Hasso Plattner Institut

IT Systems Engineering | Universität Potsdam

Question Answering Systems

An Introduction

Potsdam, Germany, 14 July 2011

Saeedeh Momtazi
Information Systems Group

Outline

1. Introduction

Outline

1. Introduction
2. History

Outline

1. Introduction
2. History
3. QA Architecture
   - Factoid QA
   - Opinion QA

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1. Introduction
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4. Summary

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   - Opinion QA
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Why QA

Why QA

Why QA

Who is Warren Moon's agent? | Search

Why QA

Who is Warren Moon's agent? | Search

[Booking **Warren Moon** Appearances, Contact **Warren Moon Agent** ...]
Call 1-888-246-7141 to Contact **Warren Moon Agent** for Booking **Warren Moon** for corporate appearances, **Warren Moon** speaking engagements, **Warren Moon** ...
www.athletepromotions.com/.../**Warren-Moon**-appearance-booking-**agent**.php -
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www.playingfieldpromotions.com/**Warren-Moon**.php - Cached - Similar -

[What league did **Warren Moon** join? | Smart QandA: Answers and facts ...]
Newspaper article from: Seattle Post-Intelligencer (Seattle, WA) ...preseason opener, **Warren Moon** was waiting to greet...Leigh Steinberg, **Moon's agent**, ...
qanda.encyclopedia.com/.../league-did-**warren-moon**-join-211812.html -
Cached - Similar -

[**Warren Moon**: Biography from Answers.com]
Warren Moon football player Personal Information Born Harold **Warren Moon**, November 18, ... situation," **Moon's agent**, Leigh Steinberg, told the Houston Post. ...
www.answers.com/topic/**warren-moon** - Cached - Similar -

[**Warren Moon** Collectible - Find **Warren Moon** Collectible items for ...]
After playing two seasons in the Pacific Northwest, **Moon** signed as a free **agent** with the Kansas City Chiefs in 1999. **Warren Moon** retired in the January 2001 ...
popular.ebay.com/ns/Sports.../**Warren-Moon**-Collectible.html - Cached - Similar -

[Seattle Seahawks **Warren Moon** Page]
July 22, 1998 - **Warren Moon's agent** went on the offensive after another day of terse contract negotiations Tuesday, accusing the Seattle Seahawks of ...
www.beckys-place.net/**moon**.html - Cached - Similar -

[Press Release: A New **Moon**, A New Genre and a New Digital Diva ...]

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Why QA

Why QA


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HOME > SPORTS > FOOTBALL > WARREN MOON
Warren Moon
Title: NFL Hall of Famer
Birth Date: November 18, 1956
Birth Place: Los Angeles, CA
Attended: Washington
Attachment: NFL, Houston Oilers, Minnesota Vikings, Seattle Seahawks, Kansas City Chiefs. NFL Hall of Fame, FOX
Price range: $15,001-$30,000
Categories: Football, Broadcasters, Sports
Available for: Appearances, Endorsements, Speaking Engagements
Biography
Warren Moon is often referred to as being the first African-American quarterback to be inducted into the Pro Football Hall of Fame, and while that is true, his accomplishments are truly legendary regardless of his color. He also holds the distinction of being the only player ever enshrined in both the Pro Football and Canadian Football Halls of Fame. In his illustrious career, Moon threw for more than 400 touchdowns and an incredible 70,000 yards while playing with the Edmonton Eskimos of the CFL and then in the NFL with the Houston Oilers, Minnesota Vikings, Seattle Seahawks and Kansas City Chiefs. Moon played his college ball at the University of Washington, where he led the Huskies to a Rose Bowl victory over Michigan and was named MVP of the game. Despite that, he was not drafted by the NFL, perhaps in part because of his skin color, and because he wanted to play quarterback and not tight end as some scouts had
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Football
03. Marino, Dan
Football
pearance
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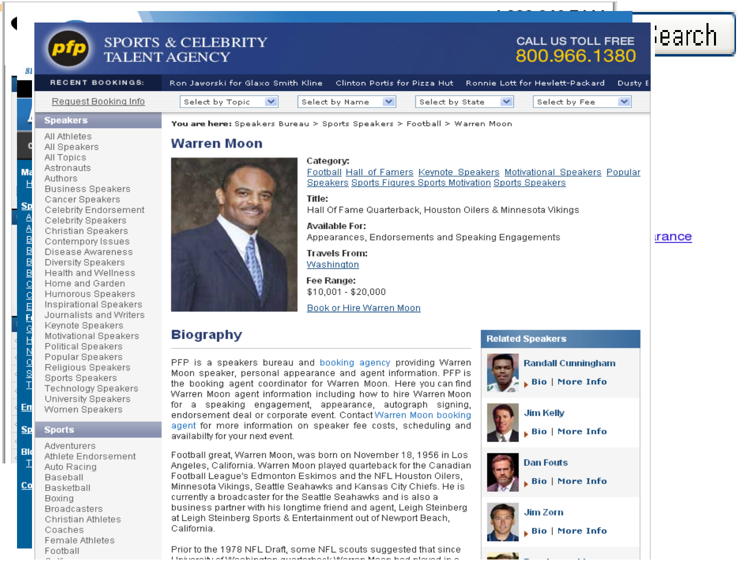
Why QA



