

Question-Answering: Shallow & Deep Techniques for NLP

Ling571

Deep Processing Techniques for NLP

March 9, 2011

Examples from Dan Jurafsky)

Roadmap

- Question-Answering:
 - Definitions & Motivation
- Basic pipeline:
 - Question processing
 - Retrieval
 - Answering processing
- Shallow processing: AskMSR (Brill)
- Deep processing: LCC (Moldovan, Harabagiu, et al)
- Wrap-up

Why QA?

- Grew out of information retrieval community
- Web search is great, but...
 - Sometimes you don't just want a ranked list of documents
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 - Which English translation of the bible is used in official Catholic liturgies?
 - Who invented surf music?
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 - What are the seven wonders of the world?
 - Account for 12-15% of web log queries

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 - *Who invented surf music?*
 - Rank #2 snippet:
 - Dick Dale *invented surf music*
 - Pretty good, but...

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 - The table below lists the *largest 50 cities in the United States*
 - The answer is in the document – with a calculator..

Search Engines and QA

The background of the slide features a series of overlapping, wavy, horizontal bands in various shades of blue and white, creating a soft, abstract, and modern aesthetic.

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 - ‘Question mining’ tries to learn paraphrases of questions to get answer

Perspectives on QA

- TREC QA track (~2000---)
 - Initially pure factoid questions, with fixed length answers
 - Based on large collection of fixed documents (news)
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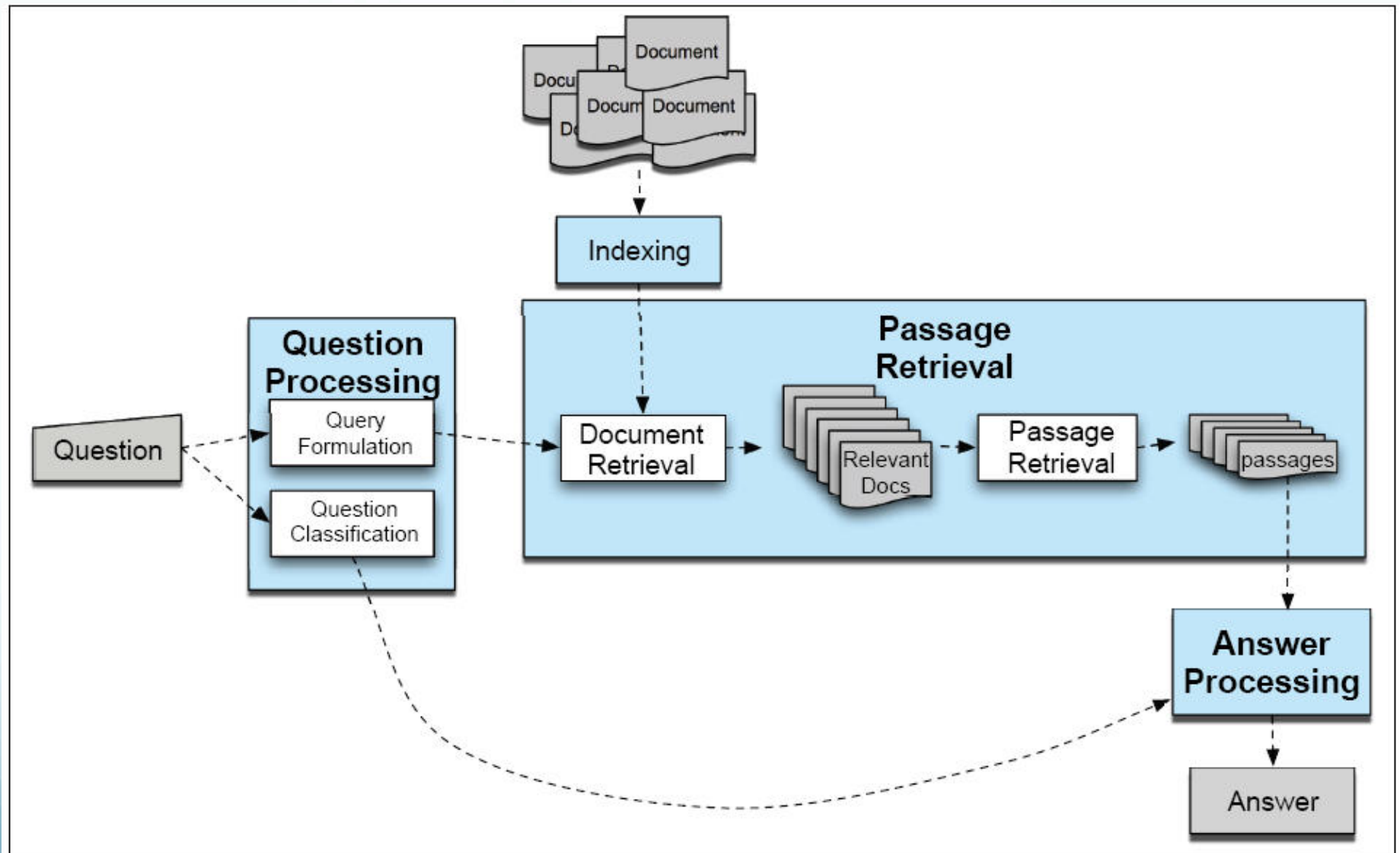
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- And, of course, Jeopardy! and Watson

