COL 772
Natural Language Processing

Instructor: Mausam

(Slides adapted from Heng Ji, Dan Klein, Jurafsky & Martin, Noah Smith, Luke Zettlemoyer)

Personnel

- Instructor: Mausam, SIT 402, mausam@cs.washington.edu

- TAs:
  - Prachi Jain
  - Bhavesh Sethi
  - Dinesh Khandelwal
  - Arindam Bhattacharya

Logistics

- Course Website:
  www.cse.iitd.ac.in/~mausam/courses/col772/spring2018
- Join class discussion group on Piazza (access code col772)
  https://piazza.com/iit_delhi/spring2018/col772/home
- Textbook:
  Dan Jurafsky and James Martin Speech and Language Processing,
  2nd Edition, Prentice-Hall (2008).
  3rd Edition (under preparation)
  Course notes by Michael Collins: www.cs.columbia.edu/~mcollins/
- Grading:
  - 30% assignments
  - 20% project
  - 20% minors/midsem
  - 30% Major
  - Extra credit: constructive participation in class and discussion group

Assignments and Project

- ~3 programming assignments
  - assignments done individually!
  - late policy: penalty of 10% maximum grade every day for a week

- Project
  - done in teams of two
    - Special permission needed for other team sizes
  - no late submissions allowed

Academic Integrity

- Cheating → negative penalty (and possibly more)
    - Exception: if one person identified as cheater
        - Non-cheater gets a zero
  - http://www.willa.me/2013/12/the-top-five-unsanctioned-software.html

- Collaboration is good!!! Cheating is bad!!!
  - No sharing of part-code
  - No written/soft copy notes
  - Right to information rule
  - Kyunki saas bhi kabhi bahu thi Rule

Class Requirements & Prereqs

- Class requirements
  - Uses a variety of skills / knowledge:
    - Probability and statistics
    - Deep learning
    - Probabilistic graphical models
    - Basic linguistics background
    - Decent coding skills
  - Most people are probably missing one of the above
  - You will often have to work to fill the gaps

- Official Prerequisites
  - Data structures

- Unofficial Prerequsites
  - B grade in some relevant course
  - A willingness to learn whatever background you are missing

Timings

- Mon/Thu 2-3:30
  - Availability after class?
- Office hours
  - By appointment
- Audit criteria
  - no audit

Goals of this course

- Learn the issues and techniques of modern NLP
- Build realistic NLP tools
- Be able to read current research papers in the field
- See where the holes in the field still are!

- Computer Engineer
  - very relevant field in the modern age

- Computer Scientist
  - an excellent source of research problems

Theory vs. Modeling vs. Applications

- Lecture balance tilted towards modeling
- Assignment balance tilted towards applications
- ~No theorems or proofs
- Desired work – lots!

What is this Class?

- Three aspects to the course:
  - Linguistic Issues
    - What are the range of language phenomena?
    - What are the knowledge sources that let us disambiguate?
    - What representations are appropriate?
    - How do you know what to model and what not to model?
  - Probabilistic/Neural Modeling Techniques
    - Increasingly complex model structures/architectures
    - Learning and parameter estimation
    - Inference: dynamic programming, search, sampling
  - Engineering Methods
    - Issues of scale
    - Where the theory breaks down (and what to do about it)
- We’ll focus on what makes the problems hard, and what works in practice…

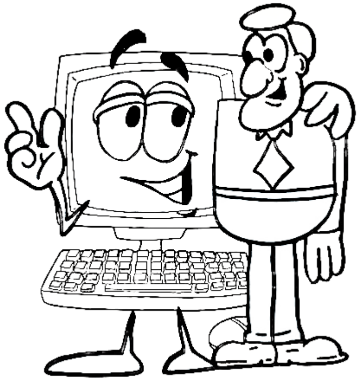
MOTIVATION

The Dream

- It’d be great if machines could
  - Process our email (usefully)
  - Translate languages accurately
  - Help us manage, summarize, and aggregate information
  - Use speech as a UI (when needed)
  - Talk to us / listen to us
- But they can’t:
  - Language is complex, ambiguous, flexible, and subtle
  - Good solutions need linguistics and machine learning knowledge
- So:

The mystery

- What’s now impossible for computers (and any other species) to do is effortless for humans



✗

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✓

The mystery (continued)

- Patrick Suppes, eminent philosopher, in his 1978 autobiography:
  - "…the challenge to psychological theory made by linguists to provide an adequate theory of language learning may well be regarded as the most significant intellectual challenge to theoretical psychology in this century."
- So far, this challenge is still unmet in the 21st century
- Natural language processing (NLP) is the discipline in which we study the tools that bring us closer to meeting this challenge

What is NLP?

What we say to dogs
Okay, Ginger! I've had it! You stay out of the garbage! Understand, Ginger? Stay out of the garbage, or else!
What they hear
blah blah GINGER blah blah blah blah blah blah blah blah GINGER blah blah blah blah blah blah blah...

- Fundamental goal: *deep* understanding of *broad* language
  - Not just string processing or keyword matching!

- End systems that we want to build:
  - Simple: spelling correction, text categorization…
  - Complex: speech recognition, machine translation, information extraction, dialog interfaces, question answering…
  - Unknown: human-level comprehension