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Auto Racing
Baseball
Basketball
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Broadcasters
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Coaches
Female Athletes
Football
You are here: Speakers Bureau > Sports Speakers > Football > Warren Moon
Warren Moon
Category:
Football Hall of Famers Keynote Speakers Motivational Speakers Popular Speakers Sports Figures Sports Motivation Sports Speakers
Title:
Hall Of Fame Quarterback, Houston Oilers & Minnesota Vikings
Available For:
Appearances, Endorsements and Speaking Engagements
Travels From:
Washington
Fee Range:
$10,001 - $20,000
Book or Hire Warren Moon
Biography
PFP is a speakers bureau and booking agency providing Warren Moon speaker, personal appearance and agent information. PFP is the booking agent coordinator for Warren Moon. Here you can find Warren Moon agent information including how to hire Warren Moon for a speaking engagement, appearance, autograph signing, endorsement deal or corporate event. Contact Warren Moon booking agent for more information on speaker fee costs, scheduling and availabilty for your next event.
Football great, Warren Moon, was born on November 18, 1956 in Los Angeles, California. Warren Moon played quarterback for the Canadian Football League's Edmonton Eskimos and the NFL Houston Oilers, Minnesota Vikings, Seattle Seahawks and Kansas City Chiefs. He is currently a broadcaster for the Seattle Seahawks and is also a business partner with his longtime friend and agent, Leigh Steinberg at Leigh Steinberg Sports & Entertainment out of Newport Beach, California.
Prior to the 1978 NFL Draft, some NFL scouts suggested that since University of Washington quarterback Warren Moon had played in a
Related Speakers
Randall Cunningham
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Q: What league did Warren Moon join?
A: Urged to change positions, Moon instead signed with the Canadian Football League's Edmonton Eskimos. Starting quarterback there from 1980, he led the team to four straight Grey Cup games (1980-3), winning three times (1980-82). Read more
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football player
Personal Information
Born Harold Warren Moon, November 18, 1956, in Los Angeles, CA; son of Harold (a laborer) and Pat (a nurse) Moon; married Felicia Hendricks, March 8, 1981; children: Joshua, Chelsea, Blair, Jeffrey.
Education: West Los Angeles Junior College, 1974-75; University of Washington, B.S., 1978.
Career
Professional football player, 1978--. Quarterback for Edmonton Eskimos, 1978-83, Houston Oilers, 1984-94, Minnesota Vikings, 1994--.
Life's Work
For more than ten years Warren Moon has been a starting quarterback in the National Football League, most of that time with the Houston Oilers. Now in the twilight of his playing career, Moon has achieved the status of respected elder statesman in the NFL. Having long ago overcome questions about his talent--based on his size and subtly, on his race as well--he brought the Houston Oilers into playoff contention and possibly earned himself a future place in the Pro Football Hall of Fame.
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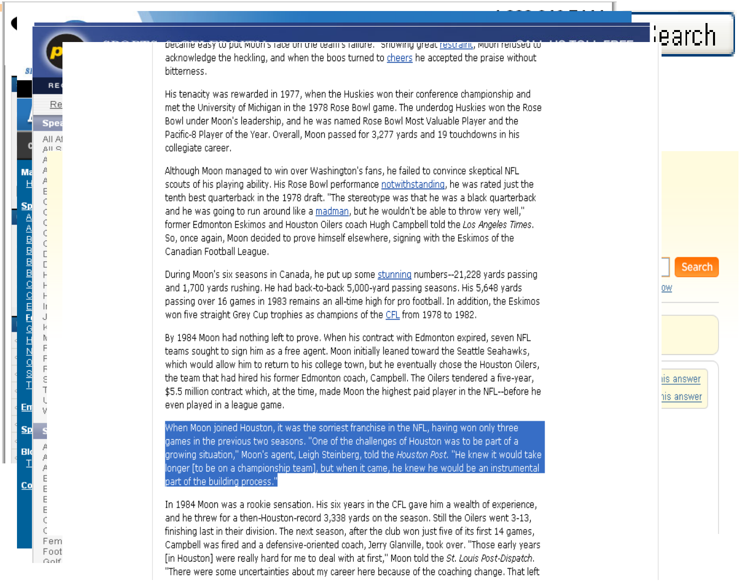

acknowledge the heckling, and when the boos turned to cheers he accepted the praise without bitterness.

His tenacity was rewarded in 1977, when the Huskies won their conference championship and met the University of Michigan in the 1978 Rose Bowl game. The underdog Huskies won the Rose Bowl under Moon's leadership, and he was named Rose Bowl Most Valuable Player and the Pacific-8 Player of the Year. Overall, Moon passed for 3,277 yards and 19 touchdowns in his collegiate career.

Although Moon managed to win over Washington's fans, he failed to convince skeptical NFL scouts of his playing ability. His Rose Bowl performance notwithstanding, he was rated just the tenth best quarterback in the 1978 draft. "The stereotype was that he was a black quarterback and he was going to run around like a madman, but he wouldn't be able to throw very well," former Edmonton Eskimos and Houston Oilers coach Hugh Campbell told the *Los Angeles Times*. So, once again, Moon decided to prove himself elsewhere, signing with the Eskimos of the Canadian Football League.

During Moon's six seasons in Canada, he put up some stunning numbers--21,228 yards passing and 1,700 yards rushing. He had back-to-back 5,000-yard passing seasons. His 5,648 yards passing over 16 games in 1983 remains an all-time high for pro football. In addition, the Eskimos won five straight Grey Cup trophies as champions of the CFL from 1978 to 1982.

By 1984 Moon had nothing left to prove. When his contract with Edmonton expired, seven NFL teams sought to sign him as a free agent. Moon initially leaned toward the Seattle Seahawks, which would allow him to return to his college town, but he eventually chose the Houston Oilers, the team that had hired his former Edmonton coach, Campbell. The Oilers tendered a five-year, $5.5 million contract which, at the time, made Moon the highest paid player in the NFL--before he even played in a league game.

When Moon joined Houston, it was the sorriest franchise in the NFL, having won only three games in the previous two seasons. "One of the challenges of Houston was to be part of a growing situation," Moon's agent, Leigh Steinberg, told the *Houston Post*. "He knew it would take longer [to be on a championship team], but when it came, he knew he would be an instrumental part of the building process."

