Admin?

Brin, 1998 Experiments

<table>
<thead>
<tr>
<th></th>
<th>1st Iteration</th>
<th>2nd Iteration</th>
<th>3rd Iteration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unique pairs</td>
<td>5</td>
<td><strong>4045</strong></td>
<td>9127</td>
</tr>
<tr>
<td>Patterns</td>
<td>199</td>
<td><strong>3097</strong></td>
<td>9938</td>
</tr>
<tr>
<td>Result pairs</td>
<td><strong>4645</strong></td>
<td>9127</td>
<td>15257</td>
</tr>
</tbody>
</table>

Were only able to extract from a subset of the repository.
Information retrieval

query

pomona college
computer science

CORPUS

ranked documents

Question answering

question

where is pomona college located?

resources

answer

Mars Polar Lander- Where Are You?

(January 18, 2000) After more than a month of searching for a single sign from
NASA's Mars Polar Lander, mission controllers have lost hope of finding it. The Mars
Polar Lander was on a mission to Mars to study its atmosphere and search for
water, something that could help scientists determine whether life even existed on
Mars. Polar Lander was to have touched down on December 3 for a 90-day
mission. It was to land near Mars' south pole. The lander was last heard from
minutes before beginning its descent. The last effort to communicate with the three-
legged lander ended with frustration at 8 a.m. Monday. “We didn’t see anything,”
said Richard Cook, the spacecraft's project manager at NASA’s Jet Propulsion
Laboratory. The failed mission to the Red Planet cost the American government
more than $200 million dollars. Now, space agency scientists and engineers will try
to find out what could have gone wrong. They do not want to make the same
mistakes in the next mission.

Sample questions:

- What is the Polar Lander's project manager?
- Where on Mars was the spacecraft supposed to touch down?
- How much folic acid should an expectant mother get daily?
- Who invented the paper clip?
- What university was Woodrow Wilson president of?
- What is Rider College located?
- Name a film in which Jude Law acted.
- Where do lobsters like to live?
- Name a film in which Jude Law acted.
- What is Rider College located?
- Where do lobsters like to live?
- How much folic acid should an expectant mother get daily?
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- When did the mission controllers lose hope of communication with the Lander?
  (Answer: 8AM, Monday Jan. 17)

- Who is the Polar Lander’s project manager?
  (Answer: Richard Cook)

- Where on Mars was the spacecraft supposed to touch down?
  (Answer: near Mars’ south pole)

- What was the mission of the Mars Polar Lander?
  (Answer: to study Mars’ atmosphere and search for water)

Challenges

Question: “When was Wendy’s founded?”

Passage candidate:

“The renowned Murano glassmaking industry, on an island in the Venetian lagoon, has gone through several reincarnations since it was founded in 1291. Three exhibitions of 20th-century Murano glass are coming up in New York. By Wendy Moonan.”

Answer: 20th Century or 1291?
Challenges

**Question:** When was Microsoft established?

Microsoft tends to establish lots of things…

*Microsoft plans to establish manufacturing partnerships in Brazil and Mexico in May.*

**Solution?**

**Challenges**

**Question:** What is the occupation of Bill Clinton’s wife?

No documents contain these keywords plus the answer.

**Ideas?**
Challenges

Question: What is the occupation of Bill Clinton's wife?
No documents contain these keywords plus the answer.

One solution: decompose into two questions:
Who is Bill Clinton's wife? = X
What is the occupation of X?

AI/planning/logic!

Question answering

How are we going to do it?

Information retrieval
Parsing
Text similarity
POS tagging
Machine learning
Information extraction
Language modeling

QA basic framework

Query processing

Why do we need query processing?
What types of things might we need to do?
Query processing

- If we’re going to feed the question into an IR system, often need to reformulate the query
  - Some things may already be done by the IR system
    - remove stopwords
    - remove question words
  - query expansion:
    - who is the president of the US -> United States
- Formulate as a statement rather than a question:

```
When was the paper clip invented?  the paper clip was invented
what is the tallest building?  the tallest building is
```

Query processing

- Analyze the query: what questions might we ask about the query that might help limit our set of answers?

- What is the expected answer type?

```
<table>
<thead>
<tr>
<th>Q-Type</th>
<th>A-Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>When did the Titanic sink?</td>
<td>event-completion</td>
</tr>
<tr>
<td>Who was Darth Vader’s son?</td>
<td>concept-completion</td>
</tr>
<tr>
<td>What is thalassemia?</td>
<td>definition</td>
</tr>
<tr>
<td></td>
<td>definition</td>
</tr>
</tbody>
</table>
```
Question classification

<table>
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</table>

How can we identify this?

