Open Domain Question Answering

Bogdan Sacaleanu

(based on slides from Bernardo Magnini, RANLP 2005)

Outline of the Tutorial

I.   **Introduction to QA**

II. **QA at TREC**

III. **System Architecture**

        - Question Processing

        - Answer Extraction

IV. **Cross-Language QA**

I. Introduction to Question Answering

What is Question Answering

Applications

Question Types

Answer Types

Evaluation

Presentation

Brief history

Query Driven vs Answer Driven Information Access

- What does LASER stand for?
- When did Hitler attack Soviet Union?
  - Using Google we find documents containing the question itself, no matter whether or not the answer is actually provided.
- Current information access is query driven.
- Question Answering proposes an answer driven approach to information access.

Question Answering

- Find the answer to a question in a large collection of documents
  - questions (in place of keyword-based query)
  - answers (in place of documents)

Why Question Answering?
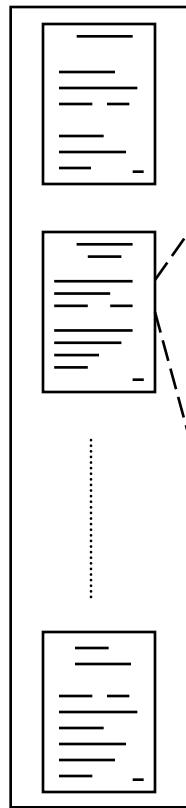
Document collection

From the Caledonian Star in the Mediterranean – September 23, 1990 (www.expeditions.com):

On a beautiful early morning the Caledonian Star approaches Naxos, situated on the east coast of Sicily. As we anchored and put the Zodiacs into the sea we enjoyed the great scenery. Under Mount Etna, the highest volcano in Europe, perches the fabulous town of Taormina. This is the goal for our morning.
After a short Zodiac ride we embarked our buses with local guides and went up into the hills to reach the town of Taormina.
Naxos was the first Greek settlement at Sicily. Soon a harbor was established but the town was later destroyed by invaders.[...]

Searching for: Taormina

Alternatives to Information Retrieval

Document Retrieval

- users submit queries corresponding to their information need
- system returns (voluminous) list of full-length documents
- it is the responsibility of the users to find their original information need, within the returned documents

Open-Domain Question Answering (QA)

- users ask fact-based, natural language questions

  What is the highest volcano in Europe?

- system returns list of short answers

  … Under Mount Etna, the highest volcano in Europe, perches the fabulous town …

- more appropriate for specific information needs

What is QA?

Find the answer to a question in a large collection of documents

What is the brightest star visible from Earth?

1. *Sirio A is the **brightest star visible from Earth** even if it is…*

2. *the planet is 12-times brighter than Sirio, the **brightest star** in the sky…*

QA: a Complex Problem (1)

Problem: discovery implicit relations among question and answers

Who is the author of the "Star Spangled Banner"?

…Francis Scott Key wrote the *"Star Spangled Banner" in 1814.*

…comedian-actress Roseanne Barr sang her famous rendition of the *"Star Spangled Banner"* before …

Problem: discovery implicit relations among question and answers

Which is the Mozart birth date*?*

…. Mozart (1751 – 1791) ….

QA: a complex problem (3)

Problem: discovery implicit relations among question and answers

Which is the distance between Naples and Ravello?

"From the Naples Airport follow the sign to Autostrade (green road sign). Follow the directions to Salerno (A3). Drive for about 6 Km. Pay toll (Euros 1.20). Drive appx. 25 Km. Leave the Autostrade at Angri (Uscita Angri). Turn left, follow the sign to Ravello through Angri. Drive for about 2 Km. Turn right following the road sign "Costiera Amalfitana". Within 100m you come to traffic lights prior to narrow bridge. Watch not to miss the next Ravello sign, at appx. 1 Km from the traffic lights. Now relax and enjoy the views (follow this road for 22 Km). Once in Ravello …".

QA: Applications (1)

Information access:

- Structured data (databases)
- Semi-structured data (e.g. comment field in databases, XML)
- Free text

To search over:

- The Web
- Fixed set of text collection (e.g. TREC)
- A single text (reading comprehension evaluation)

QA: Applications (2)

Domain independent QA

Domain specific (e.g. help systems)

Multi-modal QA
- Annotated images
- Speech data

QA: Questions (1)

Classification according to the **answer type**

- **Factual questions** (*What is the larger city …*)
- **Opinions** (*What is the author attitude …*)
- **Summaries** (*What are the arguments for and against…*)

Classification according to the **question speech act:**

- **Yes/NO questions** (*Is it true that …*)
- **WH questions** (*Who was the first president …*)
- **Indirect Requests** (*I would like you to list …*)
- **Commands** (*Name all the presidents …*)

QA: Questions (2)

Difficult questions

- **Why, How questions** require understanding causality or instrumental relations
- **What questions** have little constraint on the answer type (e.g. *What did they do?*)

QA: Answers

Long answers, with justification

Short answers (e.g. phrases)

Exact answers (named entities)

Answer construction:

- **Extraction**: cut and paste of snippets from the original document(s)
- **Generation**: from multiple sentences or documents
- QA and **summarization** (e.g. *What is this story about?)*

QA: Information Presentation

Interfaces for QA

- Not just isolated questions, but a dialogue
- Usability and user satisfaction

Critical situations

- Real time, single answer

Dialog-based interaction

- Speech input
- Conversational access to the Web

QA: Brief History (1)

NLP interfaces to databases:

- BASEBALL (1961), LUNAR (1973), TEAM (1979), ALFRESCO (1992)