In 1984 Moon was a rookie sensation. His six years in the CFL gave him a wealth of experience, and he threw for a then-Houston-record 3,338 yards on the season. Still the Oilers went 3-13, finishing last in their division. The next season, after the club won just five of its first 14 games, Campbell was fired and a defensive-oriented coach, Jerry Glanville, took over. "Those early years [in Houston] were really hard for me to deal with at first," Moon told the *St. Louis Post-Dispatch*. "There were some uncertainties about my career here because of the coaching change. That left

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Who is Warren Moon's agent? | Answer

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Who is Warren Moon's agent? | Answer

SHORT ANSWERS

Answers 1-5

- AGENT LEIGH STEINBERG
- MANNY RAMIREZ WILL CLARK STEVE
- QUARTERBACK WARREN
- CLARK STEVE YOUNG
- YOUNG WARREN

QA vs. SE

QA vs. SE

longer input

QA vs. SE

longer input

keywords

natural language questions

QA vs. SE

longer input

keywords

natural language questions

shorter output

QA vs. SE

longer input →

keywords

documents

natural language questions

short answer strings

shorter output →

QA Types

Closed-domain

only answer questions from a specific domain.

Open-domain

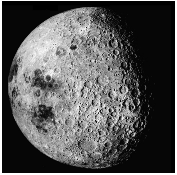
answer any domain independent question.

Outline

History

- BASEBALL [Green et al., 1963]
  - One of the earliest question answering systems
  - Developed to answer user questions about dates, locations, and the results of baseball matches

- LUNAR [Woods, 1977]
  - Developed to answer natural language questions about the geological analysis of rocks returned by the Apollo moon missions
  - Able to answer 90% of questions in its domain posed by people not trained on the system



History

- STUDENT
  - Built to answer high-school students' questions about algebraic exercises.
- PHLIQA
  - Developed to answer the user's questions about European computer systems.
- UC (Unix Consultant)
  - Answered questions about the Unix operating system
- LILOG
  - Was able to answer questions about tourism information in cities within Germany

History

- Closed-domain systems

- Extracting answers from structured data (database)

- Converting natural language question to a database query

History

- Closed-domain systems

- Extracting answers from structured data (database)

Labor intensive to build

- Converting natural language question to a database query

Easy to implement

Open-domain QA

Closed-domain QA ⇒ Open-domain QA

Using a large collection of unstructured data (e.g., the Web) instead of databases

Open-domain QA

Closed-domain QA ⇒ Open-domain QA

Using a large collection of unstructured data (e.g., the Web) instead of databases

- Covering many subjects
- Information constantly added and updated
- No manual work for building database

Open-domain QA

Closed-domain QA ⇒ Open-domain QA

Using a large collection of unstructured data (e.g., the Web) instead of databases

- Covering many subjects
- Information constantly added and updated
- No manual work for building database

- Some times information is not up to date
- Some information is wrong
- More irrelevant information

Open-domain QA

Closed-domain QA ⇒ Open-domain QA

Using a large collection of unstructured data (e.g., the Web) instead of databases

- Covering many subjects
- Information constantly added and updated
- No manual work for building database

More complex systems are required

- Some times information is not up to date
- Some information is wrong
- More irrelevant information

Open-domain QA

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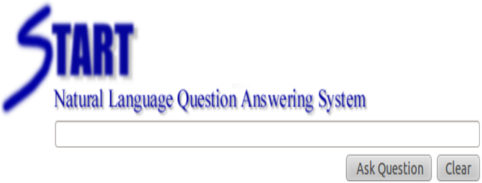
- START [Katz, 1997]
  - Utilized a knowledge-base to answer the user's questions
  - The knowledge-base was first created automatically from unstructured Internet data
  - Then it was used to answer natural language questions



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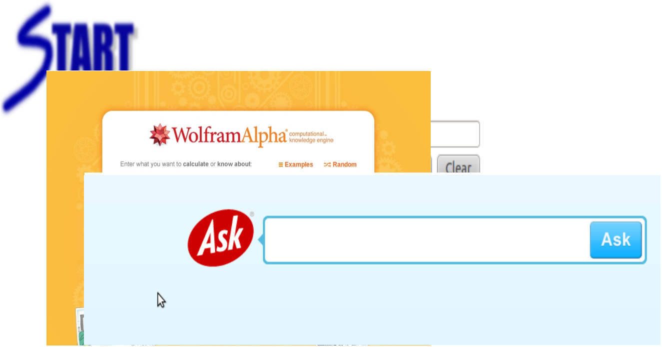

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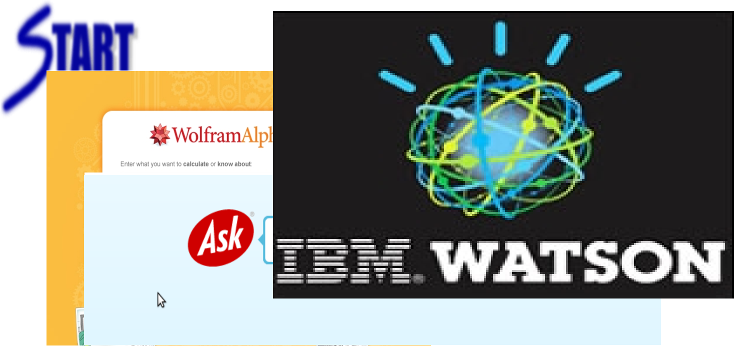

IBM Watson

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- Webpage: IBM Watson

  http://www-03.ibm.com/innovation/us/watson/index.html

- Video: IBM and the Jeopardy Challenge

  http://www.youtube.com/watch?v=FC3IryWr4c8&feature=relmfu

  http://www.youtube.com/watch?v=_1c7s7-3fXI

- Video: A Brief Overview of the DeepQA Project

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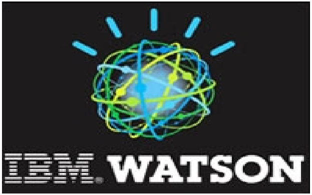

