

Question Answering Systems

An Introduction

Potsdam, Germany, 17 October 2011

Saeedeh Momtazi
Information Systems Group

Outline

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1 Introduction

Outline

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- 1 Introduction
- 2 History

Outline

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

Outline

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

Outline

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- 1 Introduction
- 2 History
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 - Factoid QA
 - Opinion QA
- 4 Summary

Why QA

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Why QA

4



Why QA

4

Who is Warren Moon's agent?

Search




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](#) -
Cached - Similar -   

[Warren Moon Speaker, Warren Moon Appearance, Warren Moon ...](#)

Whether you are looking for a **Warren Moon** speaker event, **Warren Moon** appearance, or **Warren Moon** endorsement, TSE Speakers will help you book **Warren Moon** and ...
[athletes-celebrities.tseworld.com/sports/.../warren-moon.php](#) - Cached - Similar -   

[Warren Moon Speaker Warren Moon Booking Agent Warren Moon Appearance](#)

Call 1.800.966.1380 for **Warren Moon** speaker, **Warren Moon agent** and appearance info. Find out how to hire or book **Warren Moon** and how to contact **Warren Moon** ...
[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 ...](#)

Why QA

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call for sports celebrity booking **1.888.246.7141**

ABOUT US | ATHLETE APPEARANCES | RECENT BOOKINGS | EVENTS | ATHLETE MARKETING | CONTACT

[>>> Request An Athlete Appearance](#)

START YOUR BOOKING REQUEST

Your Name

Company Name

Phone

Athlete(s) Interested For Booking

[>>> CONTINUE TO BOOKING FORM](#)

CELEBRITY ATHLETE SEARCH

Search By Name

Search By Category

Search By Booking Fee

Search for an Athlete...

BOOKING ATHLETES FOR:

- < Corporate Appearances
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- < Celebrity Appearances
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Warren Moon [Request Info for Booking Warren Moon Appearance](#)
[Call 1.888.246.7141 to Hire Warren Moon](#)



Sports Celebrity Category: Football Celebrities, Hall of Famer Athletes
Warren Moon Available For: Corporate Appearances, Endorsements, Speaking & Autograph Signings
Warren Moon Appearance Booking Fee Range: Call 888.246.7141 for Booking Fees
[>>> Contact Booking Agent to Hire Warren Moon for an Appearance or Endorsement](#)

[Print Warren Moon's Bio](#) [Bookmark Warren Moon's Bio](#) [Email Warren Moon's Bio](#)

At AthletePromotions.com, we provide information about Warren Moon's accomplishments, achievements, statistics, accolades and appearance booking fees. We assist corporations in finding Warren Moon's agent, contacting Warren Moon's management company and business manager, booking Warren Moon appearances, hiring Warren Moon for endorsements, Warren Moon autograph signings, and Warren Moon speaking engagements. We are an athlete booking agency and sports marketing agency that also hires Warren Moon for corporate event appearances, celebrity golf tournaments, tradeshows, conventions, store grand openings, licensing deals, print advertising and television commercials.

Warren Moon is now available for corporate event appearances, personal appearances, casino appearances, tradeshows appearances, corporate golf tournaments, sports camps, autograph signings, endorsement deals, television commercials, radio commercials, store grand openings, new product launch campaigns, spokesperson campaigns and speaking appearances. Book Warren Moon to meet and mingle with your best corporate clients, friends and business associates. Contact us to find out about Warren Moon booking fees, availability and appearance schedule.

If your company is interested in finding out booking fees and availability for hiring Warren Moon for an appearance, endorsement or speaking engagement, call us at **1.888.246.7141** or fill out the form below.

[>>> Submit Warren Moon Appearance Booking Request Here](#)

WARREN MOON VIDEO HIGHLIGHTS:

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 ...](#)

Search

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[Appearance](#)
Find

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Why QA

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The screenshot shows the website for TSE Speakers, a company specializing in athlete and celebrity marketing. The page features a navigation menu with categories like Home, About TSE, Case Studies, Partners, Clients, and Contact Us. A main header reads 'ATHLETE & CELEBRITY MARKETING'. A left sidebar contains a 'Main Menu' with links to various sports and entertainment categories. The central content area displays a profile for Warren Moon, including a photo, his title as an NFL Hall of Famer, birth information, and a list of services he offers. A 'CONTACT TSE SPEAKERS' section is also visible, along with a search box for finding talent and a table listing top football talent.

