An Incremental Summary Generation System

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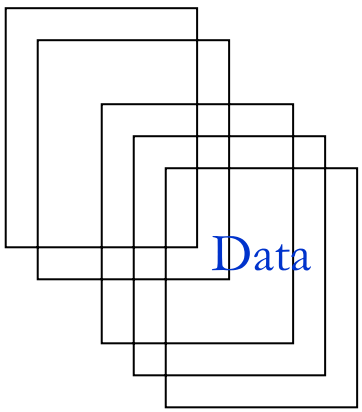
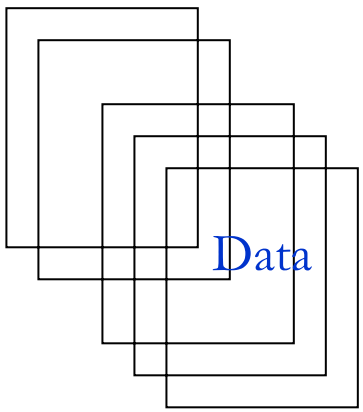
Outline

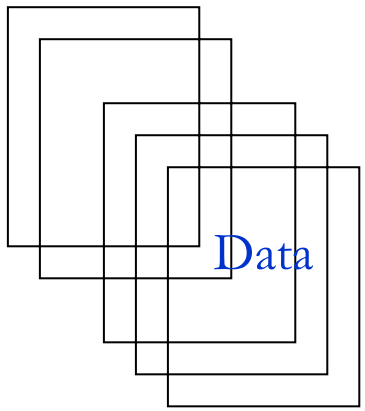
- Motivation
- Introduction
- Background
- Incremental Summary generation
- Conclusions

Motivation

- What is Information Overload Problem ?







Huge number of documents on a topic

Web | Images | Video | Local | Shopping | more

water on mars | Search | Options | Customize | YAHOO

1 - 10 of 58,900,000 for **water on mars** (About) - 0.05 s | Search

Also try: **water on mars** evidence, is there **water on mars**, More...

NASA Spacecraft Confirms Martian **Water**, Mission Extended
NASA mission news: Laboratory tests aboard NASA's Phoenix **Mars** Lander have identified **water** in a soil sample.
www.**nasa.gov**/mission_pages/phoenix/news/phoenix-20080731.html - Cached

[PDF] Is There **Water on Mars**
4720k - Adobe PDF - View as html
NASA Educator Guide explores the question of whether there is **water on Mars**.
www.**nasa.gov**/pdf/58223main_Is.There.**Water.on.Mars**.pdf

Water Ice **on Mars** Confirmed - SPACE.com
SPACE.com article about the Phoenix **Mars** Lander's confirmation of the existence of **water** ice **on Mars**.
www.**space.com**/missionlaunches/080731-phoenix-update.html - 68k - Cached

Water On Mars - News Results
Water-tanker seaplane takes residence **on** Lake Elsinore for firefighting season
The Press-Enterprise - Oct 10 12:07am
The Martin **Mars** firefighting seaplane should be back at Lake Elsinore by this weekend.
Yahoo! Shortcut - About

SPACE.com -- NASA announces discovery of evidence of **water on Mars**
Series of SPACE.com articles relating to NASA's announcement of discovering evidence of **water on Mars**.

IITM

Motivation

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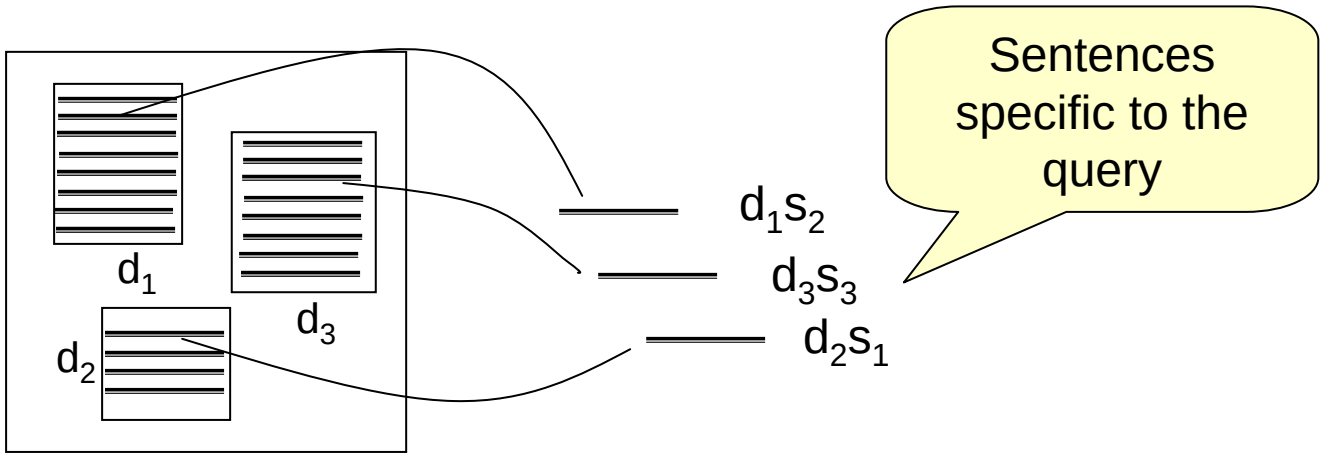
Motivation