- Better: machine learning!
- lots of clues
  - What city is pomona college in?
  - Where is pomona college located?
  - What is the tallest building in the world?

QA basic framework

- query processing
- information retrieval
- Answer processing
- Answer
The world’s tallest structure is the 828 m (2,717 ft) tall Burj Khalifa in Dubai, United Arab Emirates. The building gained the official title of "Tallest Building in the World" at its opening on 4 January 2010. It is taller than any other man-made structure ever built.

The Council on Tall Buildings and Urban Habitat, an organization that certifies buildings as the "World’s Tallest", recognizes a building only if at least fifty percent of its height is made up of floor plates containing habitable floor areas. Structures that do not meet this criterion, such as the CN Tower, are defined as "towers".

There are dozens of radio and television broadcasting towers which measure over 600 meters (about 2,000 ft) in height, and only the tallest are recorded in publicly available information sources.

Need more information than just the text
- named entity recognition/information extraction
- parsing
- relationships between entities
  - Microsoft established vs. Microsoft was established

Pair this information with information we extracted from the query
- What are we looking for? A person? A date? …?
**Combining and normalizing evidence**

**Q:** What year did the Titanic sink?

**A:** 1912

**Supporting evidence:**

It was the worst peacetime disaster involving a British ship since the Titanic sank on the 14th of April, 1912.

The Titanic sank after striking an iceberg in the North Atlantic on April 14th, 1912.

The Herald of Free Enterprise capsized off the Belgian port of Zeebrugge on March 6, 1987, in the worst peacetime disaster involving a British ship since the Titanic sank in 1912.

---

**What happened?**

- Different formats for answer candidates detected, normalized and combined:
  - “April 14th, 1912”
  - “14th of April, 1912”

- Supporting evidence detected and combined:
  - “1912” supports “April 14th, 1912”

- Structure of date expressions understood and correct piece output:
  - “1912” rather than “April 14th, 1912”

- Most frequent answer candidate found and output:
  - “April 14th, 1912” rather than something else.

---

**NLP is expensive!**

- We need to run:
  - sentence identifier
  - tokenizer
  - IE
  - parsers
  - ...

- These are expensive! (and there may be many documents)

- Can we reduce this time?

---

**QA actual framework**

- Question
- Query
- Docs
- Answers

- Extraction
- Query processing
- Information retrieval
- Passage retrieval
- Answer processing

- Answer

Find relevant passages before doing NLP
IR Systems return the N most relevant documents
Passage retrieval systems then return the N most relevant passages
The answer processing is then only run on these passages

- How can/should we evaluate the system?
  - Ideas:
    - Accuracy
    - Precision/Recall (often we allow it to say “No Answer”)
    - Produce multiple answers and use IR like measures

Reciprocal ranking scheme:
For the purposes of evaluating the systems, several answer candidates are often ranked by confidence.

Reciprocal Ranking Scheme: the score for a question is $1/R$, where $R$ is a rank of the first correct answer in the list.

Q: What is the capital of Utah?
A1: Ogden
A2: Salt Lake City
A3: Provo
A4: St. George
A5: Salt Lake

RRS?
For the purposes of evaluating the systems, several answer candidates are often ranked by confidence. 

**Reciprocal Ranking Scheme:** the score for a question is \( 1/R \), where \( R \) is a rank of the first correct answer in the list.

**Question:** What is the capital of Utah?

**Answers:**
A1: Ogden
A2: Salt Lake City
A3: Provo
A4: St. George
A5: Salt Lake

The score for the question Q would be \( 1/3 \).

**Sample Results**

<table>
<thead>
<tr>
<th>Question</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>What is the capital of Utah?</td>
<td>1/3</td>
</tr>
<tr>
<td>What is the capital of New York?</td>
<td>1</td>
</tr>
<tr>
<td>What is the capital of California?</td>
<td>1/3</td>
</tr>
</tbody>
</table>

**Does it work?**

**START's reply**

I don't know what the online building is.

**Does it work?**

**START's reply**

Salt Lake City, Utah, United States.
Does it work?

What's the population of Maryland?

- three

Where do lobsters like to live?

- on a Canadian airlines

Where do hyenas live?

- in Saudi Arabia
- in the back of pick-up trucks

Where are zebras most likely found?

