Connect Them

——A news search engine

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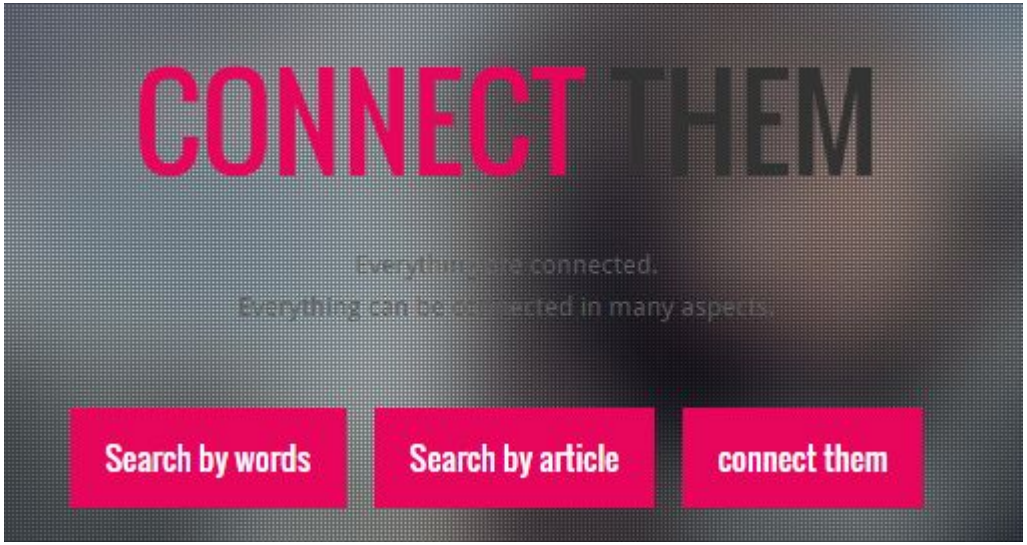
Functions

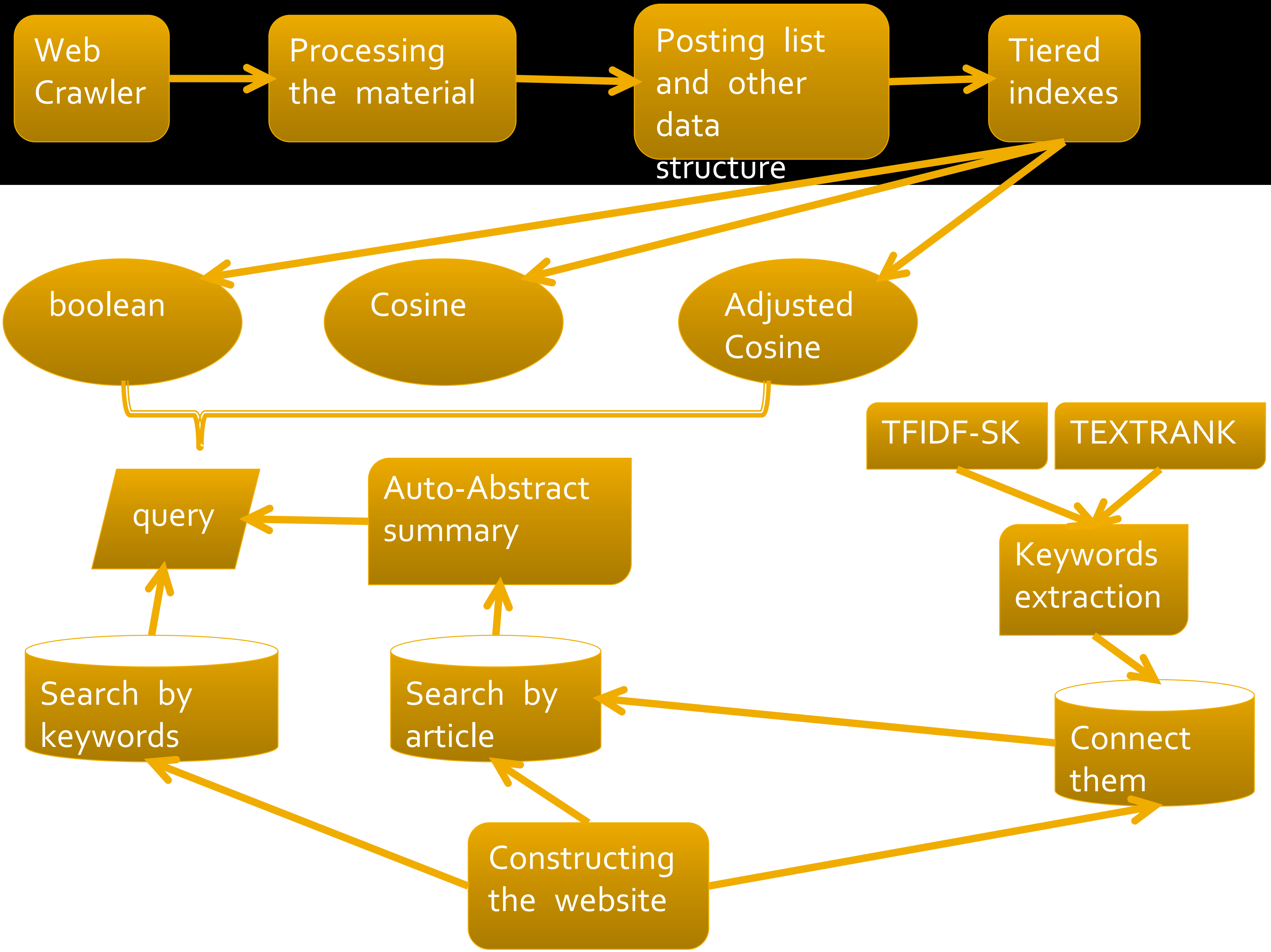
- ○ Search by words
- ○ Search by an article
- ○ Connect two different articles.