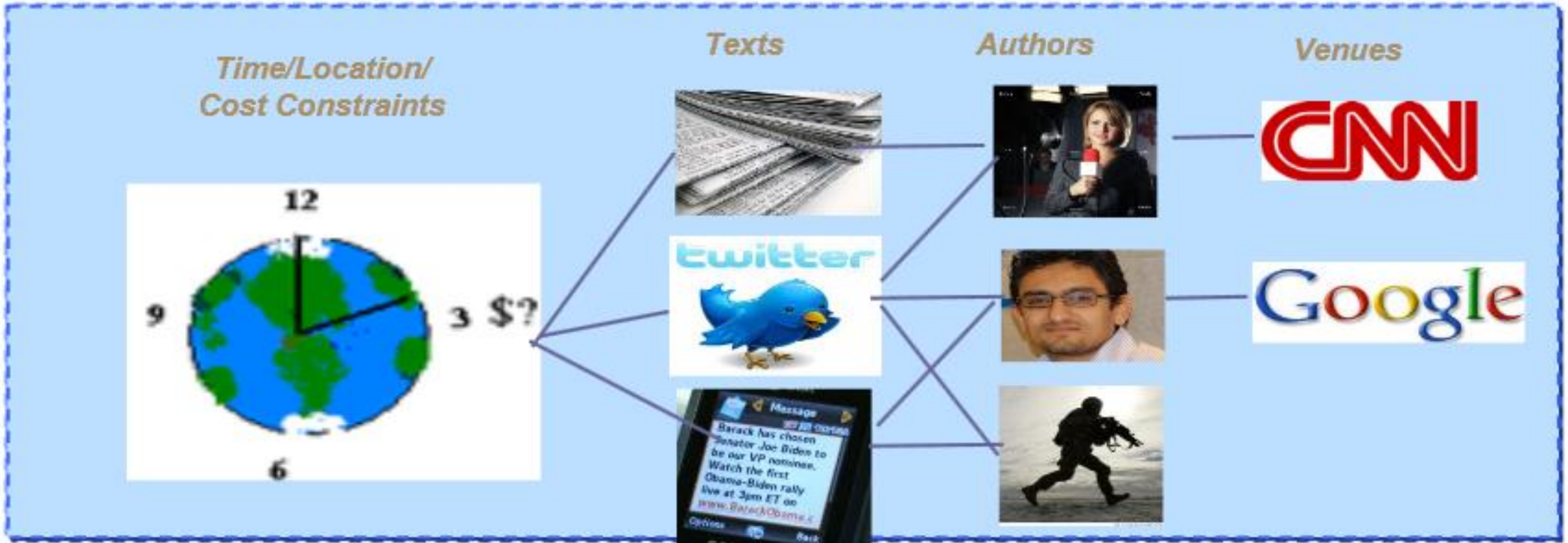
Why Should You Care?

Three trends

1. An enormous amount of knowledge is now available in machine readable form as natural language text
2. Conversational agents are becoming an important form of human-computer communication
3. Much of human-human communication is now mediated by computers

NLP for Big Data

- Huge Size
  - Google processes 20 PB a day (2008)
  - Wayback Machine has 15 PB (5/2014)
  - Facebook has 30+ PB of user data + 500 TB/day (2015)
  - eBay has 6.5 PB of user data + 50 TB/day (5/2009)
- 80% data is unstructured (IBM, 2010)
- More importantly, Heterogeneous


Time/Location/
Cost Constraints
12
9
3
6
$?
Texts
twitter
Message
Barack has chosen Senator Joe Biden to be our VP nominee. Watch the first Obama-Biden rally live at 3pm ET on www.BarackObama.c
Authors
Venues
CNN
Google

Any Light at The End of The Tunnel?

- Yahoo, Google, Microsoft → Information Retrieval
- Monster.com, HotJobs.com (Job finders) → Information Extraction + Information Retrieval
- Systran powers Babelfish → Machine Translation
- Ask Jeeves → Question Answering
- Myspace, Facebook, Blogspot → Processing of User-Generated Content
- Tools for “business intelligence”
- All “Big Guys” have (several) strong NLP research labs:
  - IBM, Microsoft, AT&T, Xerox, Sun, etc.
- Academia: research in an university environment

Some Early NLP History

- 1950s:
  - Foundational work: automata, information theory, etc.
  - First speech systems
  - Machine translation (MT) hugely funded by military (imagine that)
    - Toy models: MT using basically word-substitution
  - Optimism!

- 1960s and 1970s: NLP Winter
  - Bar-Hillel (FAHQT) and ALPAC reports kills MT
    - “Little John was looking at his toy box. Finally, he found it. The box was in the pen. John was very happy.”
  - Work shifts to deeper models, syntax
  - … but toy domains / grammars (SHRDLU, LUNAR)

SHRDLU

Person: Pick up a big red block.
Computer: OK.
Person: Grasp the pyramid.
Computer: I DON'T UNDERSTAND WHICH PYRAMID YOU MEAN.
Person (changing their mind): Find a block which is taller than the one you are holding and put it into the box.
Computer: BY "IT", I ASSUME YOU MEAN THE BLOCK WHICH IS TALLER THAN THE ONE I AM HOLDING.
Computer: OK.
Person: What does the box contain?
Computer: THE BLUE PYRAMID AND THE BLUE BLOCK.
Person: What is the pyramid supported by?
Computer: THE BOX.
Person: How many blocks are not in the box?
Computer: FOUR OF THEM.
Person: Is at least one of them narrower than the one which i told you to pick up?
Computer: YES, THE RED CUBE.
Person: Is it supported?
Computer: YES, BY THE TABLE.
Person: Can the table pick up blocks?
Computer: NO.

NLP History: pre-statistics

- (1) Colorless green ideas sleep furiously.
- (2) Furiously sleep ideas green colorless
  - It is fair to assume that neither sentence (1) nor (2) (nor indeed any part of these sentences) had ever occurred in an English discourse. Hence, in any statistical model for grammaticalness, these sentences will be ruled out on identical grounds as equally "remote" from English. Yet (1), though nonsensical, is grammatical, while (2) is not.” (Chomsky 1957)
- 70s and 80s: more linguistic focus
  - Emphasis on deeper models, syntax and semantics
  - Toy domains / manually engineered systems
  - Weak empirical evaluation

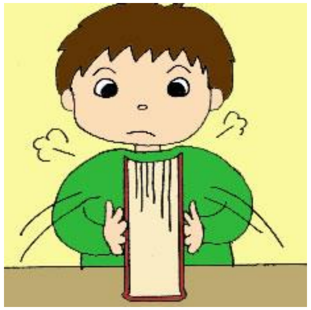
NLP: machine learning and empiricism

“Whenever I fire a linguist our system performance improves.” –Jelinek, 1988

- 1990s: Empirical Revolution
  - Corpus-based methods produce the first widely used tools
  - Deep linguistic analysis often traded for robust approximations
  - *Empirical evaluation* is essential
- 2000s: Richer linguistic representations used in statistical approaches, scale to more data!
- 2010s: Probabilistic NLP gives way to Neural NLP

Three Generations of NLP

- Hand-crafted Systems – Knowledge Engineering [1950s–]
  - Rules written by hand; adjusted by error analysis
  - Require experts who understand both the systems and domain
  - Iterative guess-test-tweak-repeat cycle

