Multimodal Summarization

Genoese explorer Christopher Columbus

Genoa

Christopher Columbus

reached

1492

IN

several Caribbean islands

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Motivation

- Lots of information available on the web
- Unaccessible for:
  - low literate/illiterate people
  - people with cognitive difficulties
  - children, ...
- First step to help people access information
- Personal motivation:
  - majority people of Bangladesh
Parameters

- Illustration increases comprehension
- Summarization conveys main idea
- Simple sentence makes it easier to follow
In 1492, Genoese explorer Christopher Columbus, under contract to the Spanish crown, reached several Caribbean islands, making first contact with the indigenous people.
Automatic Illustration

Mihalcea and Leong (2006)
- simple sentences

Goldberg et al. (2008)
- simple sentences
- ignores hard to depict cases
Problems with Auto-Illustration

• Domain Limitation

http://en.wikipedia.org
http://www.espncricinfo.com/
Problems with Auto-Illustration

- Illustrating complex sentence
- Finding a representative image of:
  - territory  (expanded their territory to cover.)
  - height of medieval power  (monarchy reached the height of its medieval power ...)
  - French war of religion  (civil war know as the French Wars of Religion ...)
  - ...

ROC-MMS

Evaluation
Multimodal Summarization

In 1492, Genoese explorer Christopher Columbus, under contract to the Spanish crown, reached several Caribbean islands, making first contact with the indigenous people.

• Summarize text
• Structure as simple sentence
• Keep both text and image (multimodal)
Multimodal Summarization

In 1492, Genoese explorer Christopher Columbus, under contract to the Spanish crown, reached several Caribbean islands, making first contact with the indigenous people.

- **Summary text**
- Structure as simple sentence
- Keep both text and image (multimodal)
In 1492, Genoese explorer Christopher Columbus, under contract to the Spanish crown, reached several Caribbean islands, making first contact with the indigenous people.

- Summarize text
- **Structure as simple sentence**
- Keep both text and image (multimodal)
In 1492, Genoese explorer Christopher Columbus, under contract to the Spanish crown, reached several Caribbean islands, making first contact with the indigenous people.

- Summarize text
- Structure as simple sentence
- **Keep both text and image (multimodal)**
- handle cases lacking good picture
- handle hard to depict cases
- dual code theory
- repeat important info twice
Subtasks of MMS

• Identify the main idea/event
• Identify dependent entities of the main event
• Extract pictures for the entities
• Add simple sentence structure
Subtasks of MMS

- Identify the main idea/event
- Identify dependent entities of the main event
- Extract pictures for the entities
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Subtasks of MMS

- Identify the main idea/event
- Identify dependent entities of the main event
- **Extract pictures for the entities**
- Add simple sentence structure
Subtasks of MMS

- Identify the main idea/event
- Identify dependent entities of the main event
- Extract pictures for the entities
- Add simple sentence structure
In 1492, Genoese explorer Christopher Columbus, under contract to the Spanish crown, reached several Caribbean islands, making first contact with the indigenous people.
Identify Main Event

In 1492, Genoese explorer Christopher Columbus, under contract to the Spanish crown, reached several Caribbean islands, making first contact with the indigenous people.

- TRIOS system (UzZaman and Allen, 2010) for event extraction
- Classify main event using a MLN classifier
- Trained on TimeBank corpus
- Features used:
  - **lexical features** (word, stem, next word, previous word, ...)
  - **syntactic features** (part-of-speech tag, tense, voice, polarity, ...)
  - **semantic features** (abstract semantic class, semantic roles, ...)
In 1492, Genoese explorer Christopher Columbus, under contract to the Spanish crown, reached several Caribbean islands, making first contact with the indigenous people.
In 1492, Genoese explorer Christopher Columbus, under contract to the Spanish crown, reached several Caribbean islands, making first contact with the indigenous people.
Extract Pictures for Entities

Genoese explorer Christopher Columbus
reached
several Caribbean islands

Genoa

Christopher Columbus

1492
Extract Pictures for Entities

Ignore event pictures

Future work: combining with subject/object
Extract Pictures for Entities

Find the wiki page

Genoese explorer **Christopher Columbus**, under contract

http://en.wikipedia.org/wiki/Christopher_Columbus
Extract Pictures for Entities

Find the image in wiki page

input query: Christopher Columbus

<table>
<thead>
<tr>
<th>Filename</th>
<th>Tokenized</th>
</tr>
</thead>
<tbody>
<tr>
<td>Christopher_Columbus_.PNG</td>
<td>Christopher Columbus</td>
</tr>
<tr>
<td>Columbus_Signature.svg</td>
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<td>ColombusNotesToMarcoPolo.jpg</td>
<td>Colombus Notes To Marco Polo</td>
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<td>Atlantic Ocean Toscanelli 1474</td>
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<tr>
<td>Columbus1.PNG</td>
<td>Columbus 1</td>
</tr>
<tr>
<td>...</td>
<td>...</td>
</tr>
</tbody>
</table>
Simple Sentence Structure