Outline

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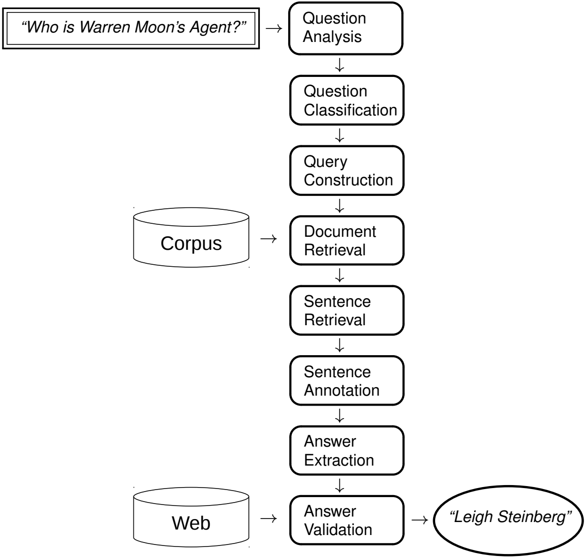
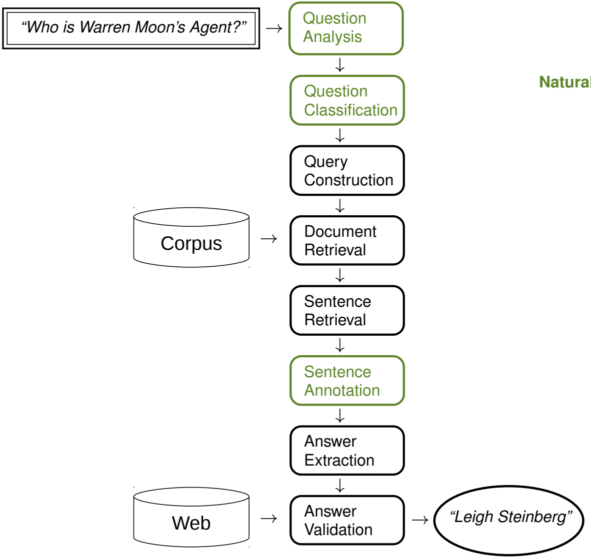
2. History
3. QA Architecture
   - Factoid QA
   - Opinion QA
4. Summary

Architecture

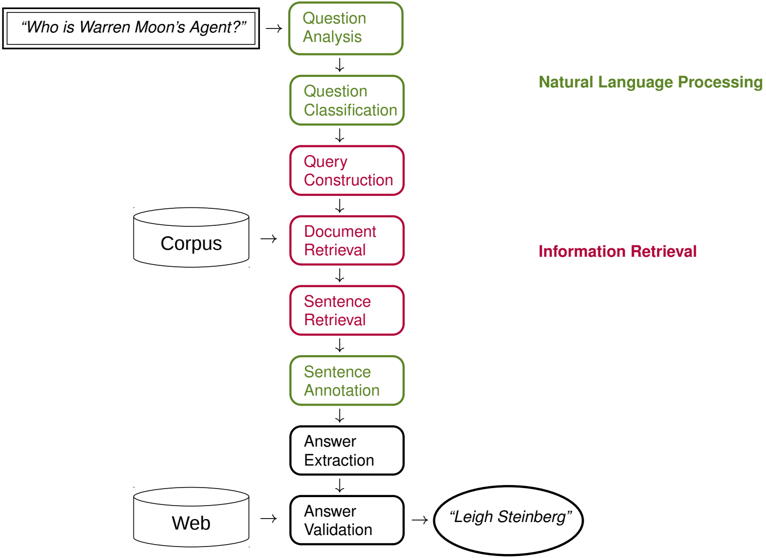


Architecture

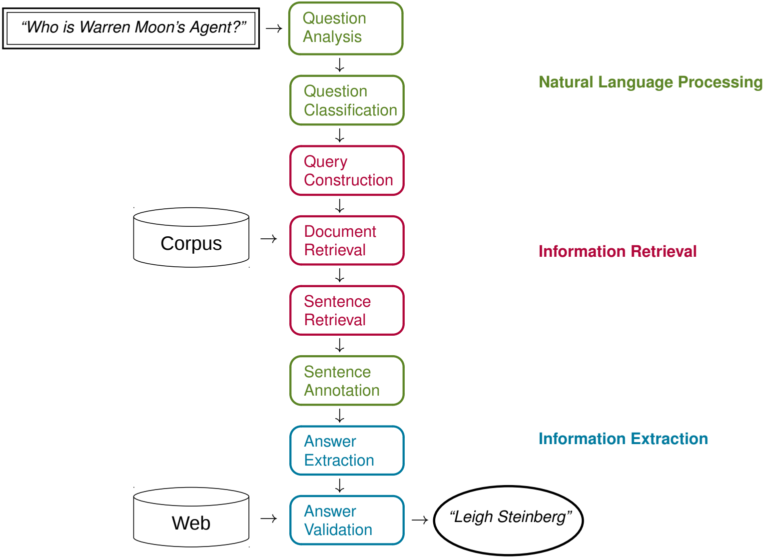


Natural Language Processing

Architecture



Architecture



Question Analysis

- Target Extraction
  - Extracting the target of the question
  - Using question target at the query construction step

Question Analysis

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- Pattern Extraction
  - Extracting a pattern from the question
  - Matching the pattern with a list of pre-defined question patterns
  - Finding the corresponding answer pattern
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examples:

Question: *“In what country was Albert Einstein born?”*

Question Pattern: *“In what country was X born?”*

Answer Pattern: *“X was born in Y.”*

Question Analysis

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  - Realizing the position of the answer in the sentence at the answer extraction step
- Parsing
  - Using a dependency parser to extract the syntactic relations between question terms
  - Using the dependency relation path between question words to extract the correct answer at answer extraction step

