Hasso Plattner Institut

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Seminar Question Answering

Question Analysis

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Agenda

- Surface Text Patterns
  - Pattern Learning
- Named Entity Annotation
- Semantic Role Labeling
  - FrameNet
  - Dependency Parsing

Surface Text Patterns

- Characteristic answer phrases
- "When was X born?"
  - "Mozart was born in 1756."
  - "Ghandi (1869 – 1948) …"
- Regular expressions
  - "<NAME> was born in <BIRTHDATE>"
  - "<NAME> (<BIRTHDATE> - "

Surface Text Patterns – Learning of Patterns

- Pattern-learning algorithm by example
- 1.) Example query: BIRTHYEAR
  - "Mozart 1756"
- 2.) Retrieve top 1000 documents
- 3.) Create suffix tree from normalized sentences
  - *"The great composer Mozart (1756–1791) achieved fame at a young age"*
  - *"Mozart (1756–1791) was a genius"*
  - *"The whole world would always be indebted to the great music of Mozart (1756–1791)"*
  - → **"Mozart (1756 – 1791)"**, 3 times

Surface Text Patterns – Learning of Patterns (2)

- 4.) Filter resulting substrings
- 5.) Replace ...
  - … question term by "<NAME>"
  - … answer term by "<ANSWER>"
- 6.) Repetition for different examples
  - *born in <ANSWER> , <NAME>*
  - *<NAME> was born on <ANSWER> ,*
  - *<NAME> (<ANSWER> -*
  - *<NAME> (<ANSWER -)*

Surface Text Patterns – Learning of Patterns (3)

- 7.) Calculate Precision of patterns
  - Query with question term
  - Compare results that fit pattern with answer
- 8.) Remove bad performing patterns

Surface Text Patterns - Shortcomings

- Best performance, when question type is known
- "Where are the Rocky Mountains located?"
  - *"Denver's new airport, topped with white fiberglass cones in imitation of the Rocky Mountains in the background, continues to lie empty."*
- "the <NAME> in <ANSWER>"
  - No knowledge that "background" is no location
- Regular expressions → problems with long-distance dependencies

Named Entity Annotation

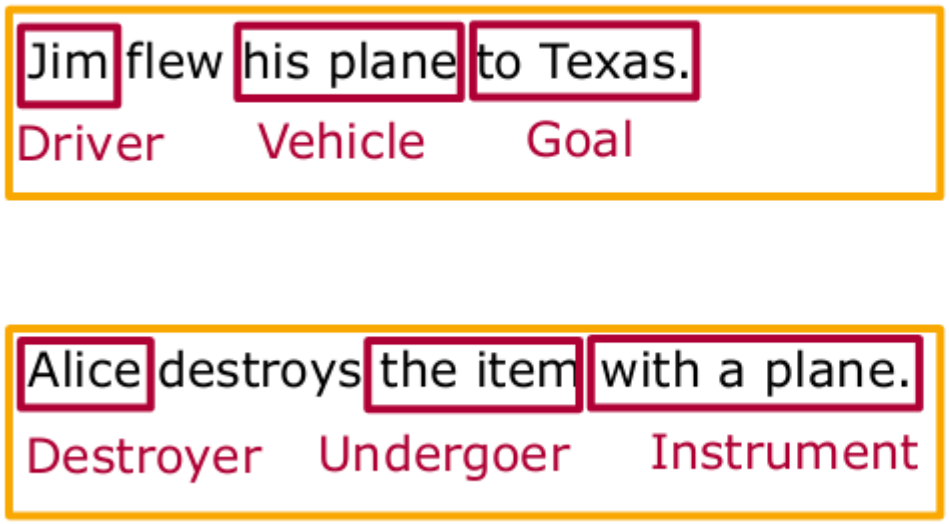
- Gain knowledge on type of answer
- "When" implies date
  - → Filter answer candidates

example:

Steven Paul Jobs, co-founder of Apple, was born in 1955.

person organization year

Semantic Role Labeling



Semantic Role Labeling - FrameNet

- Lexical database of English
- More than 170,000 manually annotated sentences
- **Semantic frame**: "Description of type of event, relation, or entity and the participants in it."

$_{\text{Cook}}$[The boys] *GRILL* $_{\text{Food}}$[their catches] $_{\text{Heating\_instrument}}$[on an open fire].

Semantic Role Labeling – Example (1)

- Find the questions **head verb**
  - *(Who **purchased** YouTube?)*
- FrameNet: *purchase*
  - *Commerce_buy* Frame
  - *Buyer* [Subj,NP] VERB *Goods* [Obj,NP]
  - *Buyer* [Subj,NP] VERB *Goods* [Obj,NP] *Seller* [Dep,PP-from]
  - …

PP - Prepositional Phrases

NP – Noun Phrases

Semantic Role Labeling – Example (2)

- Who purchased YouTube?
  - *Buyer* [Subj,NP] VERB *Goods* [Obj,NP]

- "Who" is subject → *Buyer*
- "YouTube" is object → *Goods*

- Question asks for *Buyer* role

Semantic Role Labeling – Answer Templates

- Creation of pattern
  - ANSWER [NP] purchased YouTube
  - YouTube was purchased by ANSWER [NP]
- Makes use of synonyms & tenses