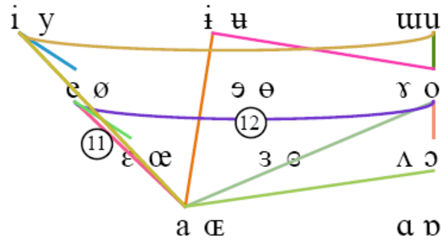


- Automatic, Trainable (Machine Learning) Systems with engineered features [1985s–2012]
  - The tasks use statistical models with hand-coded features
  - More robust techniques based on rich annotations
  - Perform better than rules (Parsing 90% vs. 75% accuracy)

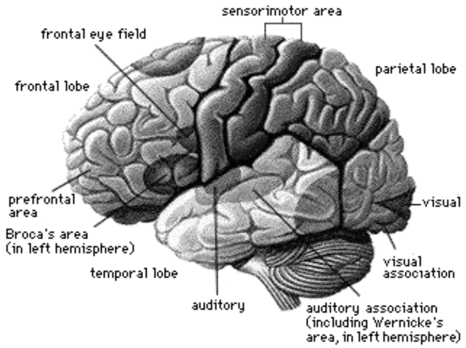
- Automatic, Trainable Neural architectures with no/limited engineered features [2012--]
  - The tasks use deep learning
  - Perform better than hand-coded features but not by too much

What is Nearby NLP?

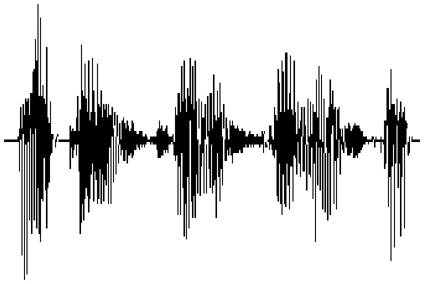
- Computational Linguistics
  - Using computational methods to learn more about how language works
  - We end up doing this and using it



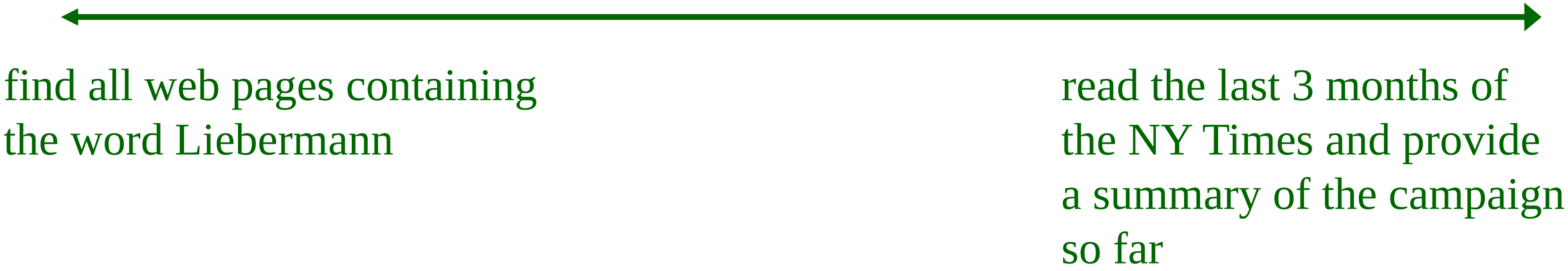
- Cognitive Science
  - Figuring out how the human brain works
  - Includes the bits that do language
  - Humans: the only working NLP prototype!



- Speech?
  - Mapping audio signals to text
  - Traditionally separate from NLP, converging?
  - Two components: acoustic models and language models
  - Language models in the domain of stat NLP



Web Search … n.0



find all web pages containing the word Liebermann

read the last 3 months of the NY Times and provide a summary of the campaign so far

Caveat

NLP has an AI aspect to it.

- We're often dealing with ill-defined problems
- We don't often come up with exact solutions/algorithms
- We can't let either of those facts get in the way of making progress

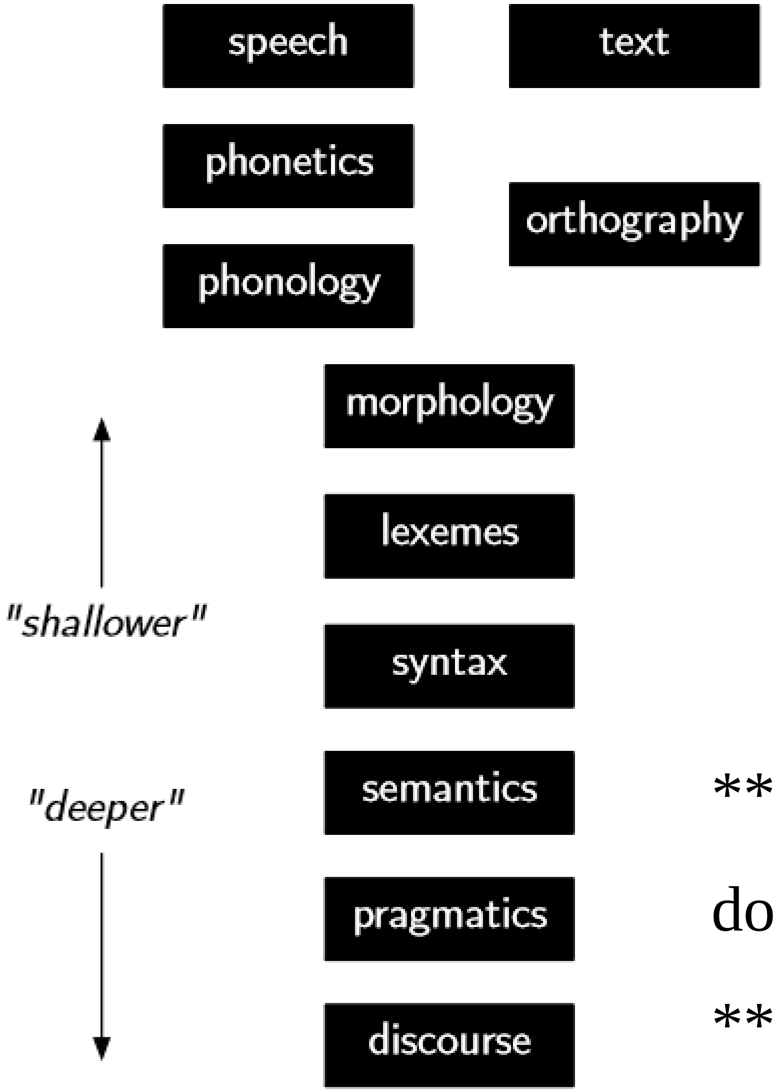
NLP is AI Complete

Turing Test

young woman: Men are all alike.
eliza: In what way?
young woman: They're always bugging us about something specific or other.
eliza: Can you think of a specific example?
young woman: Well, my boyfriend made me come here.
eliza: Your boyfriend made you come here?