Question Classification

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- Classifying the input question into a set of question types
- Defining a map between question types and available named entity labels
- Using question type to extract strings that have the same type as the input question at the answer extraction step

Question Classification

- Classifying the input question into a set of question types
- Defining a map between question types and available named entity labels
- Using question type to extract strings that have the same type as the input question at the answer extraction step

Example:

Question: *"In what country was Albert Einstein born?"*

Type: *Country*

Question Classification

- Classification taxonomies
  - BBN
  - Pasca & Harabagiu
  - Li & Roth

Question Classification

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Question Classification

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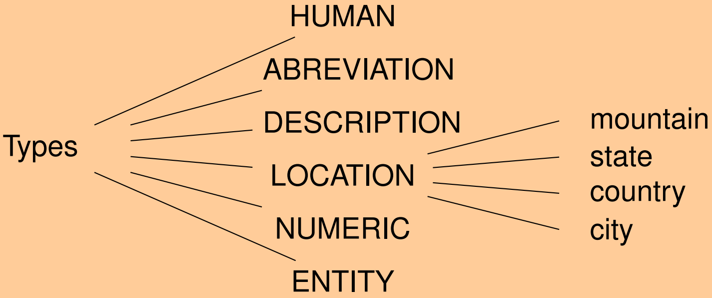
6 coarse- and 50 fine-grained classes



Question Classification

- Using available classifiers based on the favorite model
  - SVM: SVM-light
  - Maximum Entropy: Maxent, Yasmet
  - Naive Bayes

Query Construction

- Goal:
  - Formulating a query with a high chance of retrieving relevant documents

- Task:
  - Assigning a higher weight to the question target
  - Using query expansion techniques to expand the query
    - Thesaurus-based query expansion
    - Relevance feedback
    - Pseudo-relevance feedback

Document Retrieval

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- Importance:
  - QA components use computationally intensive algorithms
  - Time complexity of the system strongly depend on the size of the to be processed corpus

- Task:
  - Reducing the search space for the subsequent modules
  - Retrieving relevant documents from a large corpus
  - Selecting top *n* retrieved document for the next steps

Document Retrieval

- Using available information retrieval models
  - Vector Space Model
  - Probabilistic Model
  - Language Model

Document Retrieval

- Using available information retrieval models
  - Vector Space Model
  - Probabilistic Model
  - Language Model

- Using available information retrieval toolkits

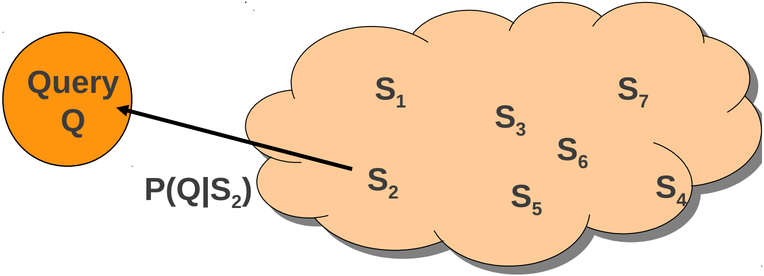
Sentence Retrieval

- Task:
  - Finding a small segment of text that contains the answer

- Benefits beyond document retrieval:
  - Documents are very large
  - Documents span different subject areas
  - The relevant information is expressed locally
  - Retrieving sentences simplifies the answer extraction step

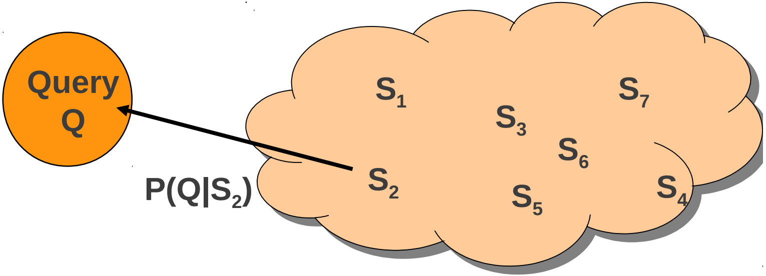
Sentence Retrieval

- Language model-based sentence retrieval



Sentence Retrieval

- Language model-based sentence retrieval



Query likelihood model:

$$P(Q|S) = \prod_{i=1}^{M} P(q_i|S)$$

Sentence Retrieval

- Challenge:
  The term mismatch problem in sentence retrieval is more critical than document retrieval

Sentence Retrieval

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  The term mismatch problem in sentence retrieval is more critical than document retrieval

- Approaches:

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  - Query expansion, (Pseudo-)Relevance Feedback

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Does not work at sentence-level retrieval

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    Does not work at sentence-level retrieval

  - Term relationship models
    - WordNet
    - Term clustering model
    - Translation model
    - Triggering model

Sentence Annotation

- Annotating relevant sentences using linguistic analyses:
  - Named entity recognition
  - Dependency parsing
  - Noun phrase chunking
  - Semantic role labeling

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Example:

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Example (NER):

Sentence1: “ *Albert Einstein was born on 14 March 1879 .*”

Sentence2: “ *Albert Einstein was born in Germany .*”

Sentence3: “ *Albert Einstein was born in a Jewish family.*”

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Example (NER):

Sentence1: " $\underbrace{\textit{Albert Einstein}}_{\textbf{Person Name}}$ *was born on* $\underbrace{\textit{14 March 1879}}_{\textbf{Date}}$."

Sentence2: " $\underbrace{\textit{Albert Einstein}}_{\textbf{Person Name}}$ *was born in* $\underbrace{\textit{Germany}}_{\textbf{Country}}$."