- Limitations: structured knowledge and limited domain

Story comprehension: Shank (1977), Kintsch (1998), Hirschman (1999)
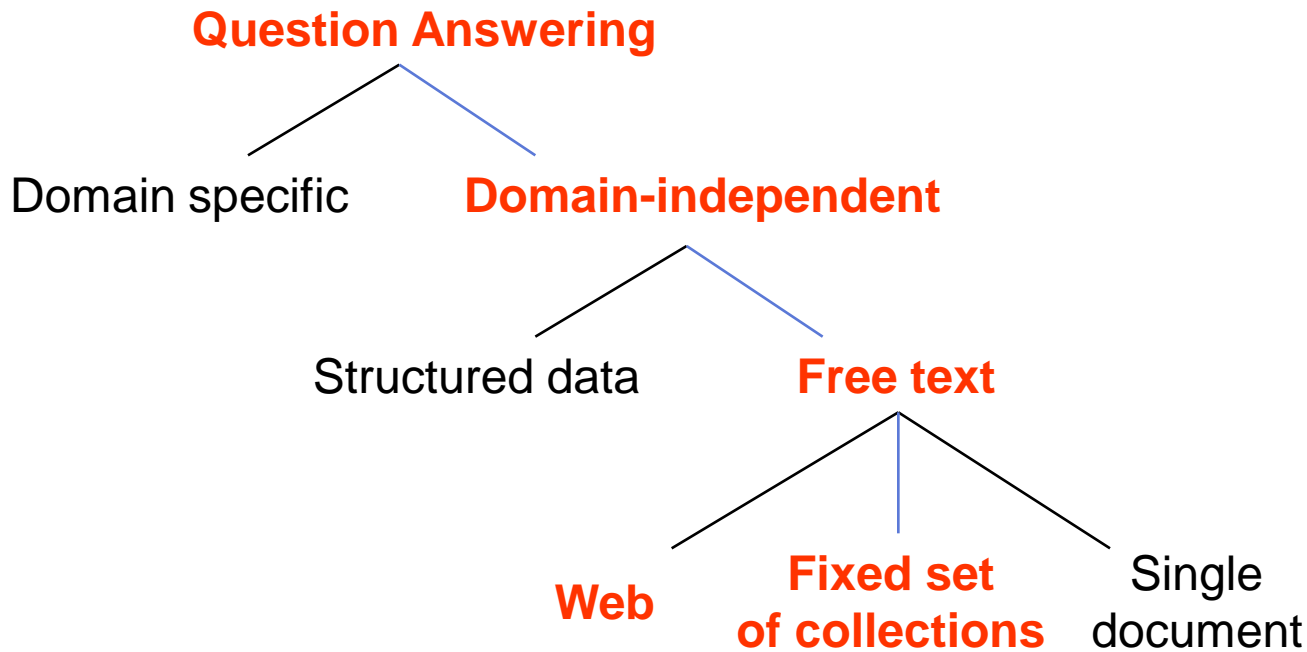
QA: Brief History (2)

Information retrieval (IR)

- Queries are questions
- List of documents are answers
- QA is close to passage retrieval
- Well established methodologies (i.e. Text Retrieval Conferences TREC)

Information extraction (IE):

- Pre-defined templates are questions
- Filled template are answers

Research Context (1)

Question Answering

Domain specific   **Domain-independent**

Structured data   **Free text**

Web   **Fixed set of collections**   Single document

Growing interest in QA (TREC, CLEF, NT evaluation campaign).

Recent focus on **multilinguality** and **context aware QA**

Research Context (2)

compactness

Automatic
Summarization
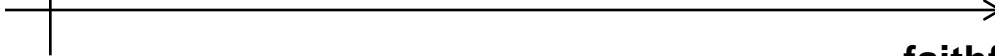
as compact as possible

**Automatic
Question Answering**

answers must be faithful w.r.t.
questions (**correctness**) and
compact (**exactness**)

Machine
Translation

as faithful as possible

faithfulness

II.   Question Answering at TREC

The problem simplified

Questions and answers

Evaluation metrics

Approaches

The problem simplified:
The Text Retrieval Conference

Goal

- Encourage research in information retrieval based on large-scale collections

Sponsors

- NIST: National Institute of Standards and Technology

- ARDA: Advanced Research and Development Activity

- DARPA: Defense Advanced Research Projects Agency

Since 1999

Participants are research institutes, universities, industries

TREC Questions

Q-1391: How many feet in a mile?

Q-1057: Where is the volcano Mauna Loa?

Q-1071: When was the first stamp issued? → **Fact-based**, short answer questions

Q-1079: Who is the Prime Minister of Canada?

Q-1268: Name a food high in zinc.

Q-896: Who was Galileo?

Q-897: What is an atom? → **Definition questions**

Q-711: What tourist attractions are there in Reims?

Q-712: What do most tourists visit in Reims?

Q-713: What attracts tourists in Reims → **Reformulation questions**

Q-714: What are tourist attractions in Reims?

Answer Assessment

Criteria for judging an answer

- **Relevance**: it should be responsive to the question
- **Correctness**: it should be factually correct
- **Conciseness**: it should not contain extraneous or irrelevant information
- **Completeness**: it should be complete, i.e. partial answer should not get full credit
- **Simplicity**: it should be simple, so that the questioner can read it easily
- **Justification**: it should be supplied with sufficient context to allow a reader to determine why this was chosen as an answer to the question

Questions at TREC

	Yes/ No	Entity	Definition	Opinion/ Procedure/ Explanation
Single answer	Is Berlin the capital of Germany?	What is the largest city in Germany ?	Who was Galileo?	
Multiple answer		Name 9 countries that import Cuban sugar		What are the arguments for and against prayer in school ?

Exact Answers

Basic unit of a response: [answer-string, docid] pair

An answer string must contain a complete, exact answer and nothing else.

What is the longest river in the United States?

The following are **correct, exact answers**

Mississippi,
the Mississippi,
the Mississippi River,
Mississippi River
mississippi

while none of the following are correct exact answers

At 2,348 miles the Mississippi River is the longest river in the US.
2,348 miles; Mississippi
Missipp
Missouri

Assessments

Four possible judgments for a triple

[Question, document, answer]