ELIZA (Weizenbaum, 1966): first computer dialogue system based on keyword matching

Levels of Linguistic Knowledge



speech

text

phonetics

orthography

phonology

morphology

lexemes

syntax

semantics

pragmatics

discourse

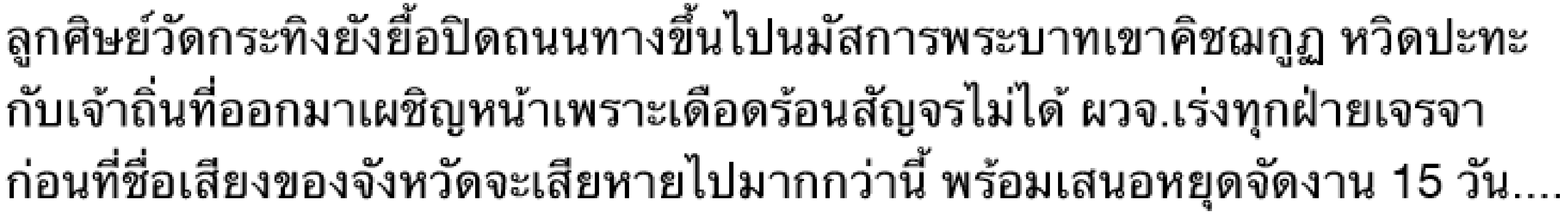
"shallower"

"deeper"

**we can go up, down and up and down and combine steps too!!

**every step is equally complex

Orthography



ลูกศิษย์วัดกระทิงยังยื้อปิดถนนทางขึ้นไปนมัสการพระบาทเขาคิชฌกูฏ หวิดปะทะ
กับเจ้าถิ่นที่ออกมาเผชิญหน้าเพราะเดือดร้อนสัญจรไม่ได้ ผวจ.เร่งทุกฝ่ายเจรจา
ก่อนที่ชื่อเสียงของจังหวัดจะเสียหายไปมากกว่านี้ พร้อมเสนอหยุดจัดงาน 15 วัน....

Morphology

uygarlaştıramadıklarımızdanmışsınızcasına
“(behaving) as if you are among those whom we could not civilize”

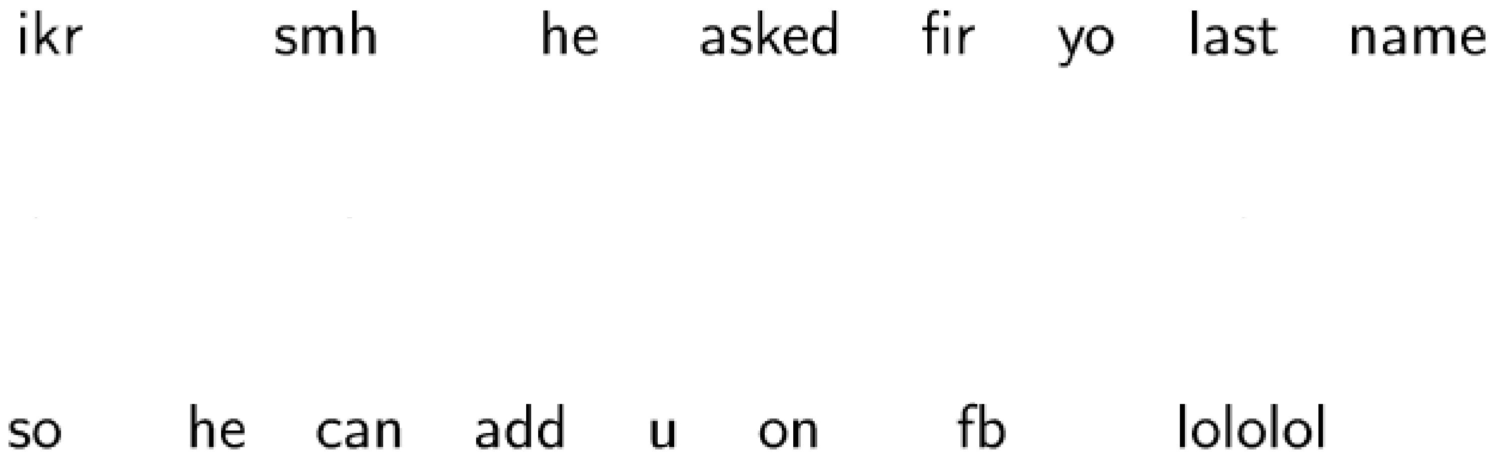
TIFGOSH ET HA-LELED BA-GAN
“you will meet the boy in the park”

unfriend, Obamacare, Manfuckinghattan

The Challenge of Words

- Segmenting text into words
  - Thai example
- Morphological variation
  - Turkish and Hebrew examples
- Words with multiple meanings:
  - bank, mean
- Domain-specific meanings:
  - latex, sport, etc.
- Multiword expressions:
  - make a decision, take out, make up