Sentence3: " $\underbrace{\textit{Albert Einstein}}_{\textbf{Person Name}}$ *was born in a* $\underbrace{\textit{Jewish}}_{\textbf{Religion}}$ *family*."

Answer Extraction

- Extracting candidate answers based on various informations:
  - The extracted patterns from question analysis
  - The dependency pars of question from the question analysis
  - The question type from question classification
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Example:

Question: *"In what country was Albert Einstein born?"*

Question Pattern: In what country was X born?
Answer Pattern: X was born in Y.

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Question Type: LOCATION - COUNTRY

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Example (NER):

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$\underbrace{\text{Albert Einstein}}_{\text{Person Name}}$ … $\underbrace{\text{Germany}}_{\text{Country}}$

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$\underbrace{\text{Albert Einstein}}_{\text{Person Name}}$ … $\underbrace{\text{Jewish}}_{\text{Religion}}$

Answer Validation

- Using the Web as a knowledge resource
- Sending question keywords and answer candidates to a search engine
- Finding the frequency of the answer candidate within the Web data
- Selecting the most likely answers based on the frequencies

Answer Validation

- Query model:
  - Bag-of-Word
  - Noun-Phrase-Chunks
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Example:

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Answer Candidate: *Germany*

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Bag-of-Word:

Albert Einstein born Germany

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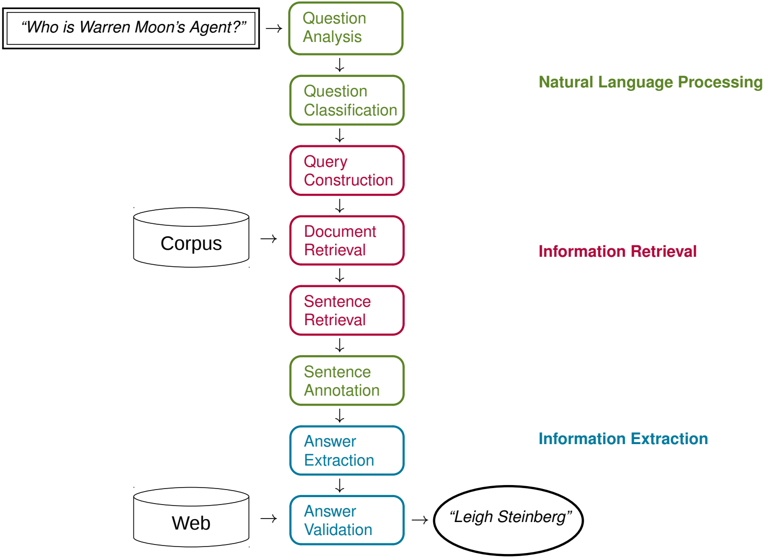
Architecture



Fact vs. Opinion

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- Factual questions

"Who is Warren Moon's Agent?"

"When was Mozart born?"

"In what country was Albert Einstein born?"

"Who is the director of the Hermitage Museum?"

Fact vs. Opinion

- Opinionated questions

"What do people like about Wikipedia?"

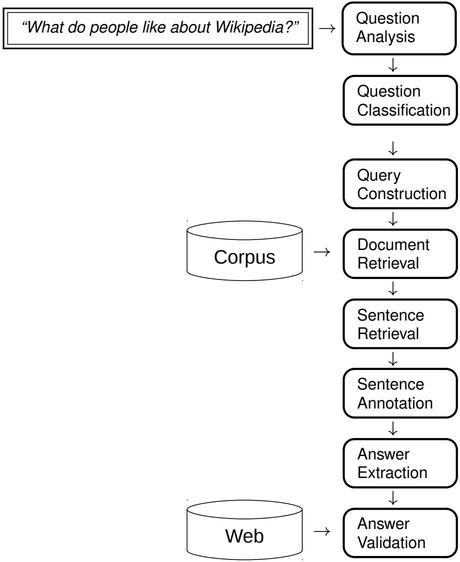
"What organizations are against universal health care?"

"What are the public opinions on human cloning?"

"How do students feel about Microsoft products?"

Outline

Architecture



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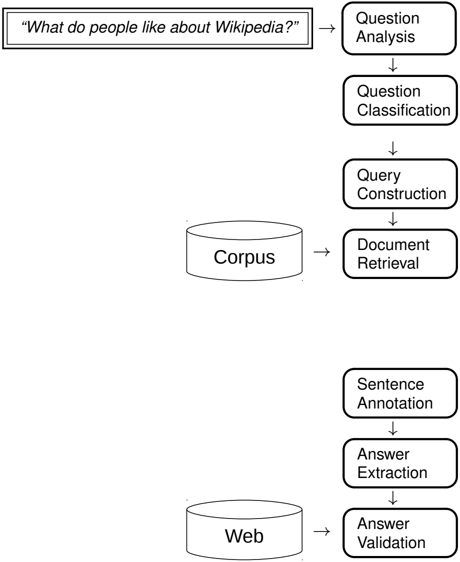

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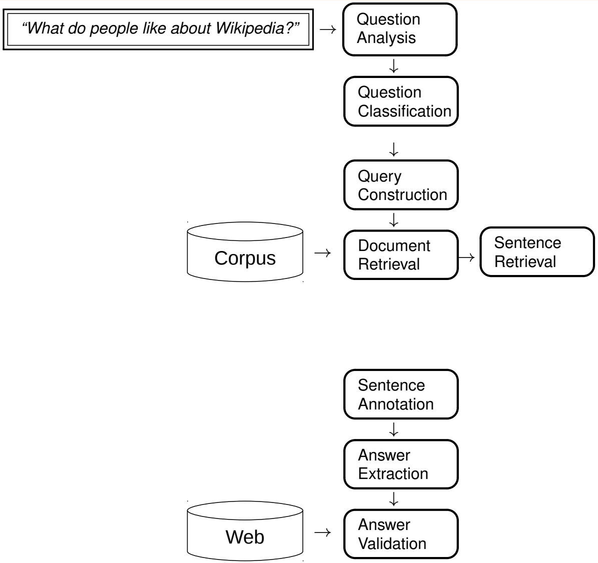