Everything are connected.
Everything can be connected in many aspects.

Design Philosophy

- Psychology
- Interdisciplinary
- Crossover
- Everything can be connected.
- Everything can be connected in many aspects.
- We can do more.



Web Crawler

Processing the material

Posting list and other data structure

Tiered indexes

boolean

Cosine

Adjusted Cosine

TFIDF-SK

TEXTRANK

query

Auto-Abstract summary

Keywords extraction

Search by keywords

Search by article

Connect them

Constructing the website

WEB CRAWLER

Crawl on the Guardian

- Queue, BFS
  - record the pages to crawl

- To continue crawling after stopping:
  - Save the queue and the list of the visited pages to the disk every time the crawler has stored 10 more articles.

- Regular Expression
  - Match the article pages

  -
    ```
    prog =
    re.compile("(http:\/\/)?www\.theguardian\.com\/(\w*?)
    \/\d{4}\/(\w*?)\/\d{2}\/.*”)
    ```

WEB CRAWLER

Crawl on the Guardian

- More details:
  - Encoding
    - Save the article: unicode -> utf-8   .encode(“utf-8”)
    - Reading the files: utf-8 ->unicode .decode(“utf-8”)
  - Try-Except mechanism
    - A necessity under the poor network condition
    - Avoid empty articles
  - Handle the url:
    - tag['href'] = urlparse.urljoin(url, tag['href'])
    - tag['href'] = tag['href'].split('#')[0]
    - nyprog.match(tag['href']) and tag['href'] not in page_visited
    - nyprog = re.compile("http\:\/\/www\.theguardian\.com.*”)

Basic search techniques

- Boolean
- Cosine
- Pivot normalized cosine

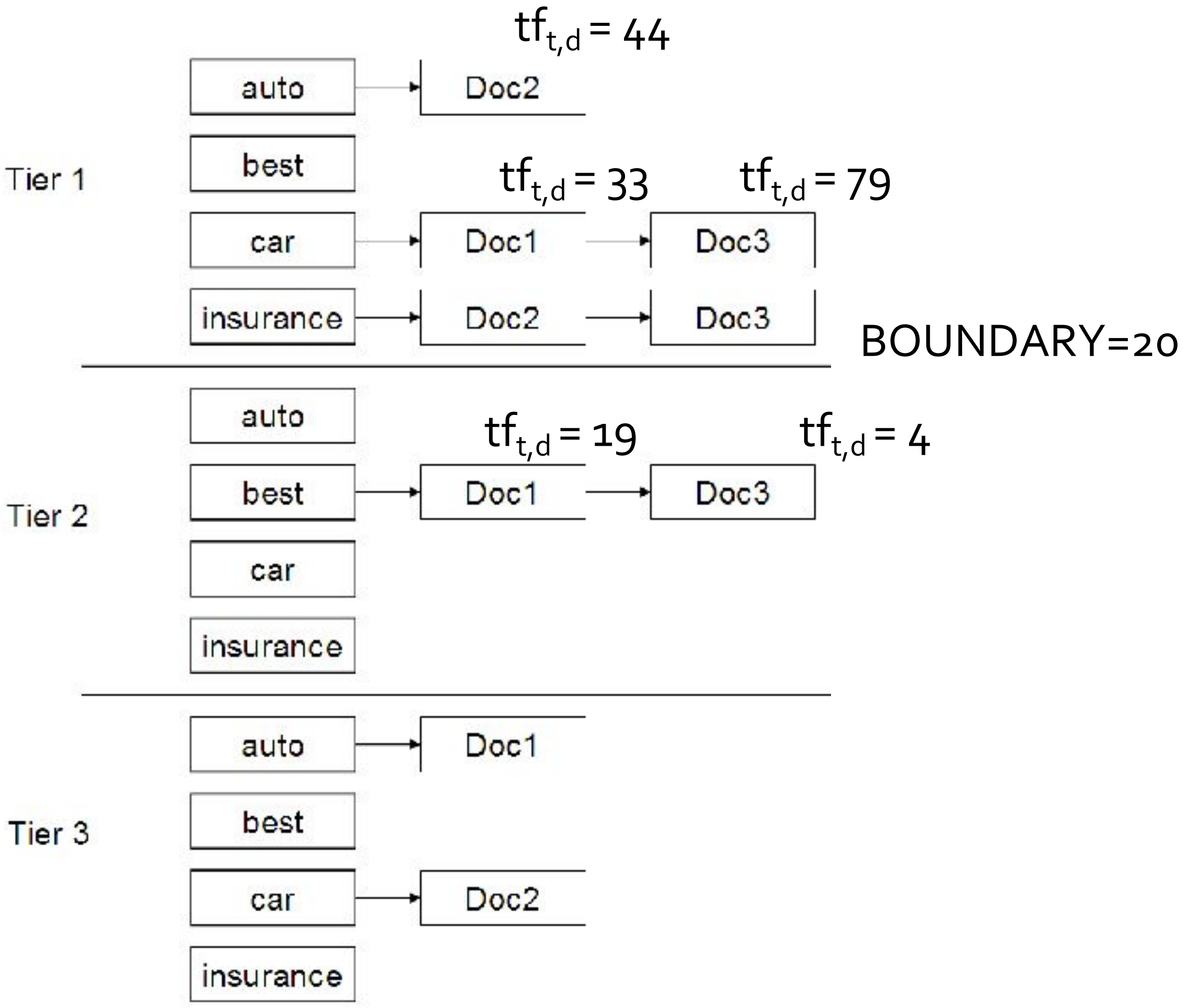
$$w_{ij} = \frac{\log(dtf)+1}{sumdtf} \times \frac{U}{1+0.0118U} \times \log\left(\frac{N-nf}{nf}\right)$$

- Levenshtein Distance

Tiered Indexes

- Pruning policy
  - Document pruning
  - extended keyword-specific document pruning based on tf
  - If $tf_{t,d}$ > BOUNDERY, Add the DocId to the term's 1st posting list
  - K
- A bold try
  - When making the posting list(only record frequency)
  - Title * 4, Description and 1st paragraph * 2
  - $tf_{t,d}$ is higher
  - Documents may have a better chance to appear in their title's 1st tier posting list

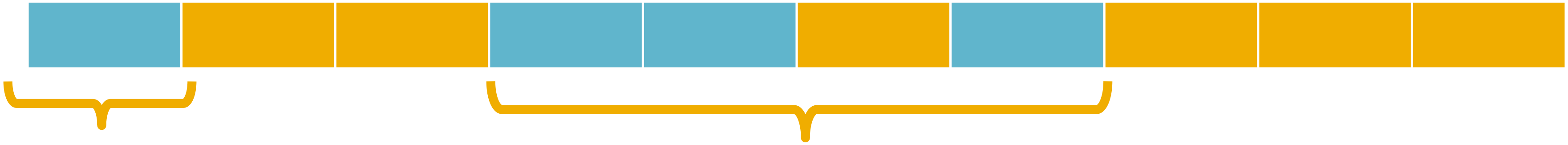
Tiered Indexes



Luhn’s Auto-Abstract Algorithm

- Score the sentences
  - Use the selected sentences to generate the summary
- Cluster
  - If important words are clustered in a sentence. The sentence will get a higher score.