POS Tagging



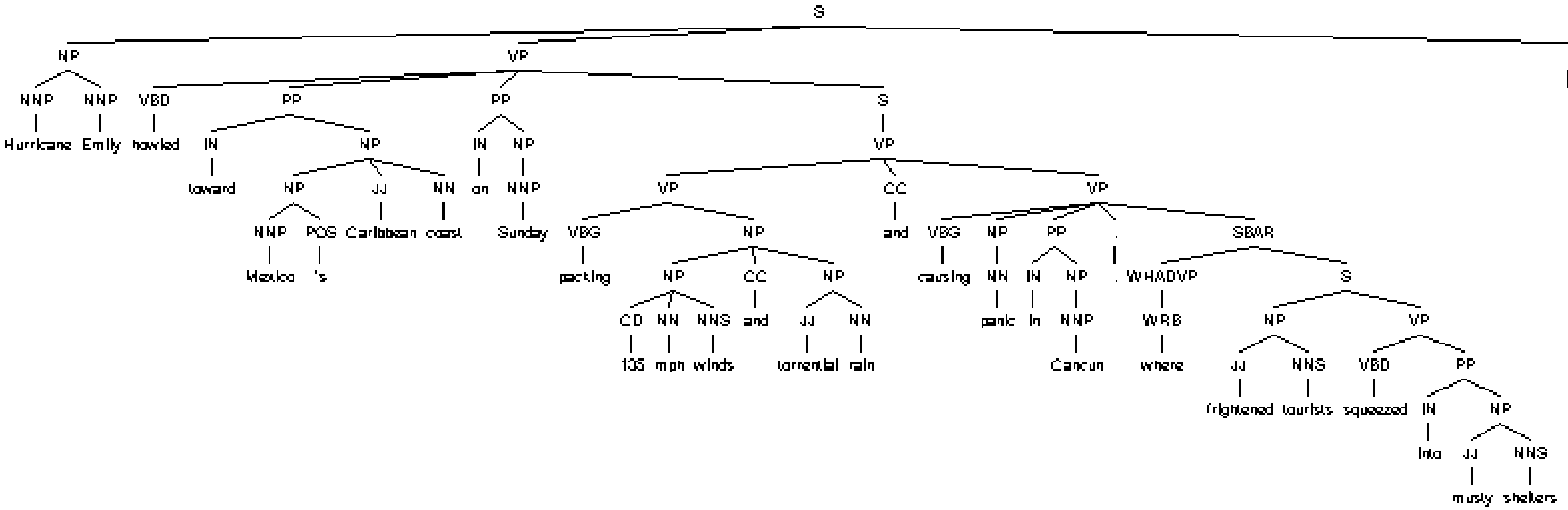
ikr smh he asked fir yo last name

so he can add u on fb lololol

Morphology+Syntax

A ship-shipping ship, shipping shipping-ships.