Semantic Role Labeling – Example (3)

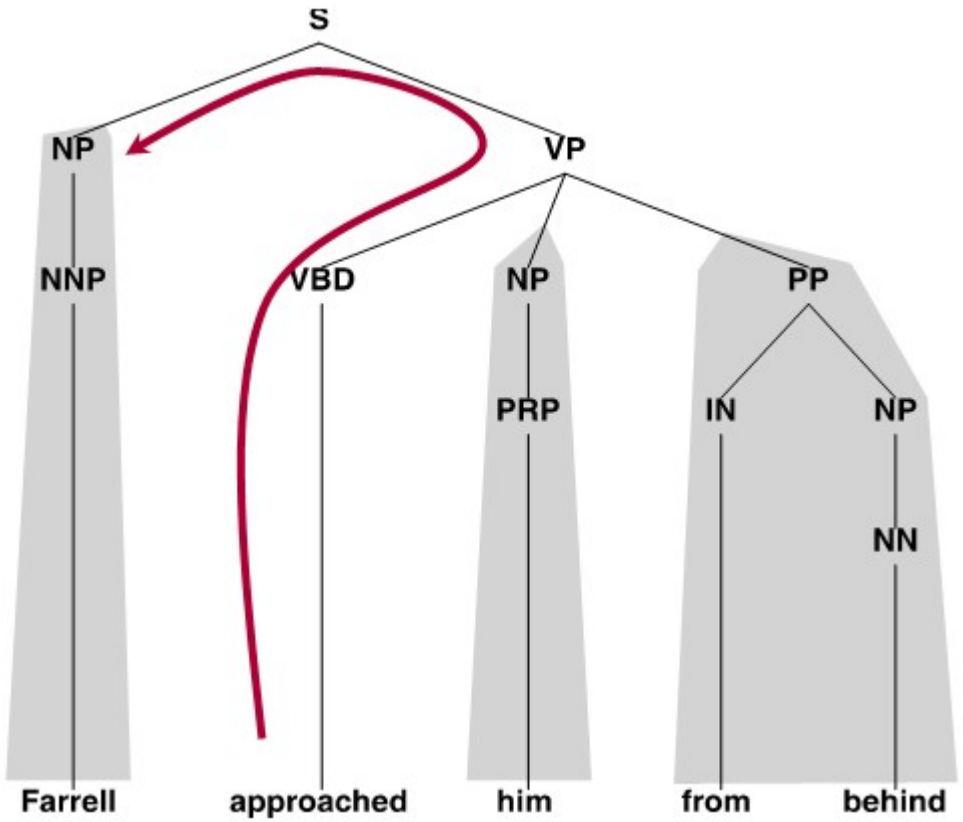
- Query:
  - "YouTube was purchased by"
- Result:
  - “On October 9, 2006, YouTube was purchased by Google for an incredible US$1.65 billion”
- "Google" fits *Buyer* role

Semantic Role Labeling - Advantages

- "When was YouTube purchased?"
  - Answer is no NP but adjunct
  - → can have different positions
- Abstract frame structure for query
  - Buyer [Subj, NP, unknown] VERB Goods [Obj, NP, "YouTube"]
  - → "has purchased YouTube"
- All PPs with correct type and position are candidates
- Rules to derive roles from question words

Dependency Parsing

- Identify grammatical structure and syntactical relations



Dependency Parsing - Scoring

- 1a) Same head verb?
- 1b) Same path to head?
- 2) Example's path to answer role?
- 3) Paths to other roles shared?
- 4) Surface strings match?

- If 1a) and 2) holds, answer can be extracted
- Higher score the more tests are passed

Dependency Parsing – Example (1)

- *"Who purchased YouTube?"*
  - role = ARG0, paths = {↓s, ↓subj} ("Who")
  - role = ARG1, paths = {↓obj} ("YouTube")
  - role = TMP, paths = {↓mod}
- *"Their aim is to compete with YouTube, which Google recently purchased for more than $1 billion."*
  - phrase = "Google", paths = {↓s, ↓subj}
  - phrase = "which", paths = {↓obj}
  - phrase = "YouTube", paths = {↑i↑rel}
  - phrase = "for more than $1 billion", paths = {↓mod}

Dependency Parsing – Example (2)

- 1a) Same head verb? ✓
- 1b) Same path to head? ✗
- 2) Example's path to answer role? ✓
- 3) Paths to other roles shared? ✓
- 4) Surface strings match? ✗

Sources

- Deepak Ravichandran, Eduard Hovy, Learning Surface Text Patterns for a Question Answering System, ACL Conference, 2002
- Michael Kaisser, Bonnie Webber, Question Answering based on Semantic Roles, ACL workshop on Workshop on Important Unresolved Matters, 2005
- Preceding Presentations
  - Named Entity Annotation – Stefan Klauck
  - Dependency Parsing – Cindy Fähnrich
  - Semantic Role Labeling – Sebastian Oergel
- FrameNet
  - https://framenet.icsi.berkeley.edu/fndrupal/about