Rigth: the answer is appropriate for the question

Inexact: used for non complete answers

Unsupported: answers without justification

Wrong: the answer is not appropriate for the question

Question			
What is the capital city of New Zealand?	R 1530 XIE19990325.0298 Wellington
What is the Boston Strangler's name?	R 1490 NYT20000913.0267 Albert DeSalvo
What is the world's second largest island?	R 1503 XIE19991018.0249 New Guinea
What year did Wilt Chamberlain score 100 points?	U 1402 NYT19981017.0283 1962
Who is the governor of Tennessee?	R 1426 NYT19981030.0149 Sundquist
What's the name of King Arthur's sword?	U 1506 NYT19980618.0245 Excalibur
When did Einstein die?	R 1601 NYT19990315.0374 April 18 , 1955
What was the name of the plane that dropped the Atomic Bomb on Hiroshima?	X 1848 NYT19991001.0143 Enola
What was the name of FDR's dog?	R 1838 NYT20000412.0164 Fala
What day did Neil Armstrong land on the moon?	R 1674 APW19990717.0042 July 20 , 1969
Who was the first Triple Crown Winner?	X 1716 NYT19980605.0423 Barton
When was Lyndon B. Johnson born?	R 1473 APW19990826.0055 1908
Who was Woodrow Wilson's First Lady?	R 1622 NYT19980903.0086 Ellen
Where is Anne Frank's diary?	W 1510 NYT19980909.0338 Young Girl

R=**Right**, X=**ineXact**, U=**Unsupported**, W=**Wrong**

1402: What year did Wilt Chamberlain score 100 points?

DIOGENE: 1962

ASSESMENT: UNSUPPORTED

PARAGRAPH: NYT19981017.0283

Petty's 200 victories, 172 of which came during a 13-year
 span between 1962-75, may be as unapproachable as Joe DiMaggio's
56-game hitting streak or Wilt Chamberlain's 100-point game.

1506: What's the name of King Arthur's sword?

ANSWER: Excalibur
PARAGRAPH: NYT19980618.0245

ASSESMENT: UNSUPPORTED

`QUEST FOR CAMELOT,' with the voices of Andrea Carr, Gabriel Byrne, Cary Elwes, John Gielgud, Jessalyn Gilsig, Eric Idle, Gary Oldman, Bronson Pinchot, Don Rickles and Bryan White. Directed by Frederik Du Chau (G, 100 minutes). Warner Brothers' shaky entrance into the Disney-dominated sweepstakes of the musicalized animated feature wants to be a juvenile feminist ``Lion King'' with a musical heart that fuses ``Riverdance'' with formulaic Hollywood gush. But its characters are too wishy-washy and visually unfocused to be compelling, and the songs (by David Foster and Carole Bayer Sager) so forgettable as to be extraneous. In this variation on the Arthurian legend, a nondescript Celtic farm girl named Kayley with aspirations to be a knight wrests the magic sword Excalibur from the evil would-be emperor Ruber (a Hulk Hogan look-alike) and saves the kingdom (Holden).

1848: What was the name of the plane that dropped the Atomic Bomb on Hiroshima?

DIOGENE: Enola
PARAGRAPH: NYT19991001.0143

ASSESMENT: INEXACT

Tibbets piloted the Boeing B-29 Superfortress Enola Gay, which dropped the atomic bomb on Hiroshima on Aug. 6, 1945, causing an estimated 66,000 to 240,000 deaths. He named the plane after his mother, Enola Gay Tibbets.

1716: Who was the first Triple Crown Winner?

DIOGENE: Barton
PARAGRAPH: NYT19980605.0423

ASSESMENT: INEXACT

Not all of the Triple Crown winners were immortals. The first, Sir Barton, lost six races in 1918 before his first victory, just as Real Quiet lost six in a row last year. Try to find Omaha and Whirlaway on anybody's list of all-time greats.

1510: Where is Anne Frank's diary?

DIOGENE: Young Girl
PARAGRAPH: NYT19980909.0338

ASSESMENT: WRONG

Otto Frank released a heavily edited version of "B" for its first publication as "Anne Frank: Diary of a Young Girl" in 1947.

TREC Evaluation Metric: Mean Reciprocal Rank (MRR)

Reciprocal Rank = inverse of rank at which first correct answer was found:

$$[1, 0, 5, 0.33, 0.25, 0.2, 0]$$

MRR: average over all questions

Strict score: unsupported count as incorrect

Lenient score: unsupported count as correct

TREC Evaluation Metrics: Confidence-Weighted Score (CWS)

$$\frac{\text{Sum for i} = 1 \text{ to } 500 \ (\text{\#-correct-up-to-question i} \ / \ i)}{500}$$

System A:

1 → C
2 → W
3 → C
4 → C
5 → W

$$\frac{(1/1) + ((1+0)/2) + (1+0+1)/3) + ((1+0+1+1)/4) + ((1+0+1+1+0)/5)}{5}$$
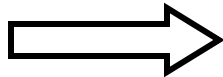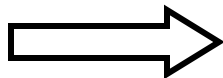
Total: 0.7

System B:

1 → W
2 → W
3 → C
4 → C
5 → C

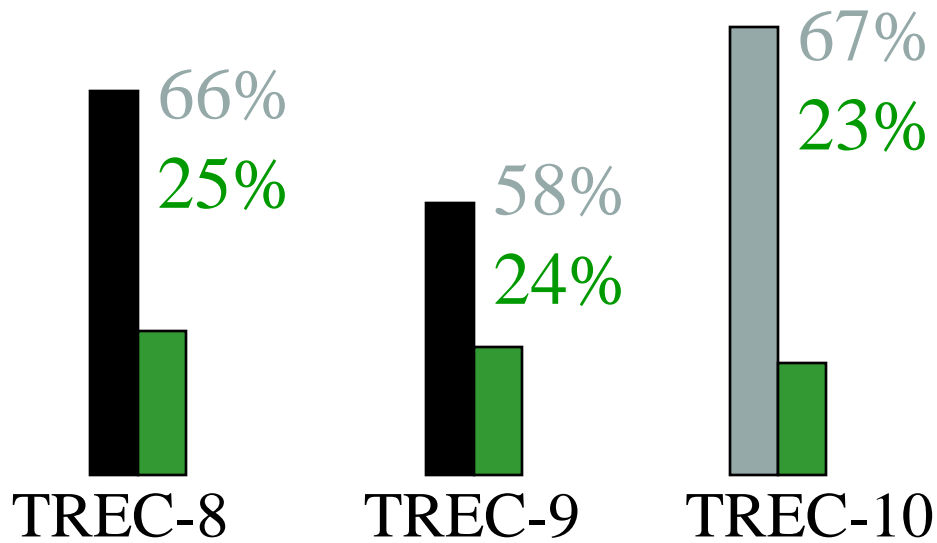$$\frac{0 + ((0+0)/2) + (0+0+1)/3) + ((0+0+1+1)/4) + ((0+0+1+1+1)/5)}{5}$$