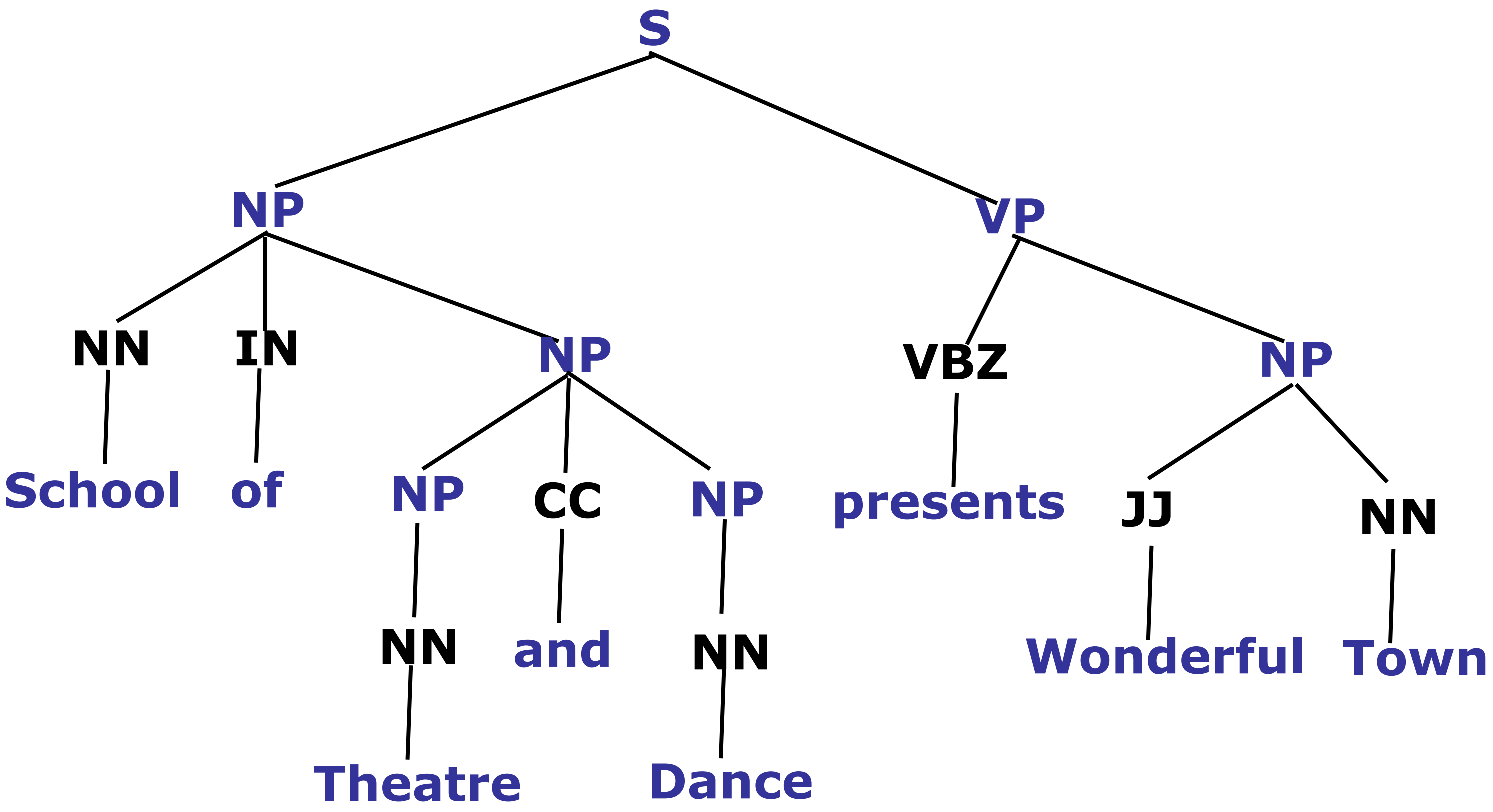
Syntactic Analysis



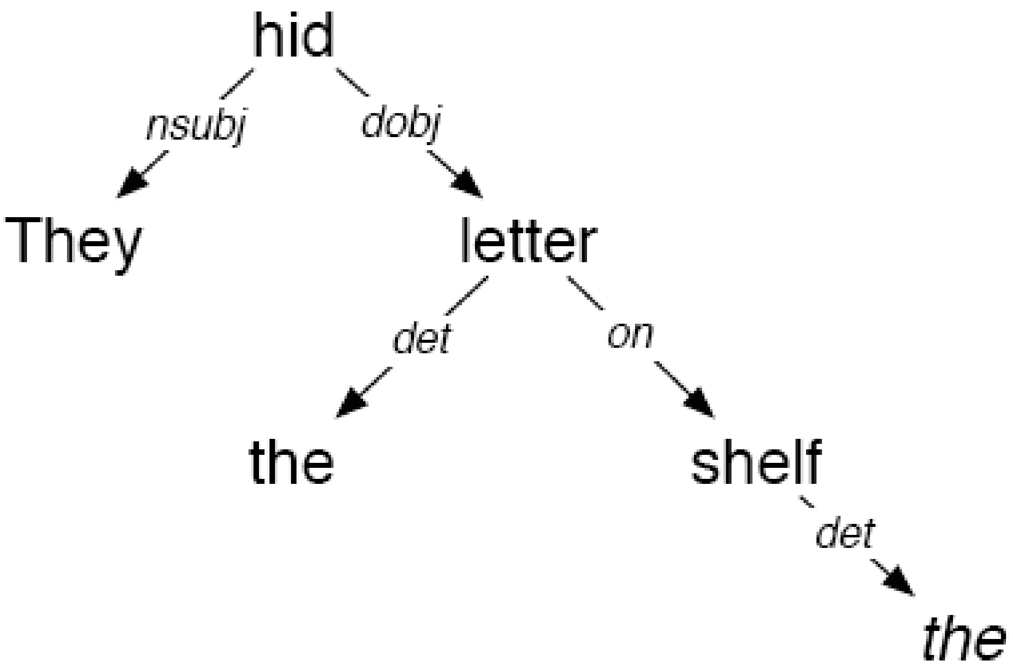
Hurricane Emily howled toward Mexico 's Caribbean coast on Sunday packing 135 mph winds and torrential rain and causing panic in Cancun , where frightened tourists squeezed into musty shelters .

- SOTA: ~90% accurate for many languages when given many training examples, some progress in analyzing languages given few or no examples

Syntactic Parsing

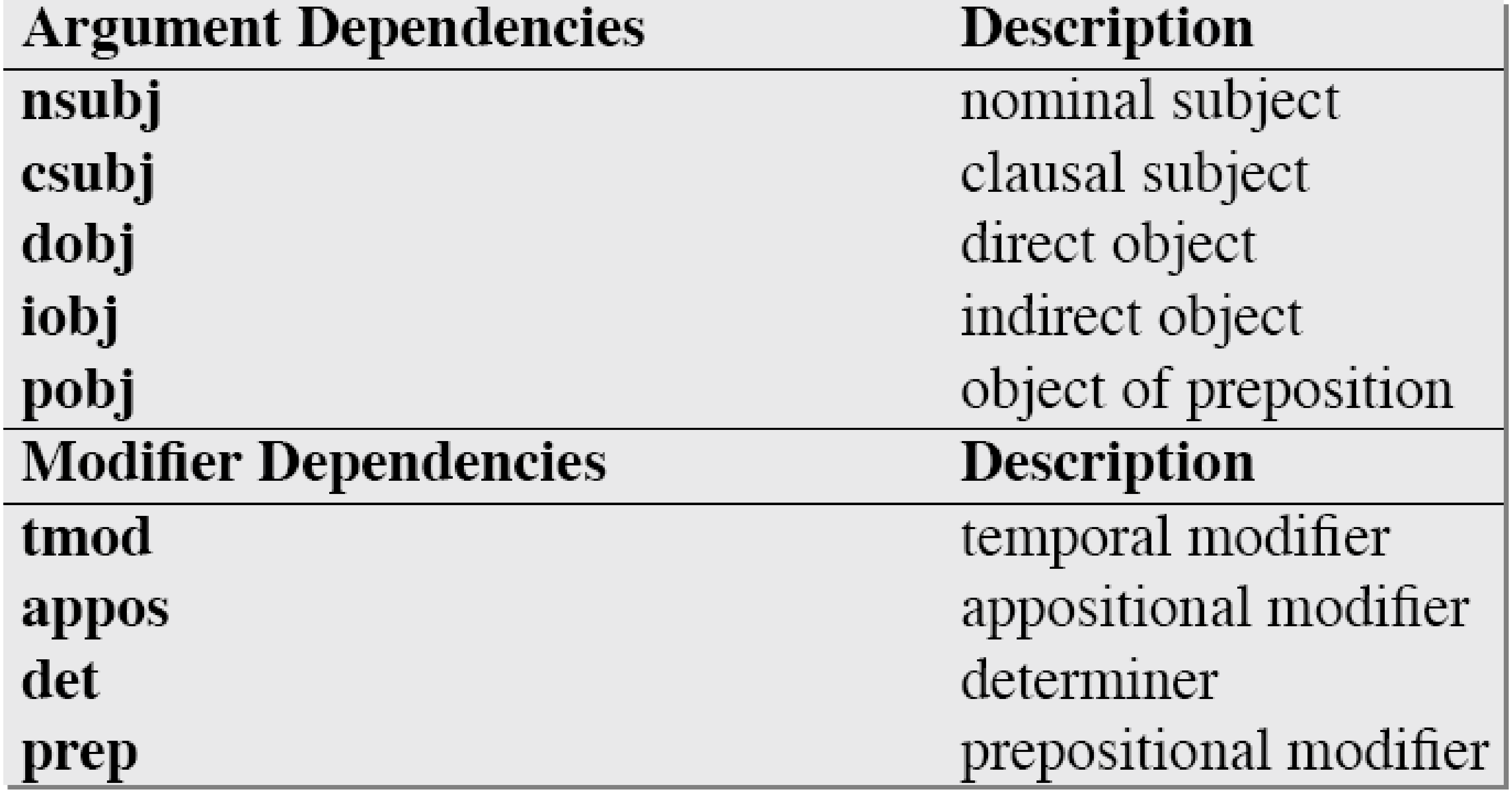


Dependency Parsing



They hid the letter on the shelf

Dependency Relations



Argument Dependencies	Description
nsubj	nominal subject
csubj	clausal subject
dobj	direct object
iobj	indirect object
pobj	object of preposition
Modifier Dependencies	**Description**
tmod	temporal modifier
appos	appositional modifier
det	determiner
prep	prepositional modifier