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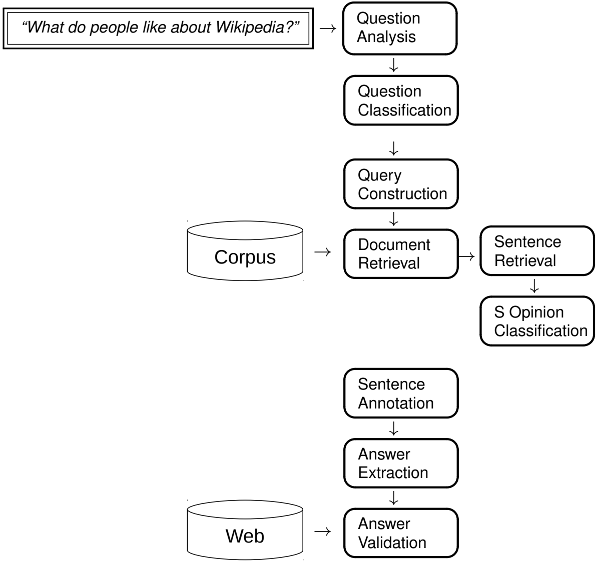

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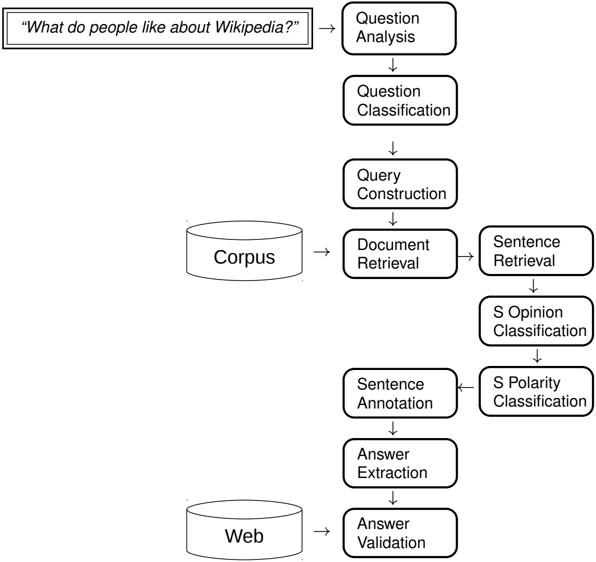

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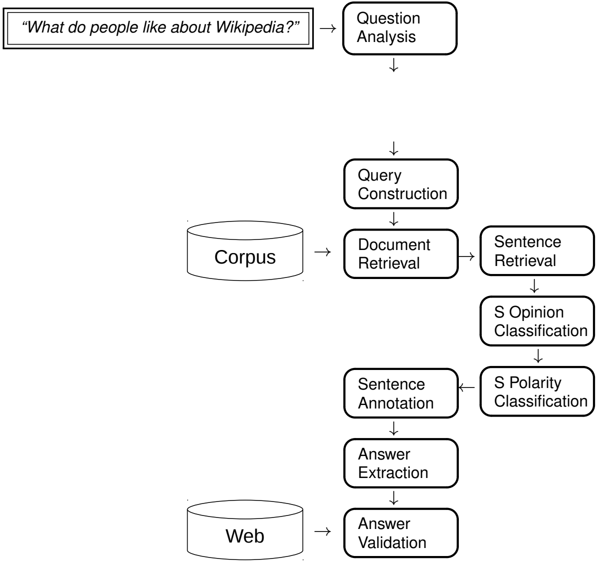

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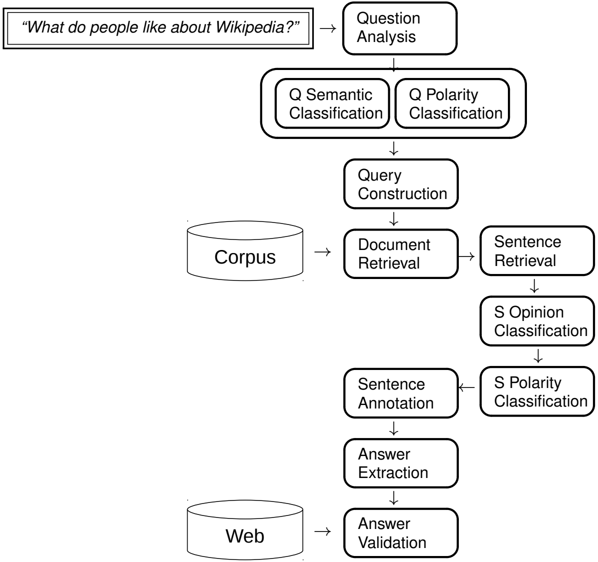