Total: 0.29

Evaluation

Best result: 67%

Average over 67 runs: 23%

Main Approaches at TREC

Knowledge-Based

Web-based

Pattern-based

Knowledge-Based Approach

Linguistic-oriented methodology

- Determine the <u>answer type</u> from question form
- Retrieve small portions of documents
- Find entities matching the answer type category in text snippets

Majority of systems use a lexicon (usually **WordNet**)

- To find answer type
- To verify that a <u>candidate answer</u> is of the correct type
- To get definitions

Complex architecture…

Web-Based Approach
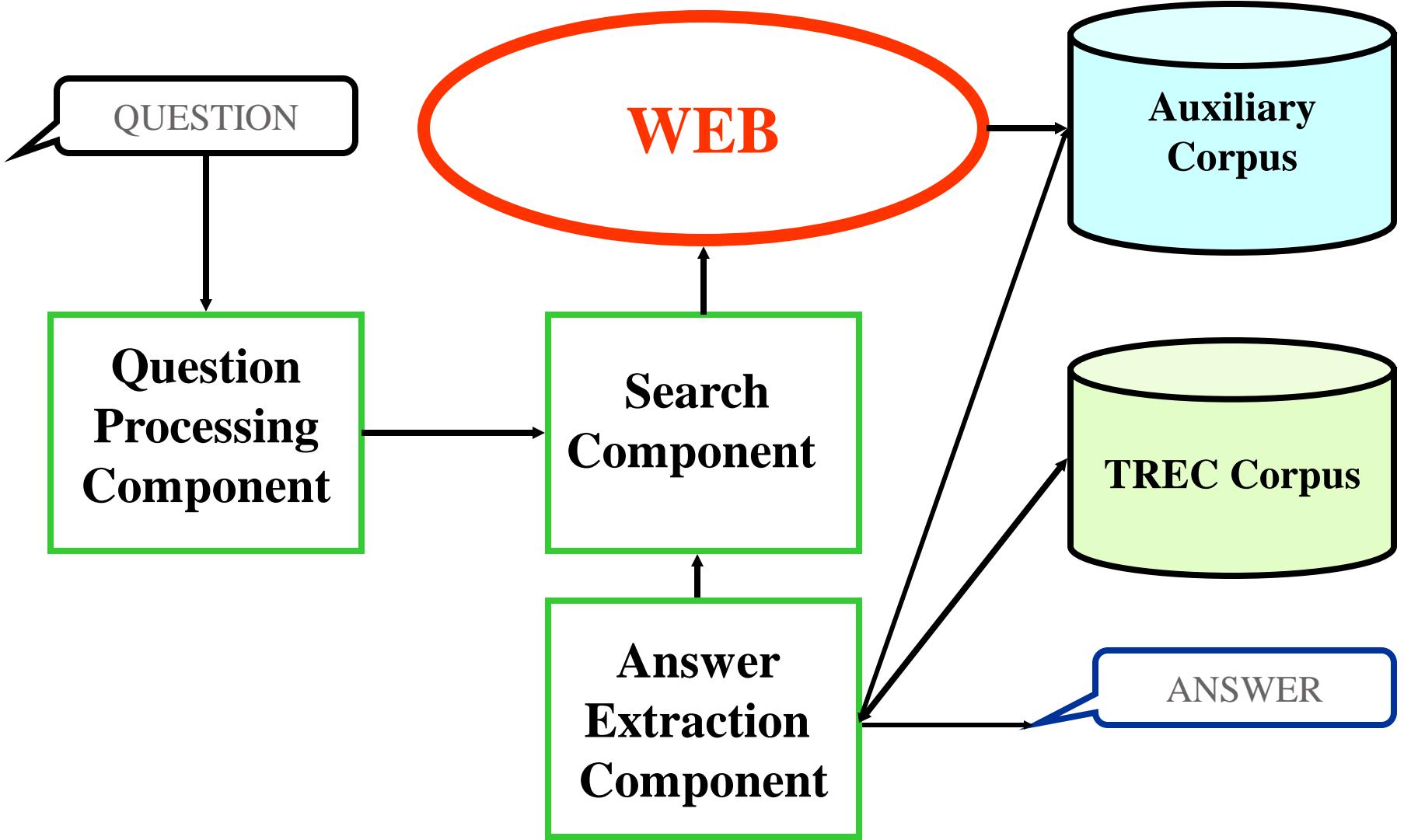
Pattern-Based Approach (1/3)

Knowledge poor

Strategy

- Search for predefined patterns of textual expressions that may be interpreted as answers to certain question types.
- The presence of such patterns in answer string candidates may provide evidence of the right answer.

Pattern-Based Approach (2/3)

Conditions

- Detailed categorization of question types

  Up to 9 types of the "Who" question; 35 categories in total

- Significant number of patterns corresponding to each question type

  Up to 23 patterns for the "Who-Author" type, average of 15

- Find multiple candidate snippets and check for the presence of patterns (emphasis on recall)

Pattern-based approach (3/3)

Example: patterns for definition questions

Question: What is A?

1. <A; is/are; [a/an/the]; X>   …23 correct answers
2. <A; comma; [a/an/the]; X; [comma/period]>   …26 correct answers
3. <A; [comma]; or; X; [comma]>   …12 correct answers
4. <A; dash; X; [dash]>   …9 correct answers
5. <A; parenthesis; X; parenthesis>   …8 correct answers
6. <A; comma; [also] called; X [comma]>   …7 correct answers
7. <A; is called; X>   …3 correct answers

**total: 88
correct answers**

Use of answer patterns

For generating queries to the search engine.

How did Mahatma Gandhi die?

Mahatma Gandhi die <HOW>

Mahatma Gandhi die of <HOW>

Mahatma Gandhi lost his life in <WHAT>

The TEXTMAP system (ISI) uses 550 patterns, grouped in 105 equivalence blocks. On TREC-2003 questions, the system produced, on average, 5 reformulations for each question.

For answer extraction

When was Mozart born?