TSE
SPORTS & ENTERTAINMENT

www.tsespeakers.com | toll free: 1.866.520.7081

HOME ABOUT TSE CASE STUDIES PARTNERS CLIENTS CONTACT US

ATHLETE & CELEBRITY MARKETING

CORPORATE HOSPITALITY ATHLETE & CELEBRITY MARKETING PROMOTIONS MEETINGS & INCENTIVES GOLF

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 suggested. So he hung out with the Edman team to a pair of...

CONTACT TSE SPEAKERS

For more information about booking athletes and celebrities with the help of TSE Speakers, please fill our [detailed contact form](#) or call us at (866) 520-7081 to speak with a dedicated TSE representative.

FIND TALENT

SEARCH BOX

name / bio keyword
Price Range
Role
Category
Submit Search

TOP FOOTBALL TALENT

| Criteria | Top Football Talent |
|--------------------|---------------------|
| 01. Aikman, Troy | Football |
| 02. Bettis, Jerome | Football |
| 03. Marino, Dan | Football |

[Press Release: A New Moon, A New Genre and a New Digital Diva ...](#)

Why QA

HPI

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pfP SPORTS & CELEBRITY TALENT AGENCY CALL US TOLL FREE 800.966.1380

RECENT BOOKINGS: Ron Javorski for Glaxo Smith Kline Clinton Portis for Pizza Hut Ronnie Lott for Hevlett-Packard Dusty D


Request Booking Info Select by Topic Select by Name Select by State Select by Fee

Speakers
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Celebrity Speakers
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Humorous Speakers
Inspirational Speakers
Journalists and Writers
Keynote Speakers
Motivational Speakers
Political Speakers
Popular Speakers
Religious Speakers
Sports Speakers
Technology Speakers
University Speakers
Women Speakers

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Adventurers
Athlete Endorsement
Auto Racing
Baseball
Basketball
Boxing
Broadcasters
Christian Athletes
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 availability 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

Search

rance

Related Speakers

| | |
|---|--|
|  | Randall Cunningham Bio More Info |
|  | Jim Kelly Bio More Info |
|  | Dan Fouts Bio More Info |
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pfp SPORTS & CELEBRITY TALENT AGENCY

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Request Booking Info Select by Topic Select by Name Select by State Select by Fee

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- Sports Speakers
- Technology Speakers
- University Speakers
- Women Speakers

Sports

- Adventurers
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- Baseball
- Basketball
- Boxing
- Broadcasters
- Christian Athletes
- Coaches
- Female Athletes
- Football
- Golf

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Prior to the 1979 NFL Draft, some NFL scouts suggested that since University of Washington quarterback Warren Moon had played in a

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Related Speakers

-  **Randall Cunningham**
[Bio](#) | [More Info](#)
-  **Jim Kelly**
[Bio](#) | [More Info](#)
-  **Dan Fouts**
[Bio](#) | [More Info](#)
-  **Jim Zorn**
[Bio](#) | [More Info](#)
-  **Dan Iversen**

Search

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SPORTS & CELEBRITY TALENT AGENCY CALL US TOLL FREE 800.966.1380

RECENT BOOKINGS: Elliot for Radspace Howie Long for Compuware Jerome Bettis for Federated Investors Mike Eruzione for

Request Booking Info Select by Topic Select by Name Select by State Select by Fee

Speakers You are here: Speakers Bureau > Sports Speakers > Football > Warren Moon

All Athletes All Speakers

Warren Moon

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Smart BETA **QandA** Answers from sources you can trust

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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](#)

[E-mail this answer](#)
[Link to this answer](#)

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[www.letmepay.co.uk/Elite_Tennis_UK](#)

Female Athletes
Football
Four

Prior to the 1979 NFL Draft, some NFL scouts suggested that since University of Washington quarterback Warren Moon had played in a

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Why QA

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The screenshot shows the Answers.com website interface. At the top, there is a search bar with the text "Search" and a "Go" button. Below the search bar, the main content area displays the search results for "Warren Moon". The page is divided into several sections:

- Ask:** A green bar with the text "Enter a question or phrase..." and a search input field containing "Warren Moon".
- Answer:** A blue bar with the text "Warren Moon" and a "Go" button.
- On this page:** A sidebar menu with categories like "Black Biography", "Columbia Ency.", "Wikipedia", "Copyrights", "Library", "Animal Life", "Business & Finance", "Entertainment & Arts", "Food & Cooking", "Health", "History, Politics, Society", "Home & Garden", "Law & Legal Issues", "Literature & Language", "Miscellaneous", "Religion & Spirituality", "Science", "Shopping", "Sports", "Technology", "Travel".
- Warren Moon:** The main article content, including a "Black Biography" section, a "Personal Information" section, and a "Life's Work" section.
- Related answers:** A section with a list of related questions and answers.
- Advertisements:** Several ads are visible, including one for "WIRST DU MILLIONÄR" and another for "Wo wurde das erste Bier gebraut?".