Question Answering (a la TREC)

Question	Answer
Where is the Louvre Museum located?	in Paris, France
What's the abbreviation for limited partnership?	L.P.
What are the names of Odin's ravens?	Huginn and Muninn
What currency is used in China?	the yuan
What kind of nuts are used in marzipan?	almonds
What instrument does Max Roach play?	drums
What's the official language of Algeria?	Arabic
What is the telephone number for the University of Colorado, Boulder?	(303)492-1411
How many pounds are there in a stone?	14

Basic Strategy

- Given an indexed document collection, and
- A question:
- Execute the following steps:
 - Query formulation
 - Question classification
 - Passage retrieval
 - Answer processing
 - Evaluation



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 - Add morphological variants, WordNet as thesaurus
 - Reformulate as declarative: rule-based
 - Where is X located -> X is located in

Question Classification

- Answer type recognition
 - Who

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 - Synsets, hyper/hypo-nyms

Tag	Example
ABBREVIATION	
abb	What's the abbreviation for limited partnership?
exp	What does the "c" stand for in the equation $E=mc^2$?
DESCRIPTION	
definition	What are tannins?
description	What are the words to the Canadian National anthem?
manner	How can you get rust stains out of clothing?
reason	What caused the Titanic to sink ?
ENTITY	
animal	What are the names of Odin's ravens?
body	What part of your body contains the corpus callosum?
color	What colors make up a rainbow ?
creative	In what book can I find the story of Aladdin?
currency	What currency is used in China?
disease/medicine	What does Salk vaccine prevent?
event	What war involved the battle of Chapultepec?
food	What kind of nuts are used in marzipan?
instrument	What instrument does Max Roach play?
lang	What's the official language of Algeria?
letter	What letter appears on the cold-water tap in Spain?
other	What is the name of King Arthur's sword?
plant	What are some fragrant white climbing roses?
product	What is the fastest computer?
religion	What religion has the most members?
sport	What was the name of the ball game played by the Mayans?
substance	What fuel do airplanes use?
symbol	What is the chemical symbol for nitrogen?
technique	What is the best way to remove wallpaper?
term	How do you say " Grandma " in Irish?
vehicle	What was the name of Captain Bligh's ship?
word	What's the singular of dice?