- Should user go through all the documents to satisfy her information need?
- Why not Query Specific Text Summarization ?
- Issues in Text Summarization
  - ❖ Scalability
  - ❖ Logical flow between sentences
  - ❖ Redundancy
  - ❖ Responsiveness etc.

Introduction

- Document collection is represented as a graph
- Each node in the graph is a sentence in a document
- Edge is placed between two sentences if the similarity value is above a threshold
- Most of the multi-document summarizers follow the above Integrated graph approach

Extractive Query Specific Multi-document Summarization Process



Background

Genres of Summaries

- Abstractive *vs.* Extractive
- Generic *vs.* Query Specific
- Indicative *vs.* Informative
- Single document *vs.* Multiple document

MEAD

- MEAD is a initially developed for multi-document generic extractive summarization.
- Each sentence is given scores based on these measures:
  - ❖ Similarity with centroid of the documents.
  - ❖ Position of the sentence within the document.
  - ❖ Similarity with the first sentence of the document.
  - ❖ Penalty value similar to MMR.
- Top scored sentences are given as summary.

[Radev et. al. IPM 2004]

Overview of our past works

- QueSTS [C R Chowdary et. al. FLAIRS 2008]
  - ❖ Integrated Graph (IG) is constructed
  - ❖ Summary is generated on IG
  - ❖ Complexity is huge
  - ❖ Time taken = *29 minute/cluster*
- Sentence ordering [C R Chowdary et. al. BNCOD 2008]
  - ❖ Sentence ordering within the summary is addressed
- ESUM [C R Chowdary et. al. ECIR 2009]
  - ❖ Efficient summarization using distributive approach

Incremental Summary Generation

- What is Incremental Summary?
  - Updating the current summary
- Why do we need it?
  - Saves time
  - Essential if the original set of documents are not accessible
- How to do it?
  - Sentence replacement method

Sentence Replacement Method

- Task
  - Given - the current summary and the query
  - Update current summary on the arrival of a new document
- Constraint
  - Size of summary is fixed
- Method Outline
  - Identify a sentence in the new document
    - more informative than a sentence in current summary
  - Exchange them
  - Repeat till convergence

Sentence Replacement Method

- How to identify the pair of sentences
  - ❖ Calculate the score of summary
  - ❖ Identify prominent nodes in the new document
    - ➢ with respect to the query
  - ❖ Temporarily replace a node in the current summary with a prominent node from new document
    - ➢ calculate the score of the resulting summary
  - ❖ Find the pair of nodes
    - ➢ That maximizes the score of the resulting summary
  - ❖ Replace or swap the sentences

Sentence Replacement Method

- How to compute the score of a summary ?
  - Based on following properties
    - Information biased towards the query
    - Non-Redundant information

Sentence Replacement Method

- Completeness
  - ❖ Presence of all query terms
- Non-Redundancy
  - ❖ Non repetition of information
- How to measure these ?
  - ❖ Node score
  - ❖ Contribution score
  - ❖ Completeness score

Node Score

- Node score captures
  - ❖ Salience of a sentence w.r.t query terms
- $w_q(s)$ is the score of a node *s* w.r.t query term *q*

$$w_q(s) = d\frac{sim(s,q)}{\sum_{m\in N} sim(m,q)} + (1-d)\sum_{v\in adj(s)} \frac{sim(s,v)}{\sum_{u\in adj(v)} sim(u,v)} w_q(v)$$

- *sim(x,y)* : similarity between *x* and *y*
  - ❖ *x* and *y* are term vectors

Summary Score

- Node Score
  - $w_Q(s) = \sum_{q \in Q} w_q(s)$ where *Q* is the query, *s* is a sentence
- Contribution score
  - captures the contribution of individual sentences in the summary S
  - $CCS(S) = \sum_i (1 - sim(n_i, N_i))$ where $N_i = S - \{n_i\}$
- Completeness score
  - *count(S,Q) = No. of query terms in the query − No. of query terms not present in the summary*
- Summary score – linear combination of above