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

Saeedeh Momtazi | QA | 17 October 2011

Why QA

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The screenshot shows a search engine interface with a search bar at the top right containing the word "Moon". Below the search bar, there are several search results. The first result is a snippet from a page about Moon's career, mentioning his performance in 1977 and 1978. The second result is a snippet about Moon's performance in 1983. The third result is a snippet about Moon's contract with the Seattle Seahawks. The fourth result is a snippet about Moon's contract with the Houston Oilers. The fifth result is a snippet about Moon's contract with the St. Louis Post-Dispatch. The search engine interface also includes a "Search" button and a "View" link.

Decade easy to put Moon's fate on the team's failure. Showing great [restraint](#), Moon refused to 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 3,336 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

Why QA

5



Why QA

5



Why QA

5



Why QA

5

Who is Warren Moon's agent?

Answer



Why QA

5

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

6



QA vs. SE

6

longer input →



QA vs. SE

6

longer input →

keywords



natural language questions



QA vs. SE

6

longer input →

keywords



natural language questions



shorter output →

QA vs. SE

6

longer input →

keywords

natural language questions



documents

short answer strings

shorter output →

QA Types

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Closed-domain

only answer questions from a specific domain.

Open-domain

answer any domain independent question.

Outline

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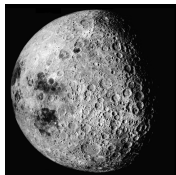
History

9

- **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

12

Closed-domain QA \Rightarrow Open-domain QA

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

Open-domain QA

12

Closed-domain QA \Rightarrow 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

12

Closed-domain QA \Rightarrow 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

12

Closed-domain QA \Rightarrow 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

- 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

The logo for the START system, featuring the word "START" in a stylized, blue, serif font. The letter "S" is significantly larger and more decorative than the other letters.

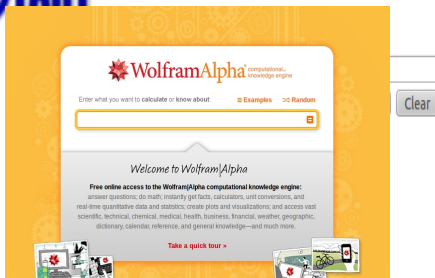
Natural Language Question Answering System

Open-domain QA

13

- START [Katz, 1997]
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START



Open-domain QA

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START



Open-domain QA

13

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IBM Watson

14

- 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

<http://www.youtube.com/watch?v=3G2H3DZ8rNc>



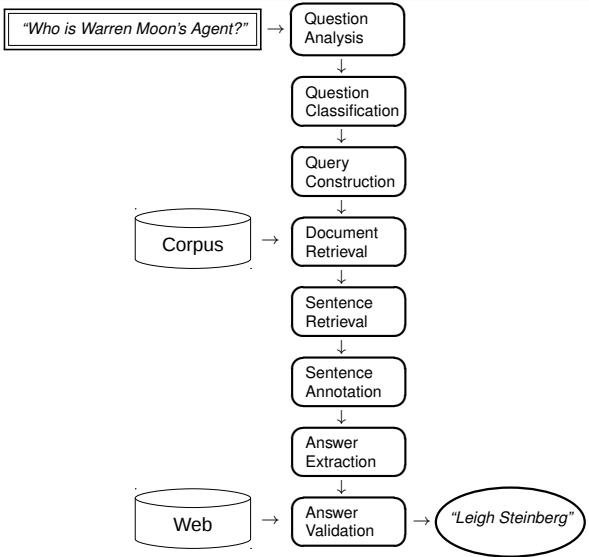
Outline

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- 1 Introduction
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Architecture