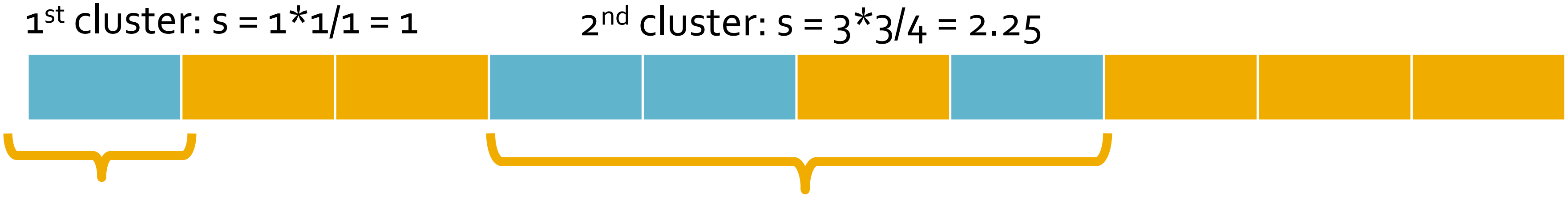
Luhn’s Auto-Abstract Algorithm



- Blue indicates important words

- Important words: top n frequent words in the whole article
    - nltk.probability.FreqDist or made by hand
- Cluster
    - CLUSTER_THRESHOLD = 3 (4 or 5 is suggested)
    - `if word_idx[i] - word_idx[i - 1] < CLUSTER_THRESOHLD:`
    - `    cluster.append(word_idx[i])`

Luhn’s Auto-Abstract Algorithm



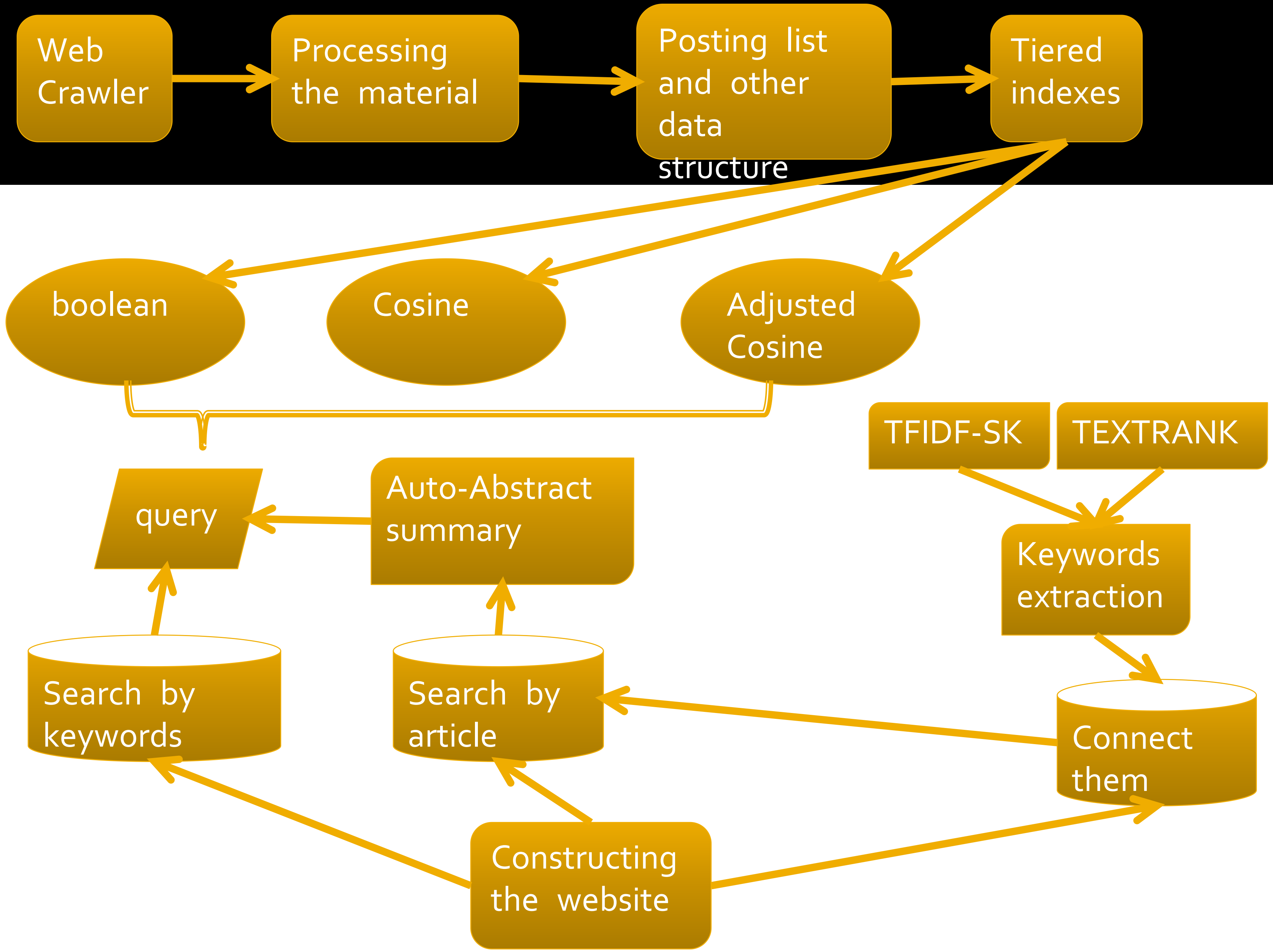
1st cluster: s = 1*1/1 = 1

2nd cluster: s = 3*3/4 = 2.25

- How to score each sentence?
  - Score the cluster first
  - The score of a cluster = $\dfrac{\text{total of significant words in a cluster}^2}{\text{total words in a cluster}}$
  - The score of a sentence = the maximum score among its clusters’ score
- Sentence score = 2.25

Luhn’s Auto-Abstract Algorithm

- How to select the scored sentences?
  - Approach1: Simply select top N sentences with highest scores
    - You can define the length of the summary
  - Approach2: Statistic threshold
    - if score > avg + 0.5 * std (numpy)
      - Avg: average score; Std: standard variance
    - If the score of the sentences are very close to each other, approach2 is better.