HUMAN	
description	Who was Confucius?
group	What are the major companies that are part of Dow Jones?
ind	Who was the first Russian astronaut to do a spacewalk?
title	What was Queen Victoria's title regarding India?
LOCATION	
city	What's the oldest capital city in the Americas?
country	What country borders the most others?
mountain	What is the highest peak in Africa?
other	What river runs through Liverpool?
state	What states do not have state income tax?
NUMERIC	
code	What is the telephone number for the University of Colorado?
count	About how many soldiers died in World War II?
date	What is the date of Boxing Day?
distance	How long was Mao's 1930s Long March?
money	How much did a McDonald's hamburger cost in 1963?
order	Where does Shanghai rank among world cities in population?
other	What is the population of Mexico?
period	What was the average life expectancy during the Stone Age?
percent	What fraction of a beaver's life is spent swimming?
speed	What is the speed of the Mississippi River?
temp	How fast must a spacecraft travel to escape Earth's gravity?
size	What is the size of Argentina?
weight	How many pounds are there in a stone?

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 - For web search, use result snippets

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Pattern	Question	Answer
<AP> such as <QP>	What is autism?	“, <u>developmental disorders</u> such as autism”
<QP>, a <AP>	What is a caldera?	“the Long Valley caldera, a <u>volcanic crater</u> 19 miles long”

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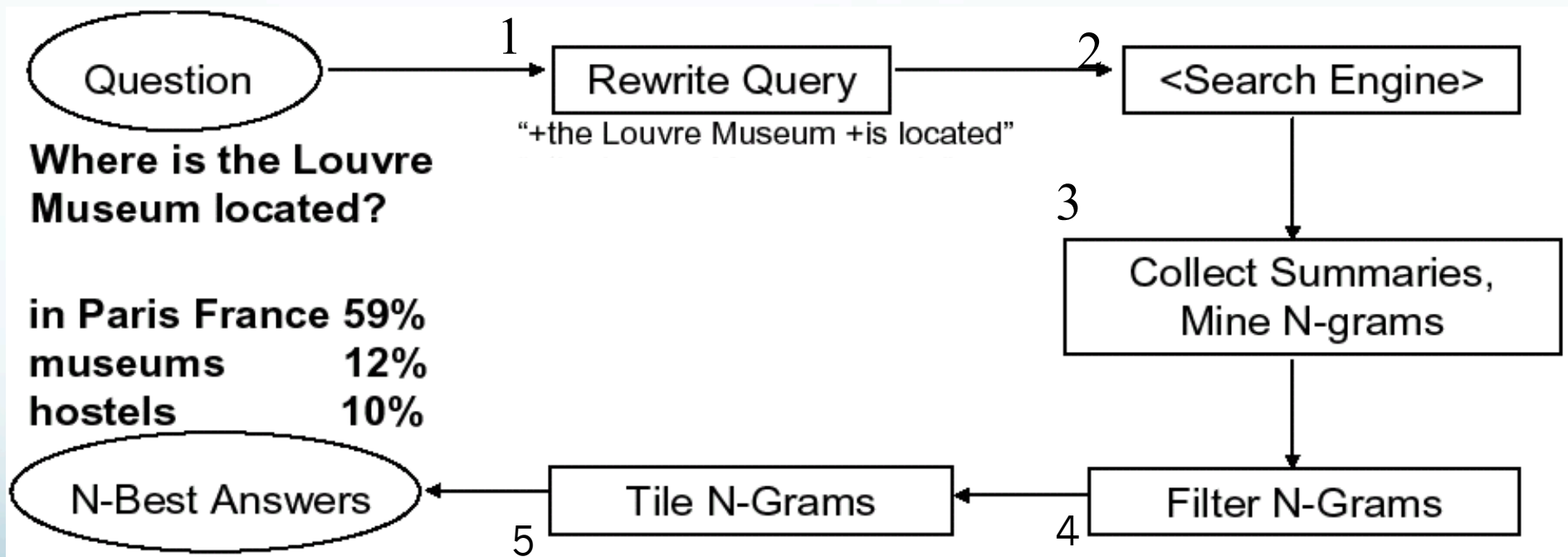
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- Measure: Mean Reciprocal Rank (MRR)
 - For each question,
 - Get reciprocal of rank of first correct answer
 - E.g. correct answer is 4 => $\frac{1}{4}$
 - None correct => 0
 - Average over all questions

$$MRR = \frac{\sum_{i=1}^N \frac{1}{rank_i}}{N}$$

AskMSR

- Shallow Processing for QA



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- Create type-specific answer type (Person, Date, Loc)