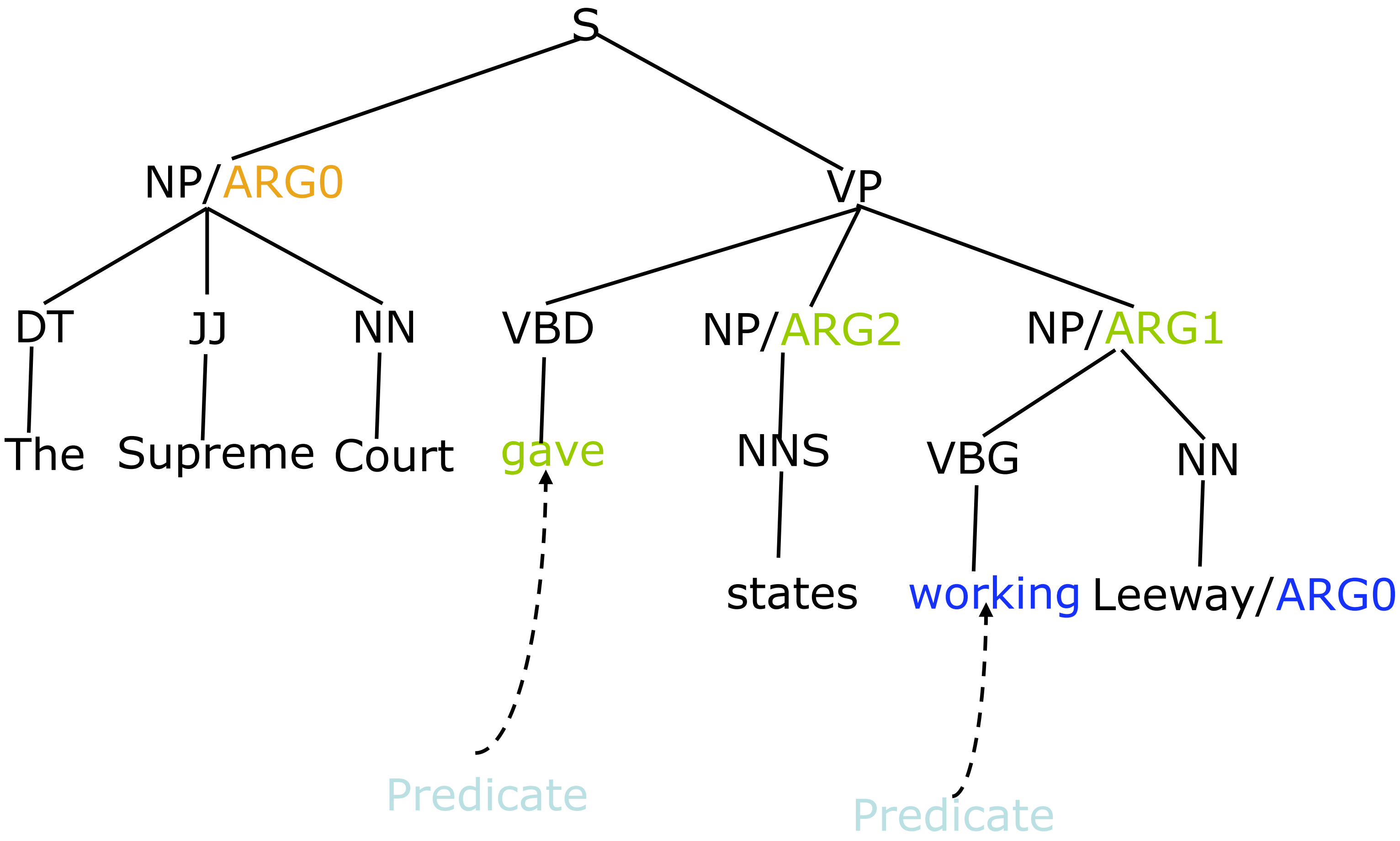
Semantics

- Lexical Semantics
  - Meanings of words
- Frame semantics
  - (shallow semantics)
- Sentential semantics
  - (full semantics)

Lexical Semantics

- Synonym
  - start-begin, bodoh-dungu, next to-near
- Antonym
  - clever x stupid, high x low, big x small, etc.
- Homonym
  - identical in spelling and pronounciation
  - bear, bank, …
- Homophones
  - sounds identical but are written differently
  - site-sight, piece-peace.
- Homograph
  - written identically but sound differently
  - lead, wind, minute
- Polysemy
  - a word which has two(or more) rated meanings

Semantic Role Labeling: Adding Semantics into Trees



Core Arguments

- Arg0 = agent
- Arg1 = direct object / theme / patient
- Arg2 = indirect object / benefactive / instrument / attribute / end state
- Arg3 = start point / benefactive / instrument / attribute
- Arg4 = end point

Full Sentential Semantics

- Formal/Logical Semantics
  - All man are mortal
  - India borders a country that borders Afghanistan.

Coreference

- But the little prince could not restrain admiration:
- "Oh! How beautiful you are!"
- "Am I not?" the flower responded, sweetly. "And I was born at the same moment as the sun . . ."
- The little prince could guess easily enough that she was not any too modest--but how moving--and exciting--she was!
- "I think it is time for breakfast," she added an instant later. "If you would have the kindness to think of my needs--"
- And the little prince, completely abashed, went to look for a sprinkling-can of fresh water. So, he tended the flower.

Information Extraction

- Unstructured text to database entries

New York Times Co. named Russell T. Lewis, 45, president and general manager of its flagship New York Times newspaper, responsible for all business-side activities. He was executive vice president and deputy general manager. He succeeds Lance R. Primis, who in September was named president and chief operating officer of the parent.