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Key Words Extraction - TFIDF–SK

- Base: TF-IDF Algorithm
- Problem
- We can make some improvement.

Key Words Extraction - TFIDF–SK

- Pos_{ij}: Weight of W_i appearing in the document D_i in the first time.
- $$Pos_{ij} = \begin{cases} 1 & title\ or\ summary \\ 0.6 & first\ or\ last\ paragraph \\ 0.2 & others \end{cases}$$

Key Words Extraction

- Noise term: terms which have little connection with the theme
- High tf and high df
- Coefficient of dispersion (CV)
- $CV_i = \frac{SD_i(TFDf_{ij})}{AVE_i(TFDf_{ij})}$
- SD: Standard deviation
- AVE: Average
- Lower CV means higher possibility of noise term

Key Words Extraction

- Term co-occurrence possibility
- If two terms appear in one sentence, there term co-occurrence add 1.
- Eg:

	A	B	C	D	E	Sum
A	-	30	26	19	18	93
B	30	-	5	50	6	154
C	26	5	-	4	23	93
D	19	50	4	-	3	89
E	18	6	23	3	-	89

- $\{x_{a1}, x_{a2}, x_{a3}, x_{a4}\}$ = {30/93,26/93,19/93,18/93}

Key Words Extraction - TFIDF–SK

- Measure of skewness
- To measure the asymmetric degree in statistical data.
- $SK_i = \frac{(N-1)\sum_j(x_{ij}-\text{avg}(x_i))^3}{(N-2)(N-3)SD_i{}^3}$ (N>=4)