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- Issue:
 - Some patterns more reliable than others
 - Weight by reliability
 - Precision/specificity – manually assigned

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 - Filter/reweight n-grams by match with answer type
 - Hand-crafted rules

N-gram Tiling

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Scores

20

Charles Dickens

15

Dickens

10

Mr Charles

merged, discard
old n-grams

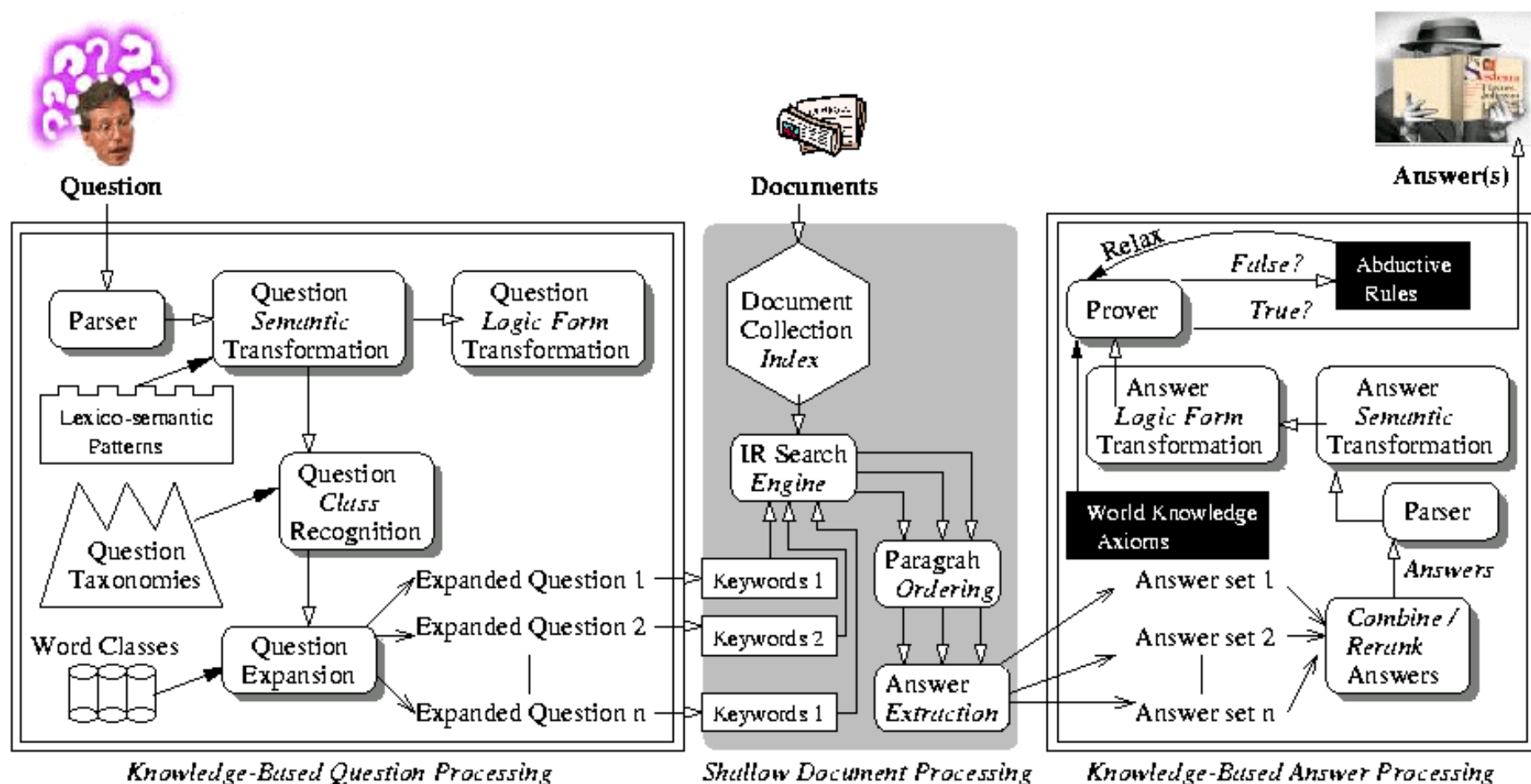


Score 45

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Deep Processing Technique for QA