Genoese explorer Christopher Columbus reached several Caribbean islands in 1492.
Simple Sentence Structure

Subject Picture and Text → Event → Object Picture and Text

Simplifying complex sentences in the process
French fur traders established outposts of New France around the Great Lakes; France eventually claimed much of the North American interior, down to the Gulf of Mexico.
The Carolingian dynasty ruled France until 987, when Hugh Capet, Duke of France and Count of Paris, was crowned King of France.
Gaul was conquered by Rome under Julius Caesar in the 1st century BC.
The borders of modern France are approximately the same as those of ancient Gaul, which was inhabited by Celtic Gauls.

Celtic Gauls inhabited

Parsing Problem
Experimental Setup

• Total 44 sentences
• Wikipedia articles on US and France
• Two annotators
• Annotators extracted
  ‣ main event
  ‣ related entities and
  ‣ images for the entities
Main Event Performance

- **Fscore:** 75.98%
- **Precision:** 79.10%
- **Recall:** 73.11%

Performance depends on:
- TRIOS event extraction
- Main event classifier

Performance depends on:
- TRIOS event extraction
- Main event classifier

Performance depends on:
- TRIOS event extraction
- Main event classifier
Entity Extraction Performance

Performance depends on:
- Stanford Dependency parser
- Entity extraction module

Can be improved by:
- Training entities from parse output
- Named entity recognition

<table>
<thead>
<tr>
<th>reference: Christopher Columbus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Columbus</td>
</tr>
<tr>
<td>Christopher Columbus</td>
</tr>
</tbody>
</table>
Extract Pictures for Entities

Image extraction performance

Can be improved by: taking benefit of existing research

Quality of extracted image

65.66% accepted images
In 1492, Genoese explorer Christopher Columbus, under contract to the Spanish crown, reached several Caribbean islands, making first contact with the indigenous people.
Asked Mechanical Turk workers

**Explain the diagram in English text**

Please explain the diagram in English text.

---

Christian revivialist movement

**fueled**

in

religion

---

Please explain the diagram in English text. (Write "Can't explain", if you can't explain in text)
source: In 1492, Genoese explorer Christopher Columbus, under contract to the Spanish crown, reached several Caribbean islands, making first contact with the indigenous people.

reference: Christopher Columbus Spanish crown reached Caribbean islands

Mturk on user created diagram
- an explorer reached Latin America
- well-known Italian navigator reached
- Christopher Columbus reached Australia during his navigation in the Indian Ocean
- There are four pictures. Two pictures are old maps
- Can’t explain
- Can’t explain
- Can’t explain
- Very Good
- Can’t explain
- Can’t explain

Mturk on ROC-MMS diagram
- Explorer Christopher Columbus discovered America in the year 1492
- Christopher Columbus reached several Caribbean islands in 1492
- Place of Genoese explorer from Christopher Columbus reached to several Caribbean islands in 1492.
- In 1492 Christopher Columbus, the greatest Italian navigator and explorer from Genoa discovered a place now called America.
- Explorer Christopher Columbus discovered America in the year 1492
- Genoese explorer Christopher Columbus reached several islands in 1492.
- Reached
- Can’t explain
Summary

• Alternative of Automatic Illustration

• Introduced Multimodal Summarization
  ‣ Keep both text and image: helps comprehension
  ‣ Create simple sentence from complex sentence
  ‣ Summarize the sentence

• Future work
  ‣ Image retrieval system for unrestricted text
  ‣ User studies to see if its helpful for target audience
  ‣ Interested in collaboration
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Rouge-1 and Rouge-L for diagrams

<table>
<thead>
<tr>
<th>Evaluation</th>
<th>Rouge-1</th>
<th>Rouge-L</th>
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</thead>
<tbody>
<tr>
<td>Explanation of Annotators’ diagrams</td>
<td>0.0892482 (F)</td>
<td>0.08451066 (F)</td>
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<td></td>
<td>0.0680995 (R)</td>
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<td></td>
<td>0.1294495 (P)</td>
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<td>Explanation of the ROC-MMS diagrams</td>
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<td></td>
<td>0.26668 (R)</td>
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<tr>
<td></td>
<td>0.2190162 (P)</td>
<td>0.199832 (P)</td>
</tr>
</tbody>
</table>
Application in Car

• Add speech modality in our MMS
  ‣ simple, summarized sentence

• Useful for news or well formed sentences

• Current implementation won’t help SMS, Tweets
  ‣ the framework will work
  ‣ will need parser for that domain

• Can be used mainly by non-drivers
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