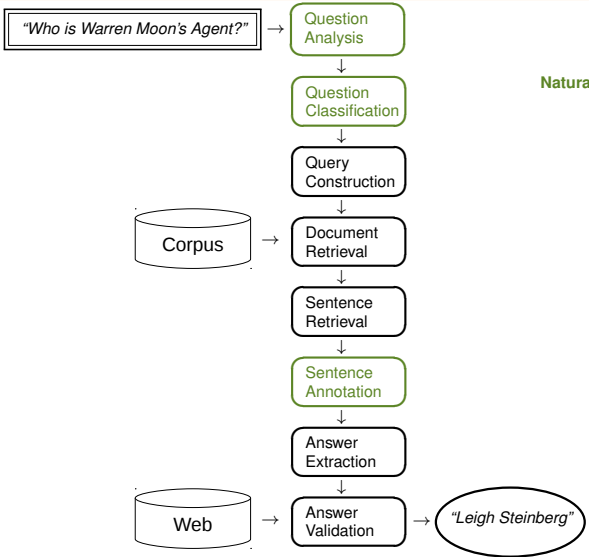
16



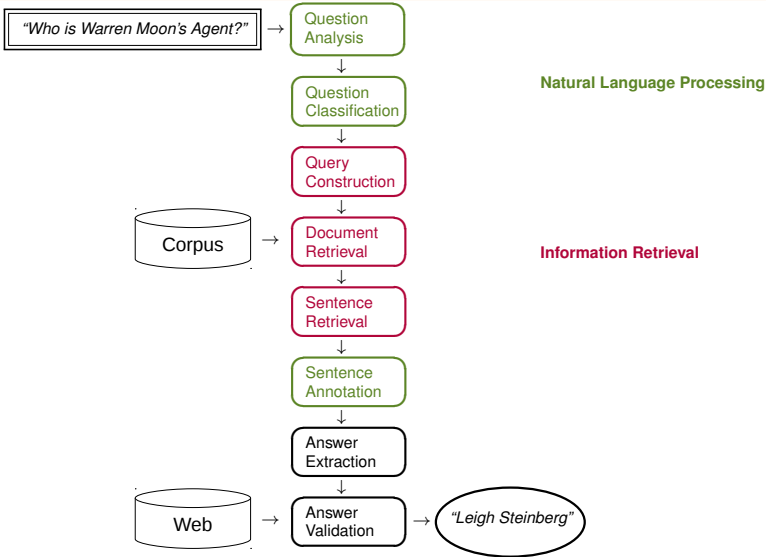
Architecture

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Natural Language Processing

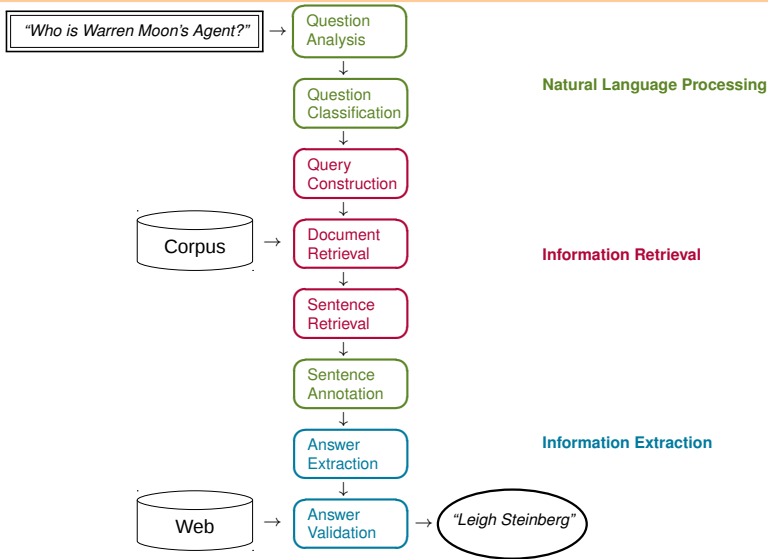


Architecture



Architecture

16



Question Analysis

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

Question Analysis

17

■ Target Extraction

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

■ Pattern Extraction

- Extracting a pattern from the question
- Matching the pattern with a list of pre-defined question patterns
- Finding the corresponding answer pattern
- Realizing the position of the answer in the sentence at the answer extraction step

Question Analysis

■ Target Extraction

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

■ Pattern Extraction

- Extracting a pattern from the question
- Matching the pattern with a list of pre-defined question patterns
- Finding the corresponding answer pattern
- Realizing the position of the answer in the sentence at the answer extraction step

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

17

■ Target Extraction

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

■ Pattern Extraction

- Extracting a pattern from the question
- Matching the pattern with a list of pre-defined question patterns
- Finding the corresponding answer pattern
- Realizing the position of the answer in the sentence at the answer extraction step

Question Analysis

17

■ Target Extraction

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

■ Pattern Extraction

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

- 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

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Example:

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

Type: *Country*

Question Classification

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

Question Classification

■ Classification taxonomies

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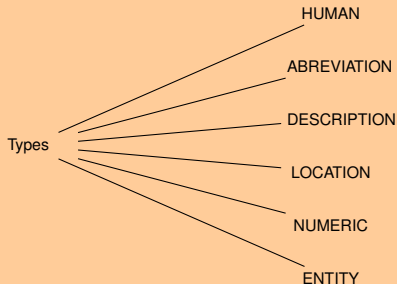
Question Classification

19

■ Classification taxonomies

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6 coarse- and 50 fine-grained classes



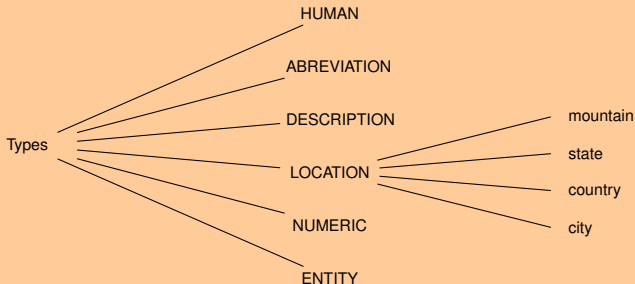
Question Classification

19

■ Classification taxonomies

- BBN
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- Li & Roth

6 coarse- and 50 fine-grained classes



Question Classification

20

- Using available classifiers based on the favorite model
 - Support Vector Machine: SVM-light
 - Maximum Entropy: Maxent, Yasmex
 - Naive Bayes

Query Construction

21

- 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

22

- 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

23

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

Document Retrieval

23

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

- Using available information retrieval toolkits



Sentence Retrieval

24

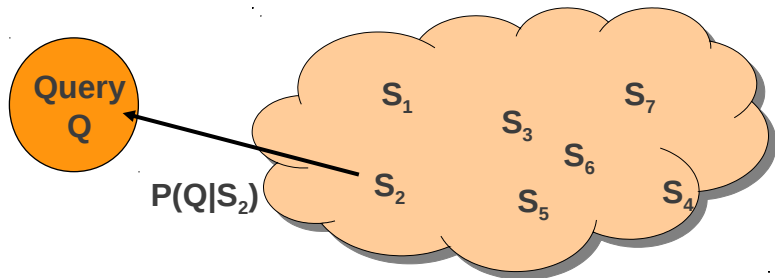
- Task:
 - Finding a small segment of text that contains the answer

- 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

25

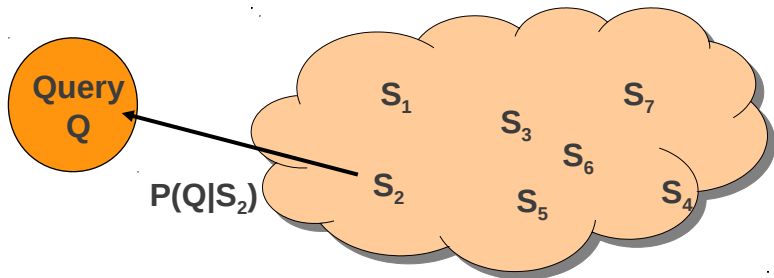
- Language model-based sentence retrieval



Sentence Retrieval

25

- Language model-based sentence retrieval



Query likelihood model:

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

Sentence Retrieval

26

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

Sentence Retrieval

26

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

Example:

Question: *"Who invented the first automobile?"*

Answer Sentence: *"The first car was built by Karl Benz."*

Sentence Retrieval

26

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

- Approaches:

Sentence Retrieval

26

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Sentence Retrieval

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Does not work at
sentence-level retrieval

Sentence Retrieval

26

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

- Approaches:
 - Query expansion, (Pseudo-)Relevance Feedback

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

Does not work at sentence-level retrieval

Sentence Annotation

27

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

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Sentence Annotation

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- Annotating relevant sentences using linguistic analyses:
 - Named entity recognition
 - Dependency parsing
 - Noun phrase chunking
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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.*”

Sentence Annotation

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 - Named entity recognition
 - Dependency parsing
 - Noun phrase chunking
 - Semantic role labeling

Example (NER):

Sentence1: “Albert Einstein was born on 14 March 1879 .”
Person Name
Date

Sentence2: “Albert Einstein was born in Germany .”
Person Name
Country

Sentence3: “Albert Einstein was born in a Jewish family.”
Person Name
Religion

Answer Extraction

28

- 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
 - All annotated data from sentence annotation

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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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Sentence3: "Albert Einstein was born in a Jewish family."
Person Name *Religion*