P=1   <PERSON> (<BIRTHDATE> - DATE)

P=.69   <PERSON> was born on <BIRTHDATE>

Acquisition of Answer Patterns

Relevant approaches:

- Manually developed surface pattern library (Soubbotin, Soubbotin, 2001)
- Automatically extracted surface patterns (Ravichandran, Hovy 2002)

Patter learning:

1. Start with a seed, e.g. (Mozart, 1756)
2. Download Web documents using a search engine
3. Retain sentences that contain both question and answer terms
4. Construct a suffix tree for extracting the longest matching substring that spans <Question> and <Answer>
5. Calculate precision of patterns
   Precision = # of correct patterns with correct answer / # of total patterns

Capturing variability with patterns

Pattern based QA is more effective when supported by **variable typing** obtained using NLP techniques and resources.

When was <A> born?

<A:PERSON> (<ANSWER:DATE> -

<A :PERSON > was born in <ANSWER :DATE >

Surface patterns can not deal with word reordering and apposition phrases:

Galileo, the famous astronomer, was born in …

The fact that most of the QA systems use syntactic parsing demonstrates that the successful solution of the answer extraction problem goes beyond the surface form analysis
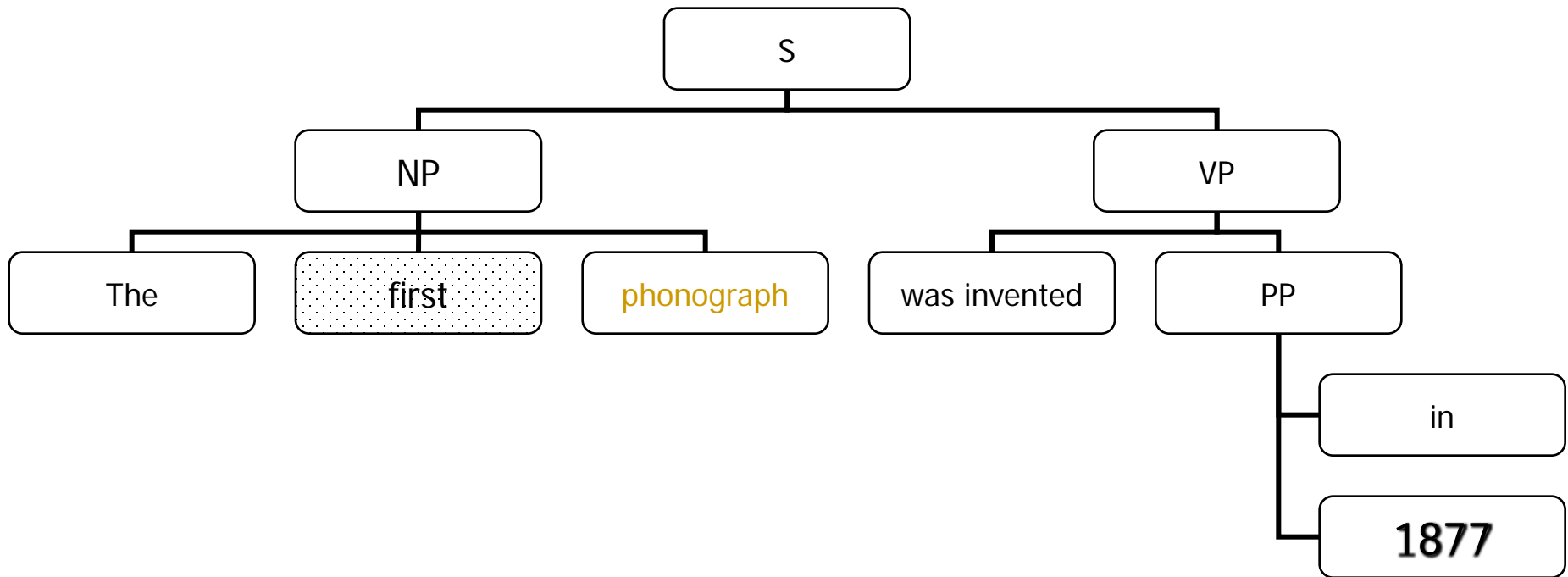
Syntactic answer patterns (1)

Answer patterns that capture the syntactic relations of a sentence.

When was <A> invented?
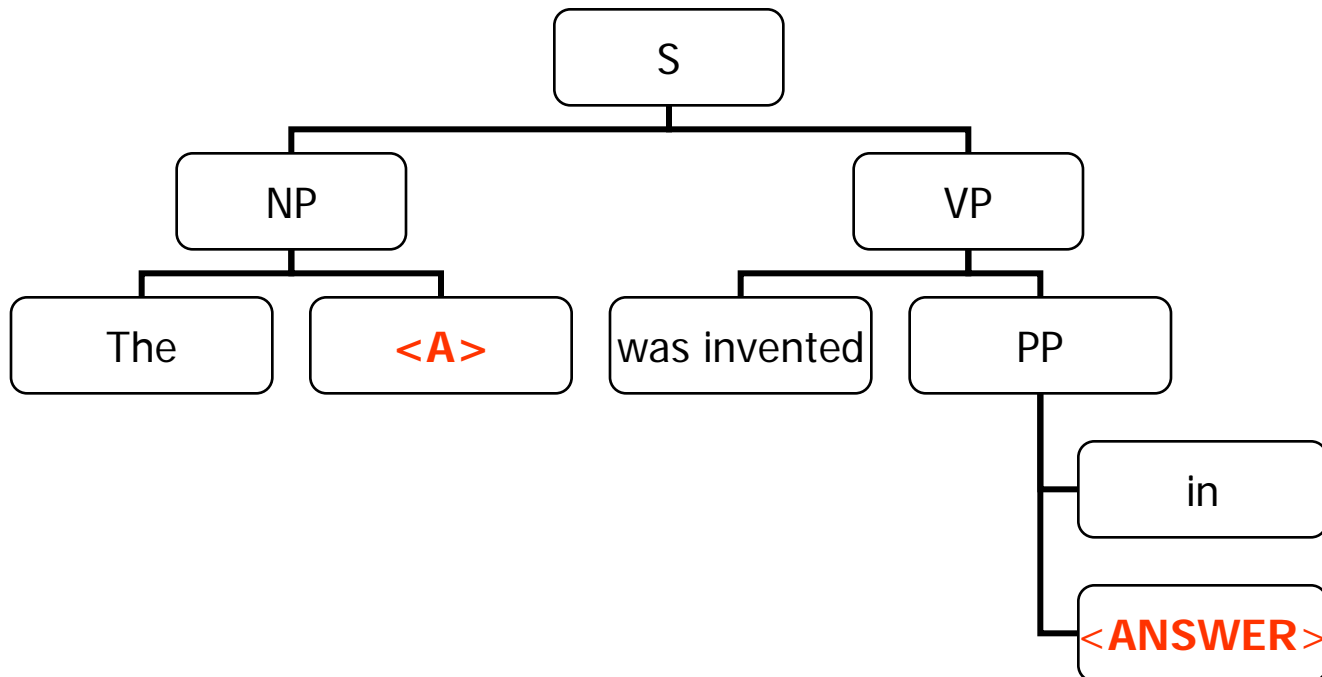
Syntactic answer patterns (2)

