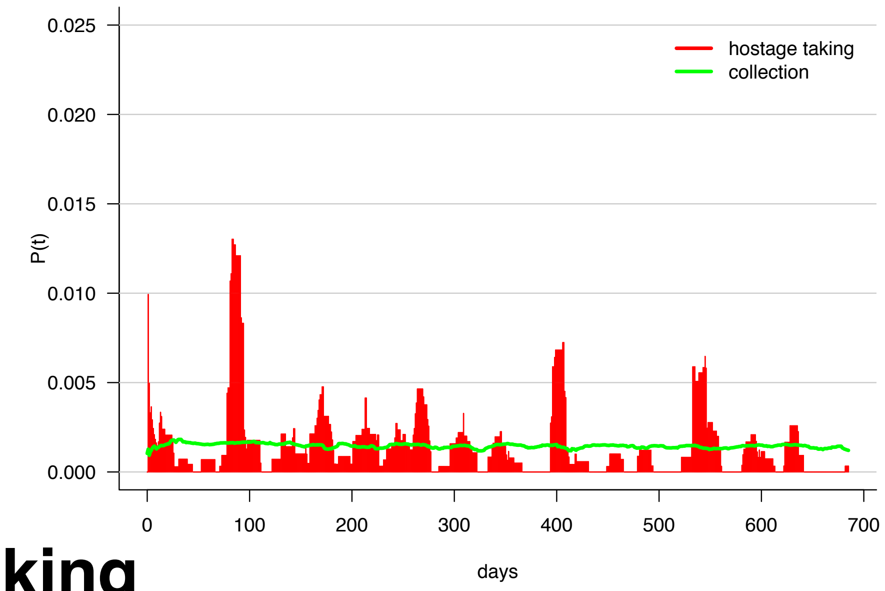


earthquake in armenia

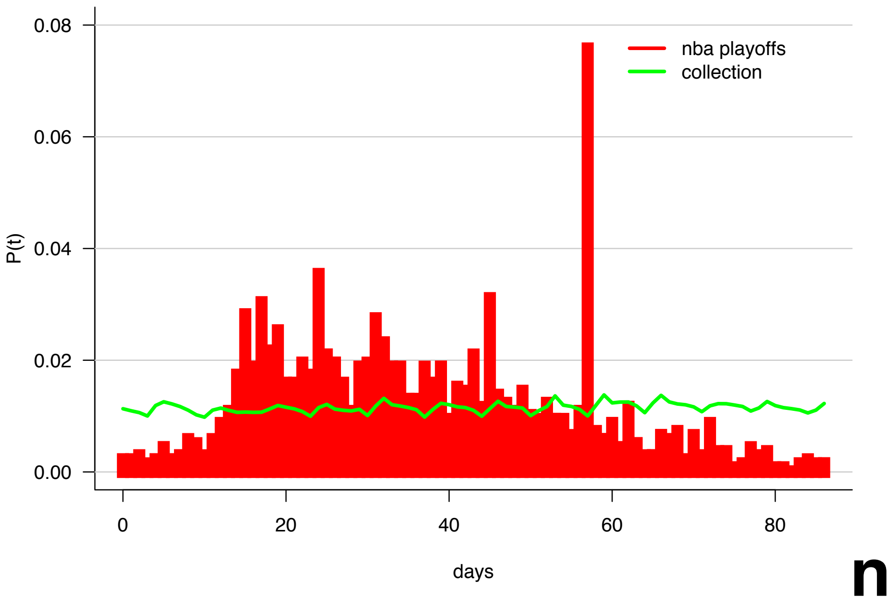


matrix

Temporal Ambiguous Queries



hostage taking



nba playoffs

References and Further Readings

- Jones, Rosie, and Fernando Diaz. “Temporal Profiles of Queries.” ACM Trans. Inf. Syst. 25, no. 3 (July 2007).
- Radinsky, Kira, Krysta M. Svore, Susan T. Dumais, Milad Shokouhi, Jaime Teevan, Alex Bocharov, and Eric Horvitz. “Behavioral Dynamics on the Web: Learning, Modeling, and Prediction.” ACM Trans. Inf. Syst. 31, no. 3 (August 2013)