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Person Name
Religion

Answer Validation

29

- 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

30

- Query model:
 - Bag-of-Word
 - Noun-Phrase-Chunks
 - Declarative-Form

Answer Validation

30

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Example:

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

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

Answer Candidate: *Germany*

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Bag-of-Word:

Albert Einstein born Germany

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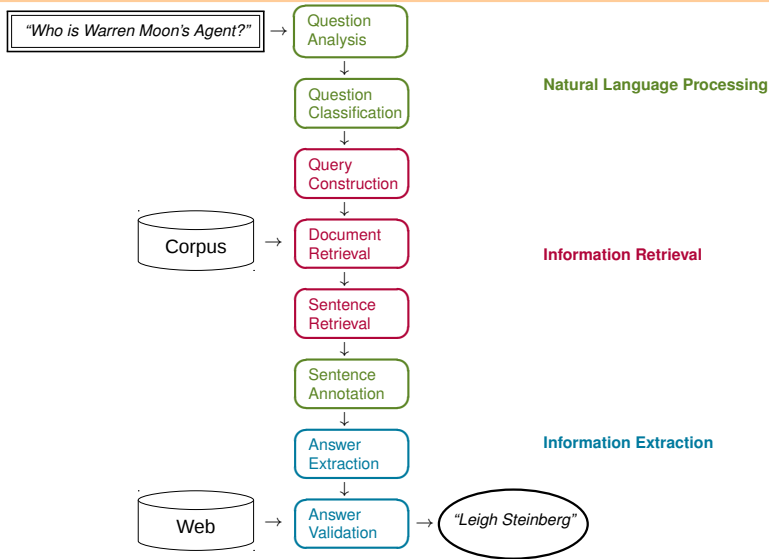
“Albert Einstein” born Germany

Declarative-Form:

“Albert Einstein born Germany”

Architecture

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Fact vs. Opinion

32

- 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

33

- 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?”