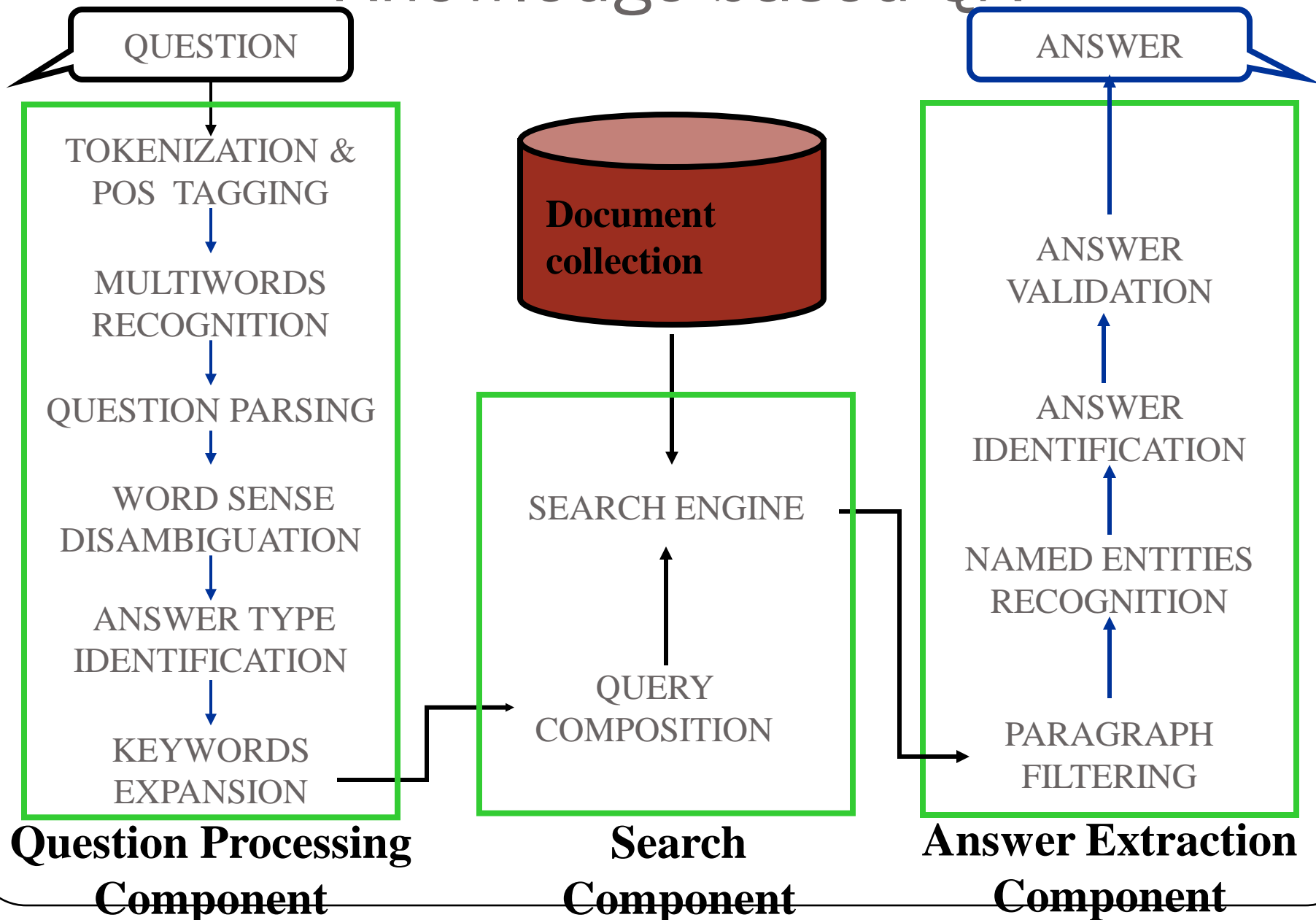The matching phase turns out to be a problem of partial match among syntactic trees.

III. System Architecture

Knowledge Based approach

- Question Processing
- Search component
- Answer Extraction

Knowledge based QA

QUESTION

ANSWER

Document collection

Question Processing Component

TOKENIZATION & POS TAGGING

MULTIWORDS RECOGNITION

QUESTION PARSING

WORD SENSE DISAMBIGUATION

ANSWER TYPE IDENTIFICATION

KEYWORDS EXPANSION

Search Component

SEARCH ENGINE

QUERY COMPOSITION

Answer Extraction Component

ANSWER VALIDATION

ANSWER IDENTIFICATION

NAMED ENTITIES RECOGNITION

PARAGRAPH FILTERING

Question Analysis (1)

Input: NLP question

Output:

- query for the search engine (i.e. a boolean composition of weighted keywords)

- Answer type

- Additional constraints: question focus, syntactic or semantic relations that should hold for a candidate answer entity and other entities

Question Analysis (2)

Steps:

1. Tokenization
2. POS-tagging
3. Multi-words recognition
4. Parsing
5. Answer type and focus identification
6. Keyword extraction
7. Word Sense Disambiguation
8. Expansions

Tokenization and POS-tagging

NL-QUESTION: *Who was the inventor of the electric light?*

Who	Who	CCHI	[0,0]
was	be	VIY	[1,1]
the	det	RS	[2,2]
inventor	inventor	SS	[3,3]
of	of	ES	[4,4]
the	det	RS	[5,5]
electric	electric	AS	[6,6]
light	light	SS	[7,7]
?	?	XPS	[8,8]

Multi-Words recognition

NL-QUESTION: *Who was the inventor of the electric light?*

Who	Who	CCHI	[0,0]
was	be	VIY	[1,1]
the	det	RS	[2,2]
inventor	inventor	SS	[3,3]
of	of	ES	[4,4]
the	det	RS	[5,5]
electric_light	electric_light	SS	[6,7]
?	?	XPS	[8,8]

Syntactic Parsing

Identify syntactic structure of a sentence

- noun phrases (NP), verb phrases (VP), prepositional phrases (PP) etc.