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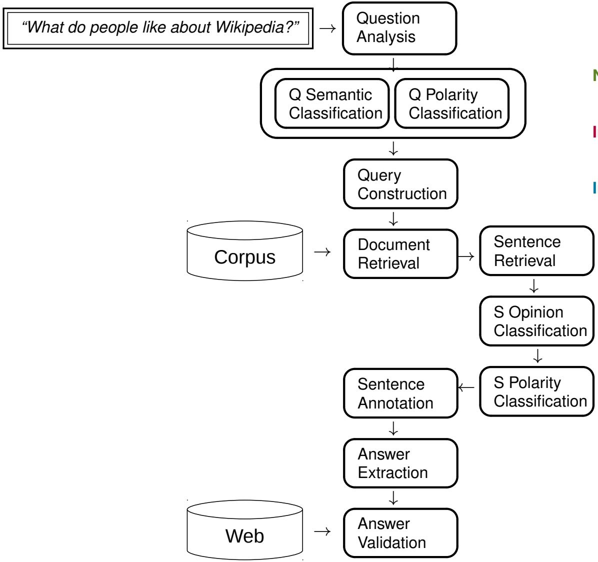
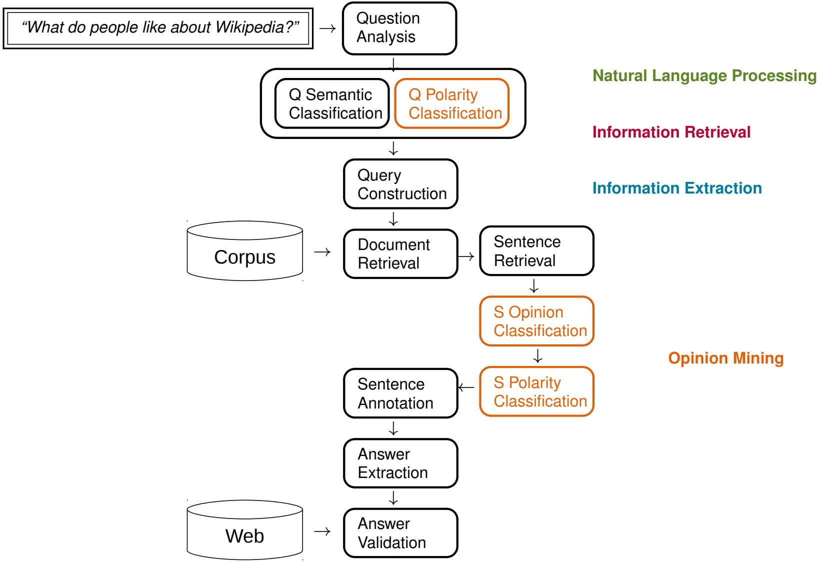


Natural Language Processing

Information Retrieval

Information Extraction

Architecture



Q Polarity Classification

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- Running in parallel with question classification
- Task:
  - Decide whether the input question has a positive or negative polarity

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examples:


“What do people like about Wikipedia?”


“Why people hate reading Wikipedia articles?”

Q Polarity Classification

- Running in parallel with question classification

- Task:
  - Decide whether the input question has a positive or negative polarity

- Approaches:
  - Using a rule-based model based on subjectivity lexicon
  - Running a classifier trained on an annotated corpus
    - Training on overall vocabulary of the dataset
    - Training on all polarity expressions from the subjectivity lexicon

S Opinion Classification

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  - Sentence retrieval output is mixed (factual & opinionated)
  - Opinion question answering systems are looking for opinionated sentences

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Question: *“What do people like about Wikipedia?”*

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examples:

S1: *"I agree Wikipedia is very much in handy when your online; however, I can not use it when I am not online."*

S2: *"Wikipedia began as a complementary project for Nupedia, a free online English-language encyclopedia project."*

S3: *"Jimmy Wales and Larry Sanger co-founded Wikipedia in January 2001."*

S4: *"Wikipedia is a great way to access lots of information."*

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Opinion

S1: *"I agree Wikipedia is very much in handy when your online; however, I can not use it when I am not online."*

S4: *"Wikipedia is a great way to access lots of information."*

Fact

S2: *"Wikipedia began as a complementary project for Nupedia, a free online English-language encyclopedia project."*

S3: *"Jimmy Wales and Larry Sanger co-founded Wikipedia in January 2001."*

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  - Sentence retrieval output is mixed (factual & opinionated)
  - Opinion question answering systems are looking for opinionated sentences
- Goal:
  - Classifying retrieved sentences as opinionated or factual.
- Approaches:
  - Running a classifier trained on an annotated corpus
    - SVM
    - Maximum Entropy
    - Naive Bayes

S Polarity Classification

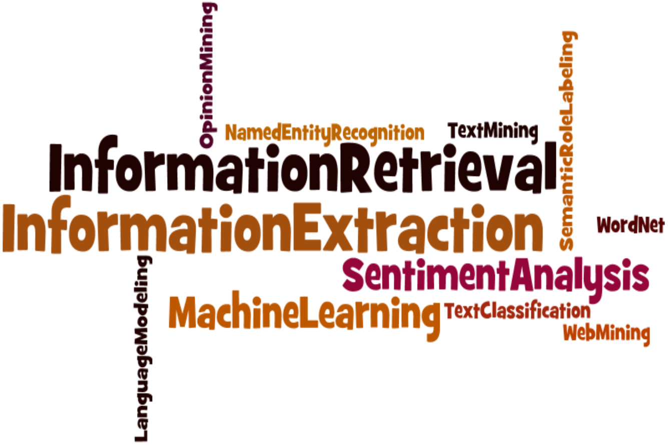
- Task:
  - Distinguishing between positive and negative sentences
  - Returning sentences which have the same polarity as the input question

- Approach:
  - Using a classifier to classify opinionated sentences as positive or negative
    - Using a small set of lightweight linguistic polarity features
    - Considering the distance between polarity features and the topic in the sentence
    - Using a dependency parser to consider syntactic features

Outline

1. Introduction
2. History
3. QA Architecture
   - Factoid QA
   - Opinion QA
4. Summary

Summary


OpinionMining
NamedEntityRecognition
TextMining
SemanticRoleLabeling
InformationRetrieval
InformationExtraction
WordNet
SentimentAnalysis
LanguageModeling
MachineLearning
TextClassification
WebMining

Next Semester

Master Seminar on Question Answering Systems

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Master Seminar on Question Answering Systems

- Question Analysis
- Q Semantic Classification
- Q Polarity Classification
- Query Construction
- Document Retrieval
- Sentence Retrieval
- S Opinion Classification
- S Polarity Classification
- Sentence Annotation
- Answer Extraction
- Answer Validation