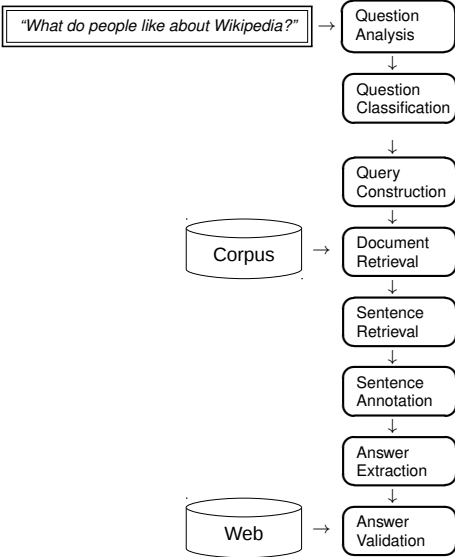
Outline

34

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

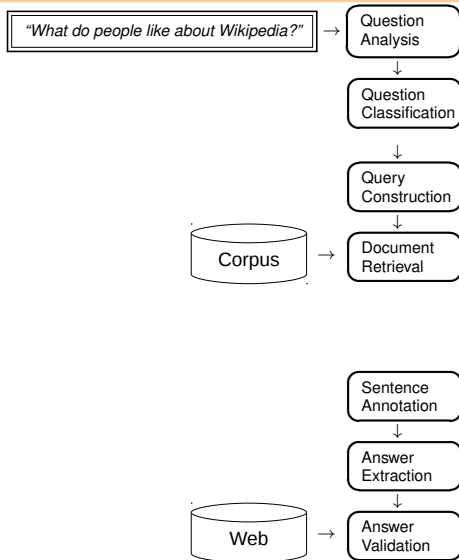
Architecture

35



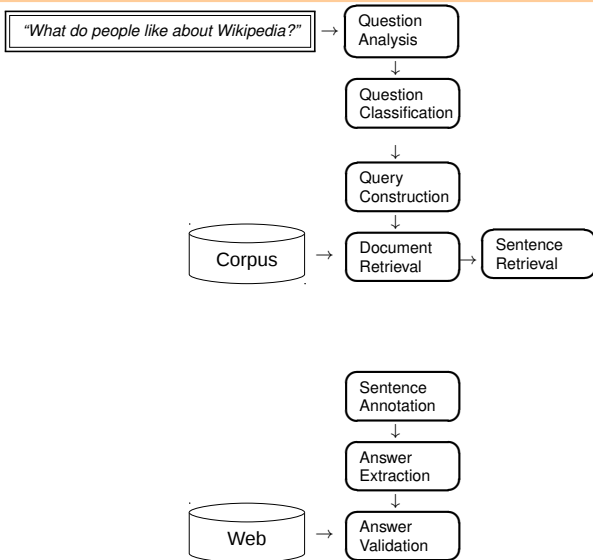
Architecture

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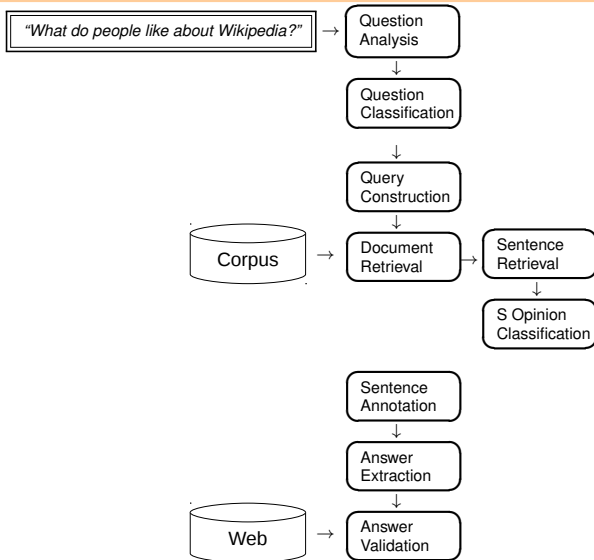
Architecture

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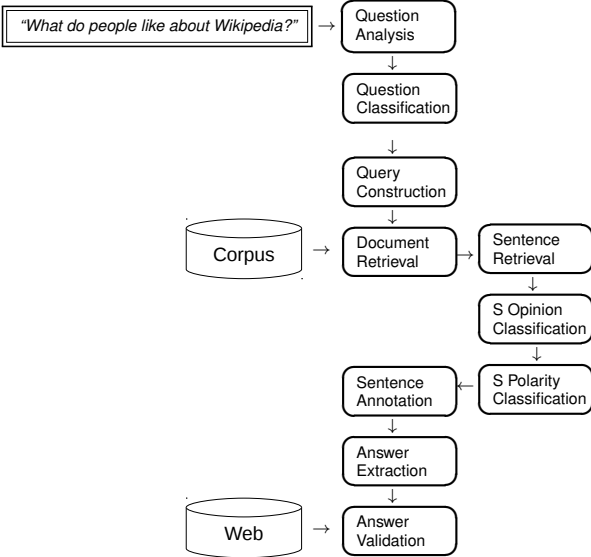
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35



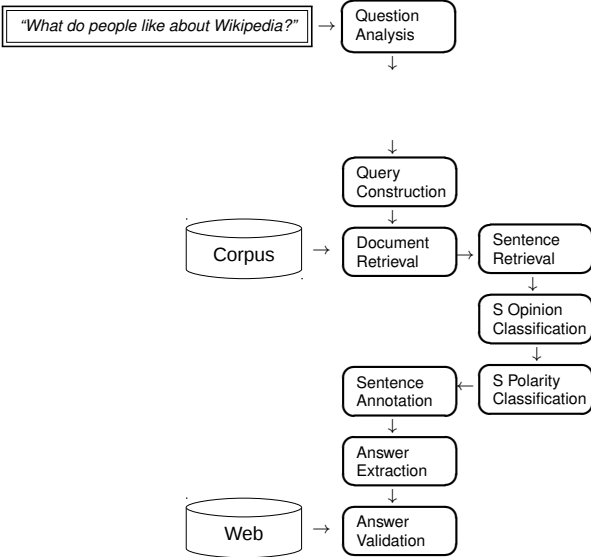
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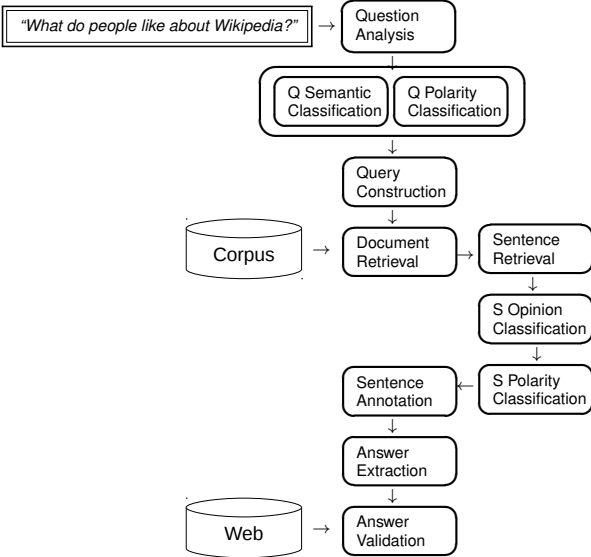
Architecture