- x_{ij}: term co –occurrence possibility of i,j

Key Words Extraction - TFIDF–SK

- Importance measuring function:
- TFIDF-SK$_i$= $\alpha\sum_j (Pos_{ij} * TFIDF_{ij}) + \beta\, SK_i$
- α,β are modifiable parameters

Key Words Extraction-Textrank

- Pagerank:

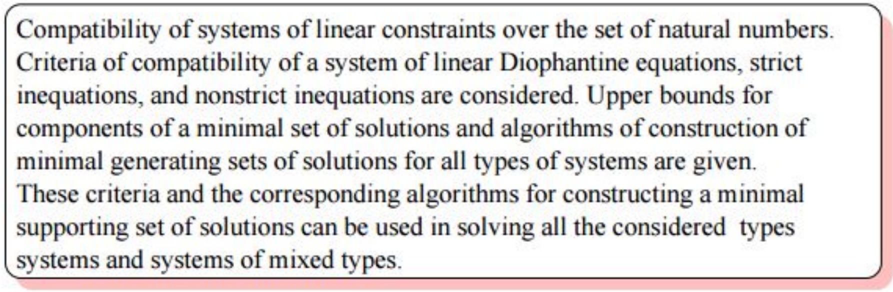
$$S(V_i) = (1 - d) + d * \sum_{j \in In(V_i)} \frac{1}{|Out(V_j)|} S(V_j)$$

- d is a daming factor that can be set between 0 and 1, which is usually 0.85.

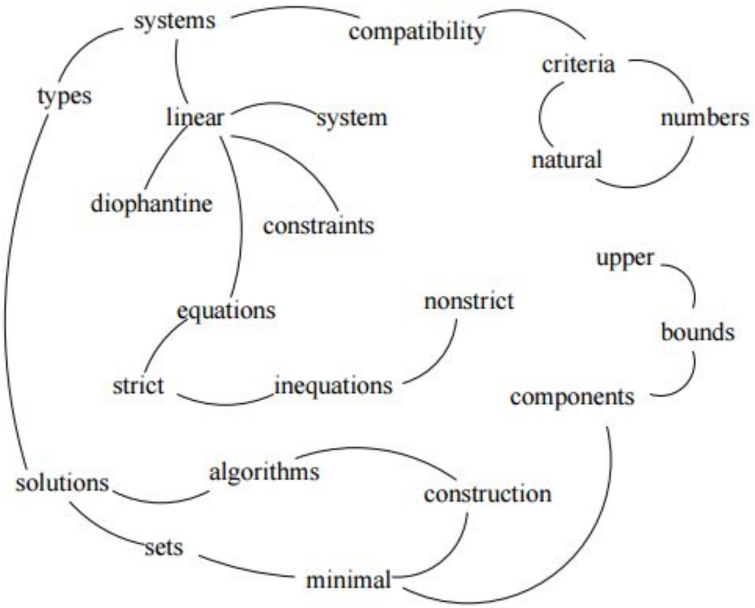
Key Words Extraction -Textrank

- Text rank:
- For every sentence, we can connect the words using the parameter window k:
- Sentence: w1,w2,w3,w4,w5,...,wn
- {w1,w2,...,wk}, {w2,w3,...,wk+1}, {w3,w4,w5,...,k+2} are all a window, two terms in a window can be connected in the graph.

Key Words Extraction -Textrank



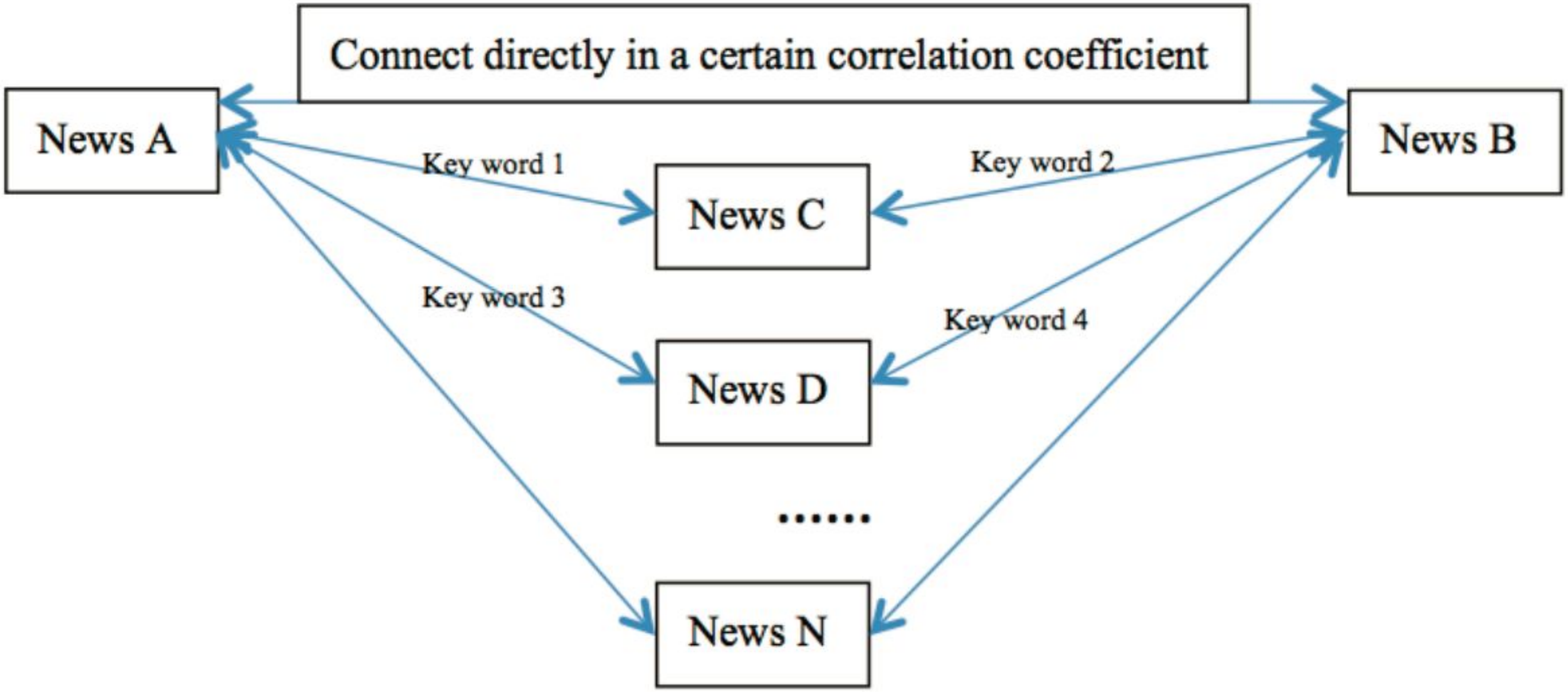
Compatibility of systems of linear constraints over the set of natural numbers. Criteria of compatibility of a system of linear Diophantine equations, strict inequations, and nonstrict inequations are considered. Upper bounds for components of a minimal set of solutions and algorithms of construction of minimal generating sets of solutions for all types