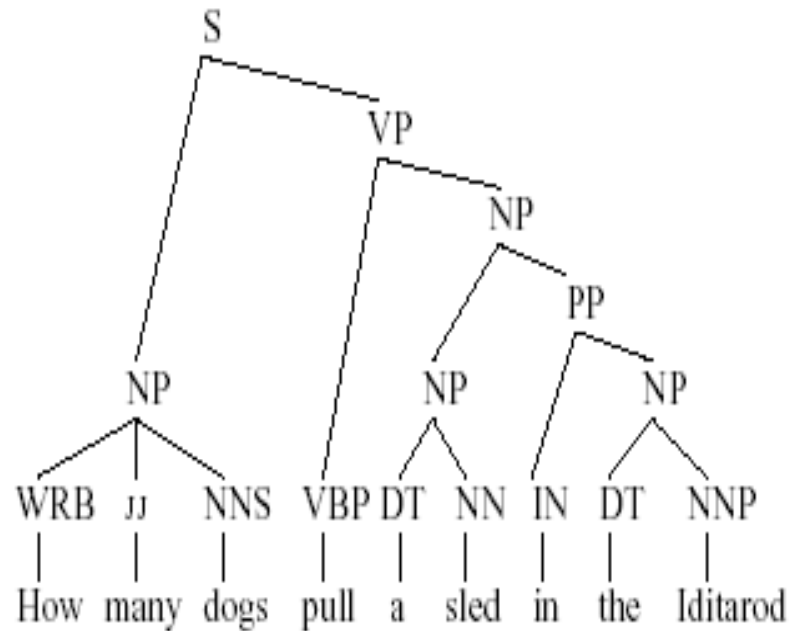
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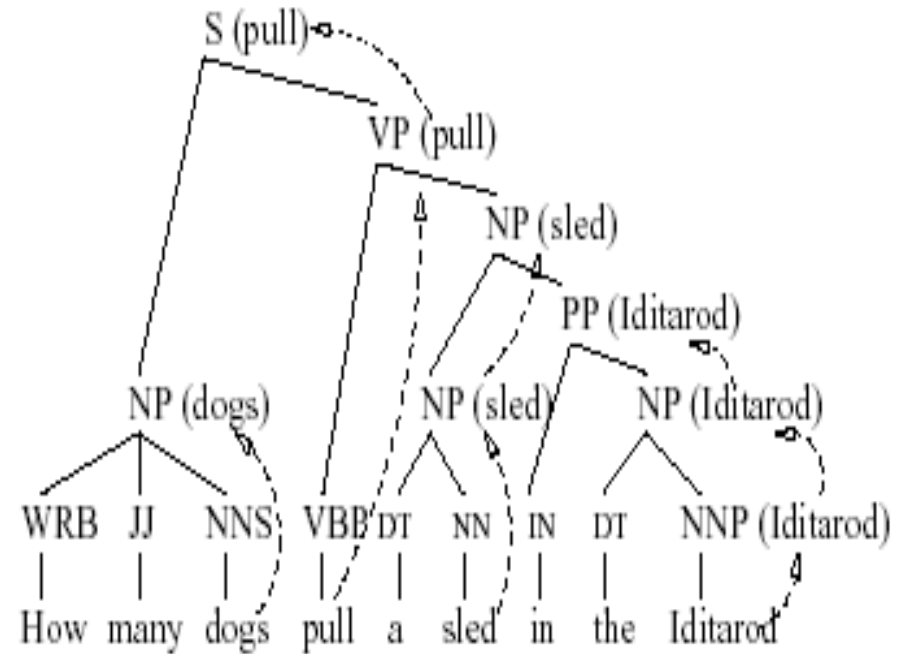
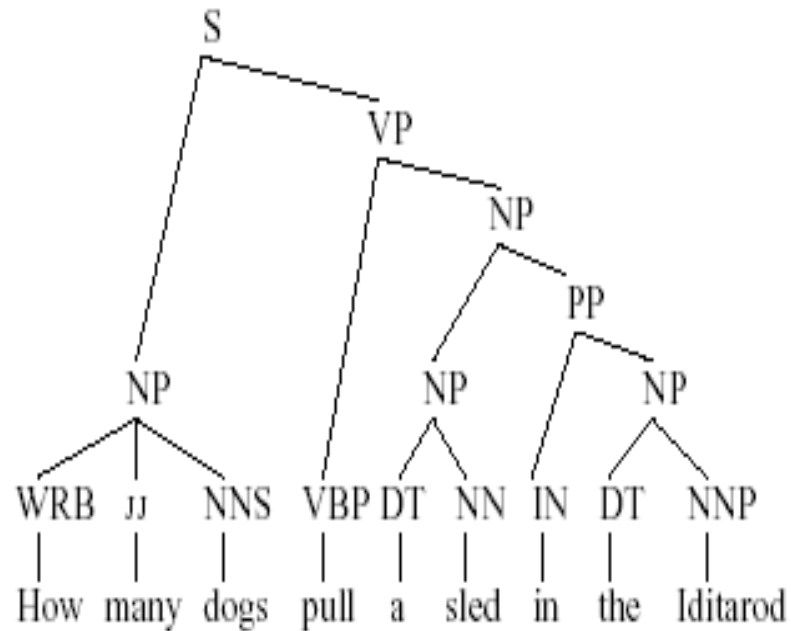
Deep Processing: Query/Answer Formulation