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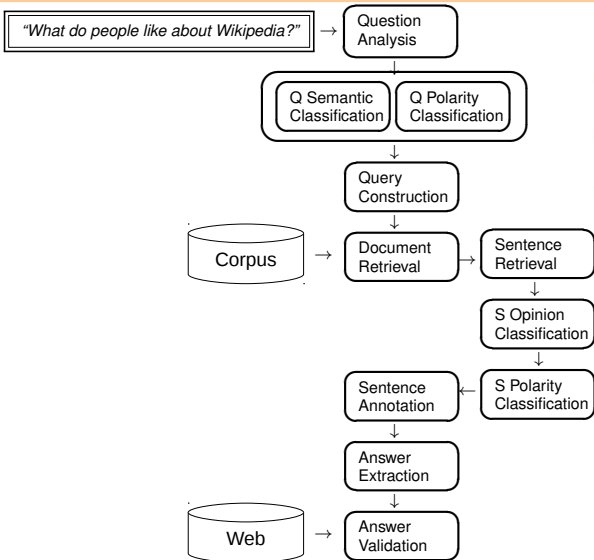
Architecture

35



Architecture

35



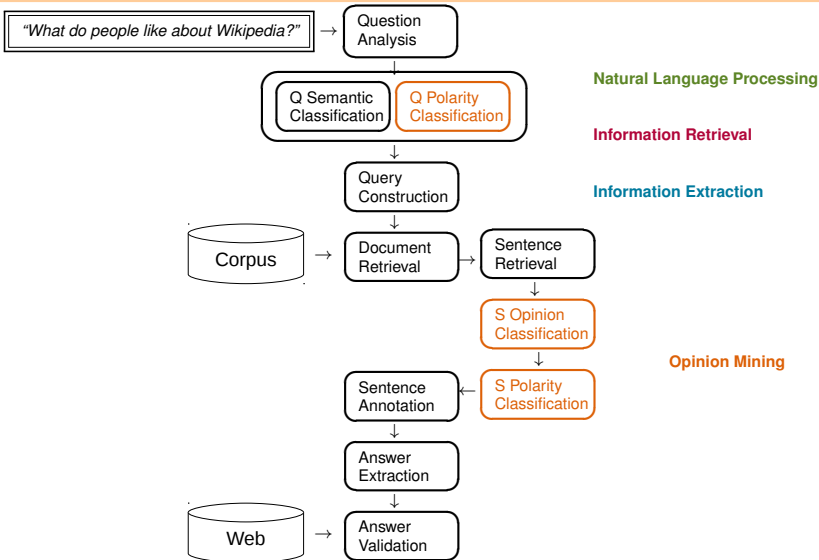
Natural Language Processing

Information Retrieval

Information Extraction

Architecture

35



Q Polarity Classification

36

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

Q Polarity Classification

36

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

examples:



“What do people like about Wikipedia?”



“Why people hate reading Wikipedia articles?”

Q Polarity Classification

36

- 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

37

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

S Opinion Classification

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- Goal:
 - Classifying retrieved sentences as opinionated or factual.

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examples:

Question: *"What do people like about Wikipedia?"*

S Opinion Classification

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 - Sentence retrieval output is mixed (factual & opinionated)
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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."*

S Opinion Classification

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- Importance:
 - 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

38

■ 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

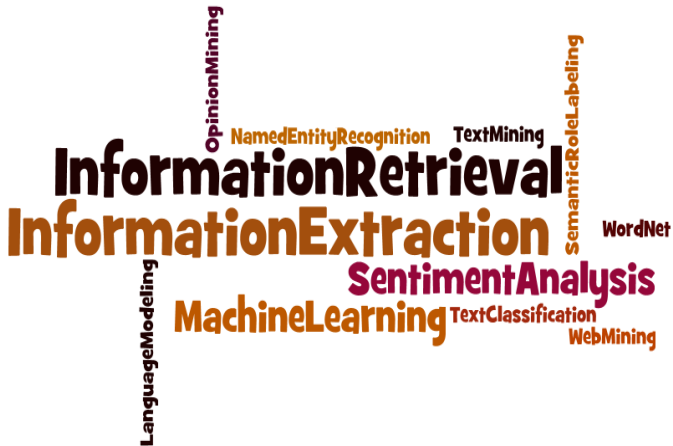
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Summary

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Master Seminar: 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