of systems are given. These criteria and the corresponding algorithms for constructing a minimal supporting set of solutions can be used in solving all the considered types systems and systems of mixed types.



Key Words Extraction -Final

- $Importance_{\,i}$ =TFIDF–SK$_i{}^{\lambda}$ * S$(V_i)^{u}$
  TFIDF–SK$_i$= α$\sum_j(Pos_{ij}$* $TFIDF_{ij}$) + β SK_i
- $S(V_i) = (1 - d) + d * \sum_{j \in In(V_i)} \frac{1}{|Out(V_j)|} S(V_j)$

Connect them



Connect them

- Connect directly coefficient:
- $importance_i$ in news A * $importance_i$ in news B
- Connect indirectly coefficient:
- $importance_i$ in news A * $importance_i$ in news C * $importance_j$ in news B * $importance_j$ in news C

Expectation

- Better stemming
- Phrase process
- Speed
- LSI LDA
- Testing and adjusting the coefficients
- Search in other aspects

Reference

- The Significance of Normalization Factor of Documents to Enhance the Quality of Search in Information Retrieval Systems. Hossein sadr, Reza Ebrahimi Atani, MohammadReza Yamaghani
- The Automatic Creation of Literature Abstracts, H.P. Luhn
- on the statistical features-based information keyword extraction method in the era of big data, Luo Fanming