Sentence Replacement Method

- Choose the best pair
  - ❖ One sentence from summary and another from document that maximizes the score of the summary
  - ❖ Swap the sentences
- Repeat till the best summary is formed
  - ❖ No more improvement in the summary score

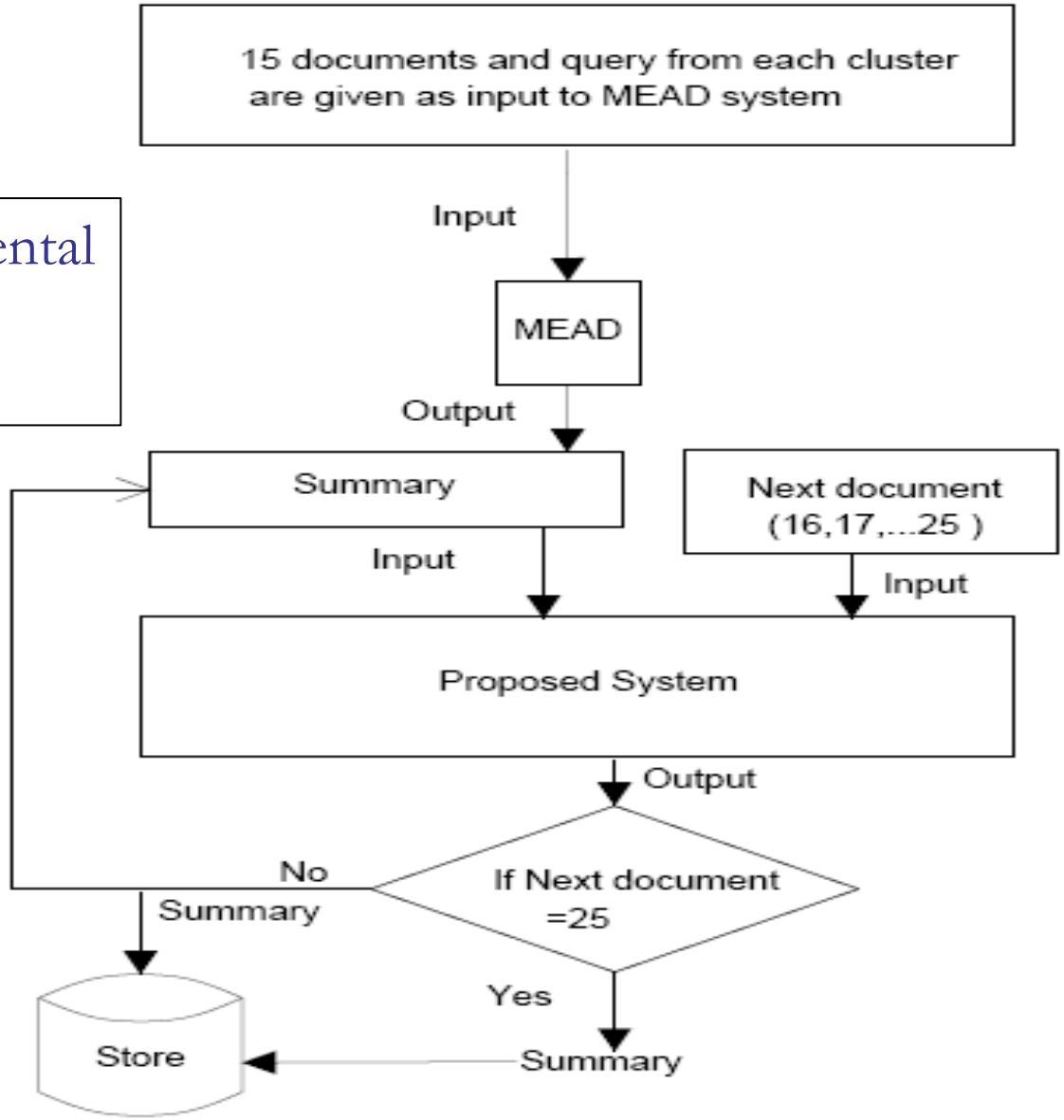
Contribution Score Revisited

Previous : $CCS(S) = \sum_i (1\text{-}sim(n_i,N_i))$

Current: $CCS(S) = \sum_i (1\text{-}MAX_j(sim(n_i,n_j)))$

- Summary score is linear combination of
  - Node score, contribution score and completeness

Experimental Setup



ROUGE values (original CCS)