Why did David Koresh ask the FBI for a word processor?
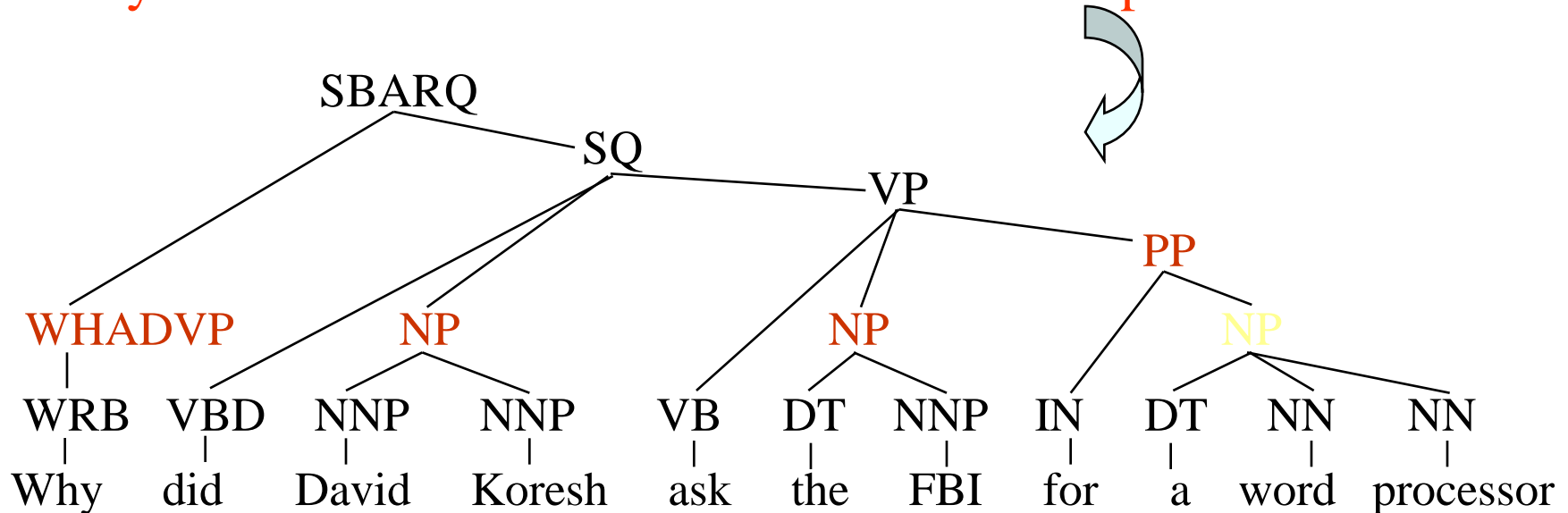
Answer Type and Focus

Focus is the word that expresses the relevant entity in the question

- Used to select a set of relevant documents
- ES: Where was **Mozart** born?

Answer Type is the category of the entity to be searched as answer

- PERSON, MEASURE, TIME PERIOD, DATE, ORGANIZATION, DEFINITION
- ES: Where was **Mozart** born?

  LOCATION

Answer Type and Focus

What famous communist leader died in Mexico City?

TEST: ["what" [¬ NOUN]* [NOUN:person-p]$_J$ +]
OUTPUT: ["PERSON" J]
RULENAME: WHAT-WHO

Answer type: **PERSON**

Focus: **leader**

This rule matches any question starting with *what*, whose first noun, if any, is a person (i.e. satisfies the *person-p* predicate)

Keywords Extraction

NL-QUESTION: *Who was the inventor of the electric light?*

Who	**Who**	**CCHI**	**[0,0]**
was	**be**	**VIY**	**[1,1]**
the	**det**	**RS**	**[2,2]**
inventor	**inventor**	**SS**	**[3,3]**
of	**of**	**ES**	**[4,4]**
the	**det**	**RS**	**[5,5]**
electric_light	**electric_light**	**SS**	**[6,7]**
?	**?**	**XPS**	**[8,8]**

Word Sense Disambiguation

What is the brightest star visible from Earth?"

STAR	star#1: celestial body	**ASTRONOMY**
	star#2: an actor who play …	ART
BRIGHT	bright #1: bright brilliant shining	**PHYSICS**
	bright #2: popular glorious	GENERIC
	bright #3: promising auspicious	GENERIC
VISIBLE	visible#1: conspicuous obvious	PHYSICS
	visible#2: visible seeable	**ASTRONOMY**
EARTH	earth#1: Earth world globe	**ASTRONOMY**
	earth #2: estate land landed_estate acres	ECONOMY
	earth #3: clay	GEOLOGY
	earth #4: dry_land earth solid_ground	GEOGRAPHY
	earth #5: land ground soil	GEOGRAPHY
	earth #6: earth ground	GEOLOGY