- near dumps
- in the dictionary

Why can't ostriches fly?

- Because of American economic sanctions

What's the population of Maryland?

- three
Summarization

- Summarization approaches aim to produce a summarized version of a text document

Applications?
Different types of summarization?
Genres

- overview/summary/abstract
- headlines
- outlines
- minutes
- biographies
- compression
- simplification
- sound bites
- movie summaries
- chronologies

Headline news — informing

U.S. Plane Fires a Missile On Iraq

TV-GUIDES — decision making

Abstracts of papers — time saving
Cliff notes — Laziness support

Cliff Notes for the Grapes of Wrath

Posted by Derek on December 02, 1997 at 11:39:45;
In Reply to: Re: I need cliff notes for a summary to TO KILL A MOCKINGBIRD posted by kandice on September 28, 1997 at 20:45:45;

Say can you send me some cliff notes for the grapes of wrath by Wednesday December 3, 1997. I would appreciate it very much and I would recommend this page to all my friends so we could not our english tests on the grapes of wrath. PLEASE SEND ME A COPY OF THE GRAVES OF WRAITH CLIFF NOTES I NEED THEM BAD!!!!!!!!!!!!

Different dimensions of summarization

- How much summarization
  - quick categorization vs. content processing
  - Background vs. just-the-news

- Extract vs. abstract (how the summarization is generated)
  - Lists fragments of text vs. rephrases content coherently

- Generic vs. query-oriented

- Single-document vs. multi-document source
  - based on one text vs. fuses together many texts.

Summarization

How are we going to do it?

- Information retrieval
- Parsing
- Text similarity
- Language modeling
- Machine learning
- Information extraction
- POS tagging
- Machine translation

Summarization

- Three common steps:
  - Content selection: what are the important concepts/clauses/sentences?
  - Content ordering: how should this information be structured?
  - Realization: concepts/sentences => output
Three common steps: the basics

<table>
<thead>
<tr>
<th>content selection</th>
<th>content ordering</th>
<th>realization</th>
</tr>
</thead>
</table>

Content selection

- General problem: identify important concepts
- Common approximation: identify important sentences
- How can we identify important sentences?

Identifying important sentences

- Word-based
  - Calculate the sentence as the average weight of the words in the sentence
  - TF-IDF weighting
  - Likelihood ratios: likelihood of occurring in this document divided by the likelihood of occurring in the whole corpus
  - Pick the highest scoring sentences
- Similarity-based
  - Pick sentences that are on average closer to the other sentences in the document
  - Might also discount for being generally similar to whole corpus

Identifying important sentences: supervised approach

- Training data

  - Could we use this to learn a sentence importance measure?
  - What features might be useful?
  - Challenges?
Summarization

- Three common steps:
  - Content selection: what are the important concepts/clauses/sentences?
  - Content ordering: how should this information be structured?
  - Realization: concepts/sentences => output

Realization (output)

- Input: a bunch of sentences
- Output: summary

- Challenges
  - Reference resolution/naming (show some examples)
  - Fluidity
  - Repetition?

Multi-document approaches

In many domains, we have multiple documents on the same topic (e.g., news) and we’d like to summarize all the documents with one summary.

How does this problem differ?
1. Algerian newspapers have reported that 18 decapitated bodies have been found by authorities in the south of the country.

2. Police found the "decapitated bodies of women, children and old men, with their heads thrown on a road" near the town of Jelfa, 275 kilometers (170 miles) south of the capital Algiers.

3. In another incident on Wednesday, seven people -- including six children -- were killed by terrorists, Algerian security forces said.

4. Extremist Muslim militants were responsible for the slaughter of the seven people in the province of Medea, 120 kilometers (74 miles) south of Algiers.

5. The killers also kidnapped three girls during the same attack, authorities said, and one of the girls was later found wounded on a nearby road.

6. Meanwhile, the Algerian daily Le Matin today quoted Interior Minister Abdul Malik Silal as saying that "terrorism has not been eradicated, but the movement of the terrorists has significantly declined."

7. Algerian violence has claimed the lives of more than 70,000 people since the army cancelled the 1992 general elections that Islamic parties were likely to win.

8. Mainstream Islamic groups, most of which are banned in the country, insist their members are not responsible for the violence against civilians.

9. Some Muslim groups have blamed the army, while others accuse "foreign elements conspiring against Algeria."
QA: Watson

http://www.youtube.com/watch?v=3G2H3D28hnc