Updated Summary	ROUGE-1	ROUGE-2	ROUGE-W	ROUGE-SU4
1	0.36993	0.06744	0.08842	0.12246
2	0.36130	0.06260	0.08500	0.11675
3	0.35948	0.05986	0.08440	0.11431
4	0.35694	0.05854	0.08343	0.11334
5	0.35175	0.05627	0.08226	0.11065
6	0.34763	0.05405	0.08079	0.10803
7	0.34420	0.05341	0.08017	0.10698
8	0.34402	0.05195	0.08009	0.10652
9	0.34676	0.05361	0.08118	0.10859
10	0.34545	0.05171	0.08031	0.10694

ROUGE values of best system of DUC 2006

Updated Summary	ROUGE-1	ROUGE-2	ROUGE-W	ROUGE-SU4
System24	0.41108	0.09558	0.11068	0.15529

Note: These values are on the whole cluster.

ROUGE values (modified CCS)

Updated Summary	ROUGE-1	ROUGE-2	ROUGE-W	ROUGE-SU4
1	0.38661	0.08077	0.09380	0.13631
2	0.38581	0.08033	0.09336	0.13566
3	0.38739	0.08159	0.09410	0.13664
4	0.38662	0.08124	0.09382	0.13641
5	0.38685	0.08180	0.09397	0.13667
6	0.38559	0.08079	0.09364	0.13591
7	0.38622	0.08067	0.09371	0.13592
8	0.38559	0.08024	0.09360	0.13560
9	0.38510	0.07997	0.09356	0.13524
10	0.38523	0.07959	0.09347	0.13516

Conclusions

- Incremental summary generation system was proposed
  - Sentence replacement
- Score was given to summary based on
  - Responsiveness
  - Informativeness
  - Non-Redundancy
- Experimental results show that our approach is effective
  - Time taken 3.6 minute/summary

Sentence Replacement Method

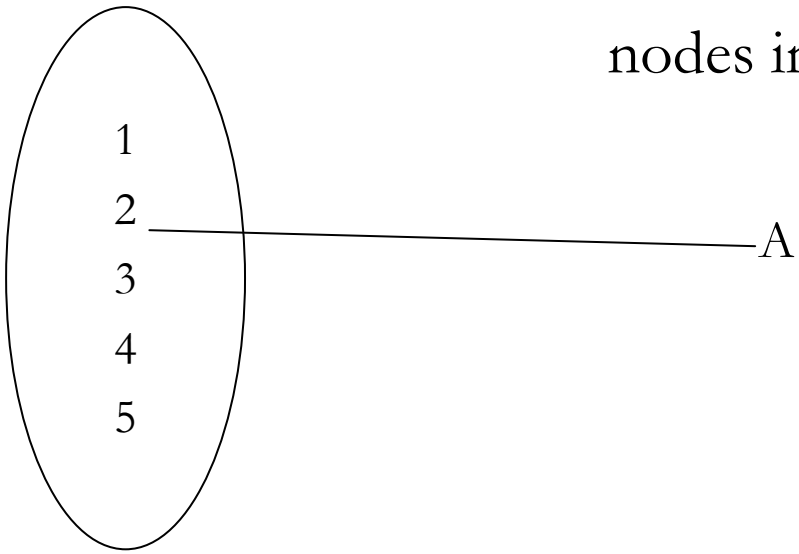
- What is the problem with this method ?
  - TIME
    - 3.6 minute/summary
- How to generate incremental summary generation *efficient ?*
  - USUM
    - 7 second/summary!!

Thank You

Backup

- Insertion Strategy

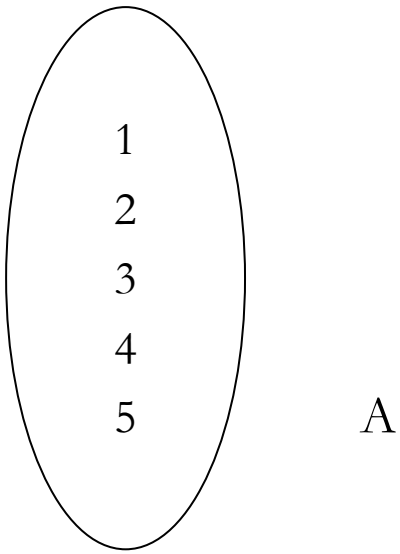
Find similarity will all nodes in summary



Summary

Backup

- Insertion Strategy



Summary

If A is having highest similarity with 3

Then find similarity with 2 and 4

Insert A in between 2 and 3 if similarity with 2 is greater than similarity 4