Expansions

- **NL-QUESTION**: *Who was the inventor of the electric light?*
- **BASIC-KEYWORDS**: *inventor   electric-light*

inventor

synonyms → discoverer, artificer

derivation → invention
  synonyms → innovation

derivation → invent
  synonyms → excogitate

electric_light

synonyms → incandescent_lamp, ligth_bulb
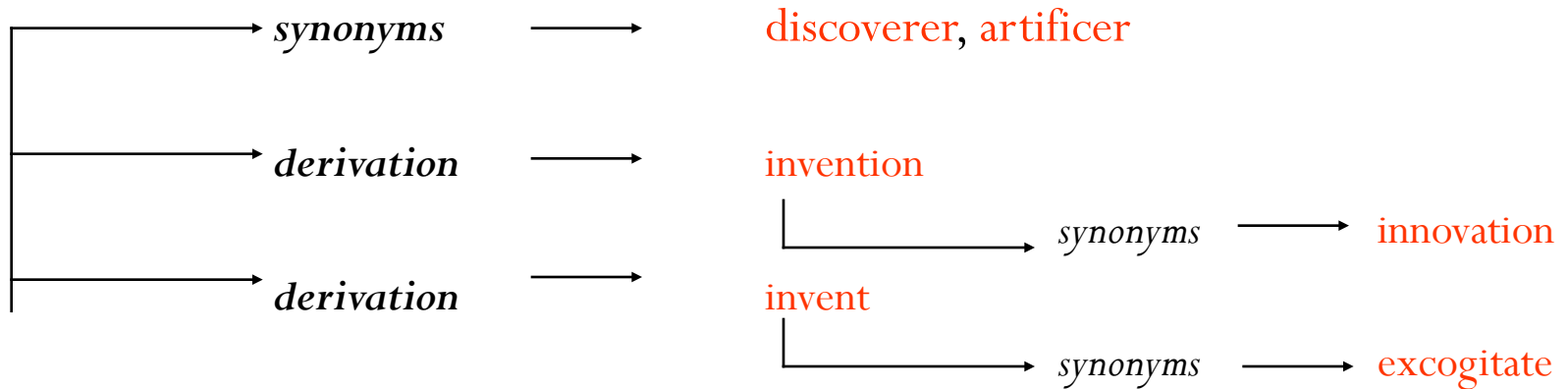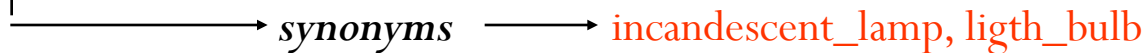
Keyword Composition

Keywords and expansions are composed in a boolean expression with AND/OR operators

Several possibilities:

- AND composition

- **Cartesian composition**

(OR (inventor AND electric_light)
OR (inventor AND incandescent_lamp)
OR (discoverer AND electric_light)
 …………………………
OR inventor OR electric_light))

Document Collection Pre-processing

For real time QA applications off-line pre-processing of the text is necessary

- Term indexing
- POS-tagging
- Named Entities Recognition

Candidate Answer Document Selection

- **Passage Selection**: Individuate relevant, small, text portions

- Given a document and a list of keywords:
  - ◆ Paragraph length (e.g. 200 words)
  - ◆ Consider the percentage of keywords present in the passage
  - ◆ Consider if some keyword is obligatory (e.g. the focus of the question).

Candidate Answer Document Analysis

Passage text tagging

Named Entity Recognition

Who is the author of the "Star Spangled Banner"?

...\<PERSON>**Francis Scott Key** \</PERSON> wrote the *"Star Spangled Banner" in* \<DATE>**1814**\</DATE>

Some systems:

- passages parsing (Harabagiu, 2001)
- Logical form (Zajac, 2001)

Answer Extraction (1)

Who is the author of the "Star Spangled Banner"?

…<PERSON>**Francis Scott Key** </PERSON> wrote the *"Star Spangled Banner" in* <DATE>**1814**</DATE>

Answer Type = **PERSON**

Candidate Answer = **Francis Scott Key**

Ranking candidate answers: keyword density in the passage, apply additional constraints (e.g. syntax, semantics), rank candidates using the Web

Answer Identification

References

Books

Pasca, Marius, Open Domain Question Answering from Large Text Collections, CSLI, 2003.

Maybury, Mark (Ed.), New Directions in Question Answering, AAAI Press, 2004.

Journals

Hirshman, Gaizauskas. *Natural Language question answering: the view from here*. JNLE, 7 (4), 2001.

TREC

E. Voorhees. *Overview of the TREC 2001 Question Answering Track*.

M.M. Soubbotin, S.M. Soubbotin. *Patterns of Potential Answer Expressions as Clues to the Right Answers.*

S. Harabagiu, D. Moldovan, M. Pasca, M. Surdeanu, R. Mihalcea, R. Girju, V. Rus, F. Lacatusu, P. Morarescu, R. Brunescu. *Answering Complex, List and Context questions with LCC's Question-Answering Server.*

C.L.A. Clarke, G.V. Cormack, T.R. Lynam, C.M. Li, G.L. McLearn. *Web Reinforced Question Answering (MultiText Experiments for TREC 2001).*

E. Brill, J. Lin, M. Banko, S. Dumais, A. Ng. Data-Intensive Question Answering.

References

Workshop Proceedings

H. Chen and C.-Y. Lin, editors. 2002. *Proceedings of the Workshop on Multilingual Summarization and Question Answering at COLING-02*, Taipei, Taiwan.

M. de Rijke and B. Webber, editors. 2003. *Proceedings of the Workshop on Natural Language Processing for Question Answering at EACL-03*, Budapest, Hungary.

R. Gaizauskas, M. Hepple, and M. Greenwood, editors. 2004. *Proceedings of the Workshop on Information Retrieval for Question Answering at SIGIR-04*, Sheffield, United Kingdom.

References

N. Kando and H. Ishikawa, editors. 2004. *Working Notes of the 4th NTCIR Workshop Meeting on Evaluation of Information Access Technologies: Information Retrieval, Question Answering and Summarization (NTCIR-04)*, Tokyo, Japan.

M. Maybury, editor. 2003. *Proceedings of the AAAI Spring Symposium on New Directions in Question Answering*, Stanford, California.

C. Peters and F. Borri, editors. 2004. *Working Notes of the 5th Cross-Language Evaluation Forum (CLEF-04)*, Bath, United Kingdom.

J. Pustejovsky, editor. 2002. *Final Report of the Workshop on TERQAS: Time and Event Recognition in Question Answering Systems*, Bedford, Massachusetts.

Y. Ravin, J. Prager and S. Harabagiu, editors. 2001. *Proceedings of the Workshop on Open-Domain Question Answering at ACL-01*, Toulouse, France.