- Preliminary shallow processing:
 - Tokenization, POS tagging, NE recognition, Preprocess
- Parsing creates syntactic representation:
 - Focused on nouns, verbs, and particles
 - Attachment
- Coreference resolution links entity references
- Translate to full logical form
 - As close as possible to syntax

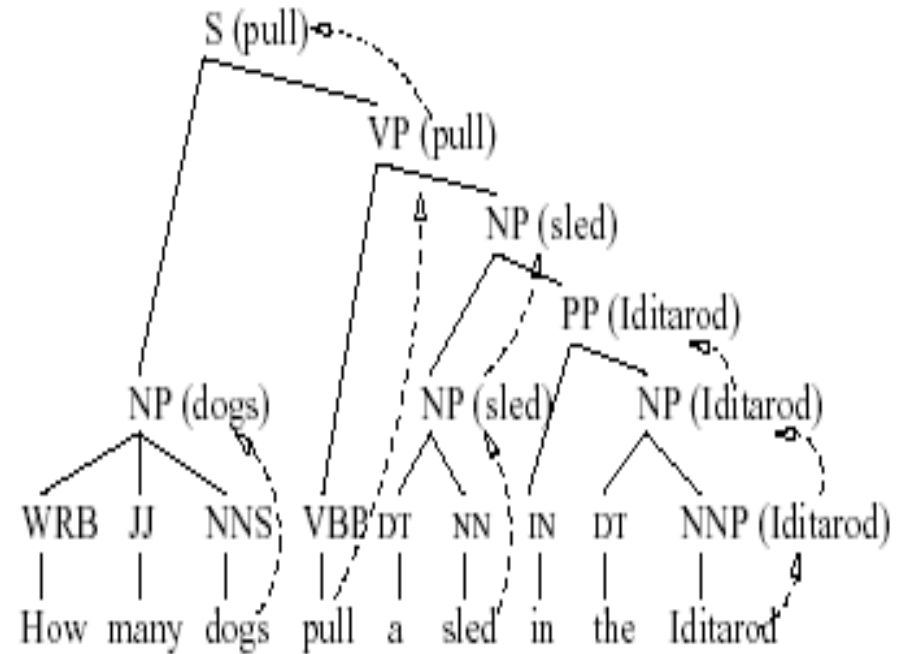
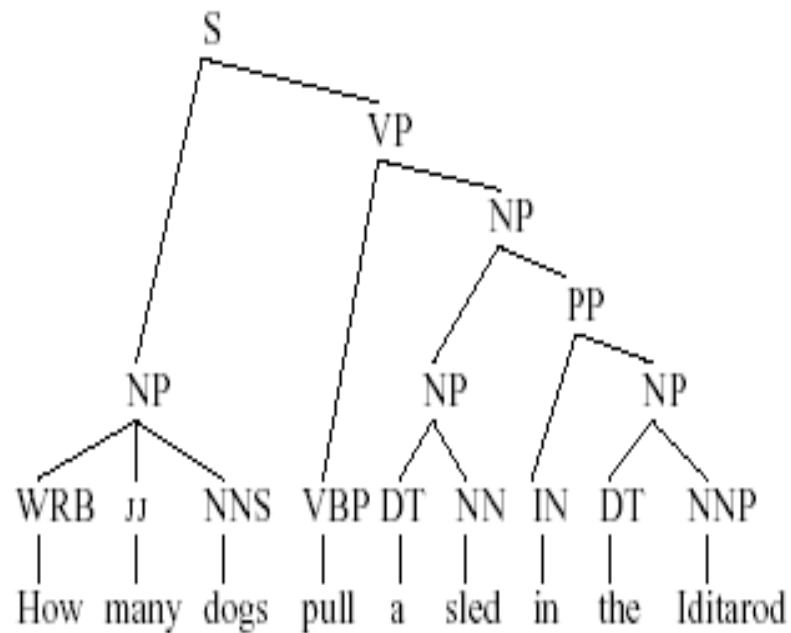
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COUNT dogs pull sled Iditarod

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 - Yields 30% improvement in accuracy!

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A Victory for Deep Processing

Run Tag	Score	#	%	Inexact	Prec	Recall
LCCmain2002	0.856	415	83.0	8	0.578	0.804
exactanswer	0.691	271	54.2	12	0.222	0.848
pris2002	0.610	290	58.0	17	0.241	0.891
IRST02D1	0.589	192	38.4	17	0.167	0.217
IBMPQSQACYC	0.588	179	35.8	9	0.196	0.630
uwmtB3	0.512	184	36.8	20	0.000	0.000
BBN2002C	0.499	142	28.4	18	0.182	0.087
isi02	0.498	149	29.8	15	0.385	0.109
limsiQalir2	0.497	133	26.6	11	0.188	0.196
ali2002b	0.496	181	36.2	15	0.156	0.848
ibmsqa02c	0.455	145	29.0	44	0.224	0.239
FDUT11QA1	0.434	124	24.8	6	0.139	0.957
aranea02a	0.433	152	30.4	36	0.235	0.174
nuslamp2002	0.396	105	21.0	17	0.000	0.000

AskMSR: 0.24 on TREC data; 0.42 on TREC queries w/full web

Conclusions

- Deep processing for QA
 - Exploits parsing, semantics, anaphora, reasoning
 - Computationally expensive
 - But tractable because applied only to
 - Questions and Passages
- Trends:
 - Systems continue to make greater use of
 - Web resources: Wikipedia, answer repositories
 - Machine learning!!!!

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 - Improved resources: treebanks (syn/disc, Framenet, Propbank)
 - Improved learning algorithms: structured learners, ...
 - Increased computation: cloud resources, Grid, etc

Notes

- Last assignment posted – Due March 15
 - No coding required
- Course evaluation web page posted:
 - Please respond!
 - <https://depts.washington.edu/oeaias/webq/survey.cgi?user=UWDL&survey=1254>
- THANK YOU!