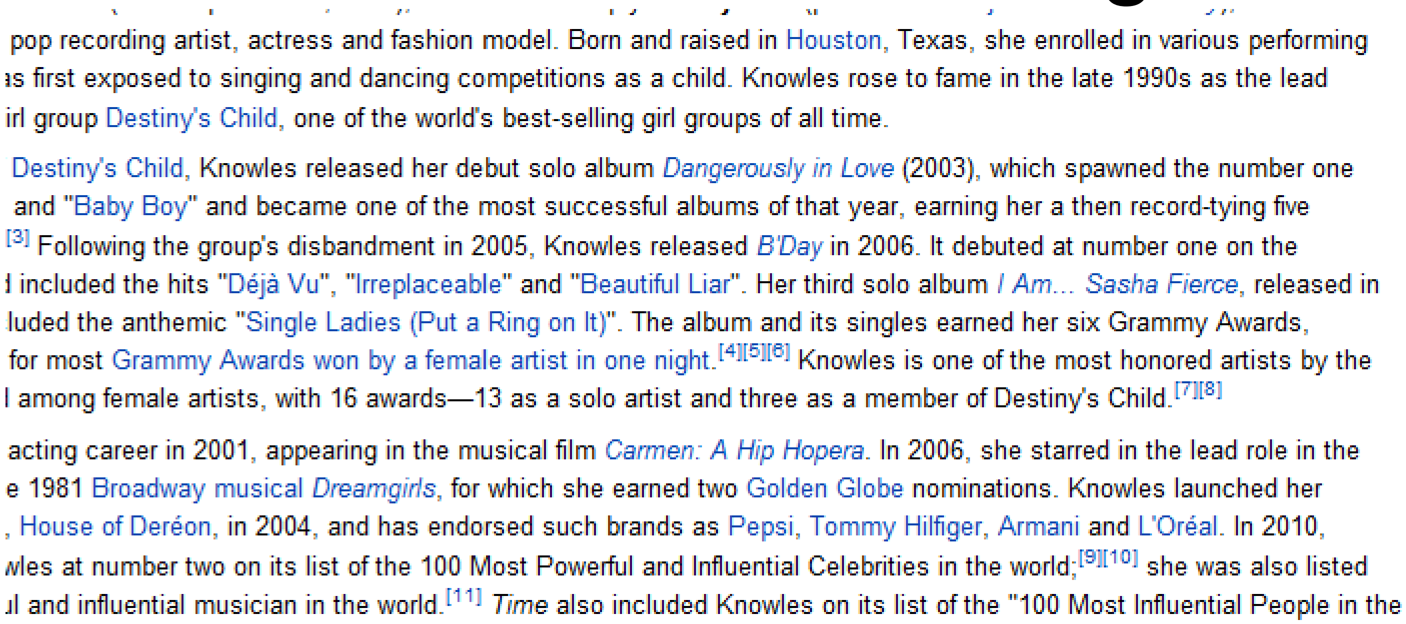
Person	Company	Post	State
Russell T. Lewis	New York Times newspaper	president and general manager	start
Russell T. Lewis	New York Times newspaper	executive vice president	end
Lance R. Primis	New York Times Co.	president and CEO	start

- SOTA: perhaps 80% accuracy for pre-defined tables, 90%+ for single easy fields
- But remember: information is redundant!

Temporal Information Extraction

- *In **1975**, after being fired from Columbia amid allegations that he used company funds to pay for his son's bar mitzvah, **Davis** founded **Arista***
  - Is ‘1975’ related to the employee_of relation between Davis and Arista?
  - If so, does it indicate START, END, HOLDS… ?
- Each classification instance represents a temporal expression in the context of the entity and slot value.
- We consider the following classes
  - START *Rob joined Microsoft in 1999.*
  - END *Rob left Microsoft in 1999.*
  - HOLDS *In 1999 Rob was still working for Microsoft.*
  - RANGE *Rob has worked for Microsoft for the last ten years.*
  - NONE *Last Sunday Rob’s friend joined Microsoft.*

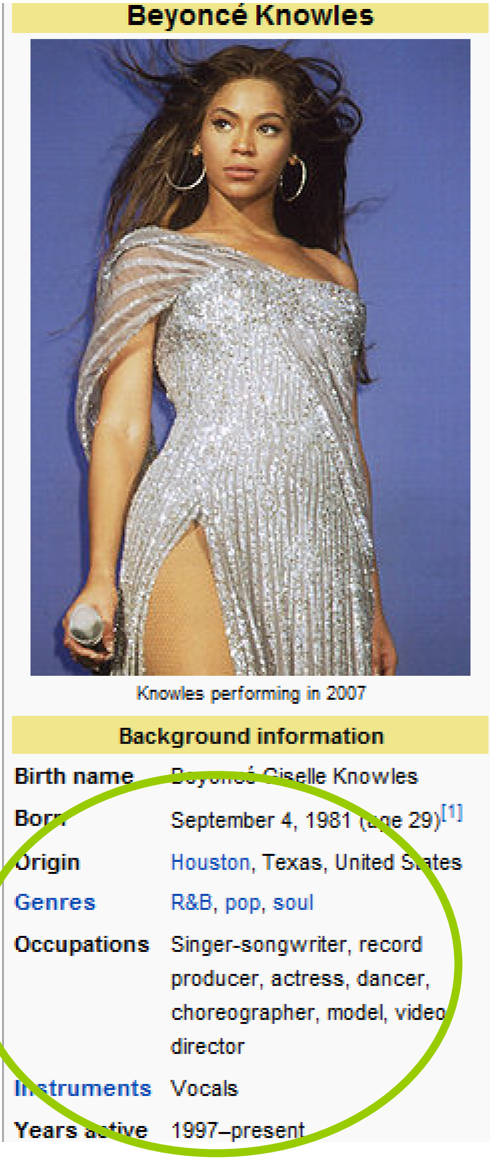
NLP+Knowledge Base



pop recording artist, actress and fashion model. Born and raised in Houston, Texas, she enrolled in various performing
as first exposed to singing and dancing competitions as a child. Knowles rose to fame in the late 1990s as the lead
irl group Destiny's Child, one of the world's best-selling girl groups of all time.

Destiny's Child, Knowles released her debut solo album *Dangerously in Love* (2003), which spawned the number one
and "Baby Boy" and became one of the most successful albums of that year, earning her a then record-tying five
[3] Following the group's disbandment in 2005, Knowles released *B'Day* in 2006. It debuted at number one on the
l included the hits "Déjà Vu", "Irreplaceable" and "Beautiful Liar". Her third solo album *I Am... Sasha Fierce*, released in
luded the anthemic "Single Ladies (Put a Ring on It)". The album and its singles earned her six Grammy Awards,
for most Grammy Awards won by a female artist in one night.[4][5][6] Knowles is one of the most honored artists by the
l among female artists, with 16 awards—13 as a solo artist and three as a member of Destiny's Child.[7][8]

acting career in 2001, appearing in the musical film *Carmen: A Hip Hopera*. In 2006, she starred in the lead role in the
e 1981 Broadway musical *Dreamgirls*, for which she earned two Golden Globe nominations. Knowles launched her
, House of Deréon, in 2004, and has endorsed such brands as Pepsi, Tommy Hilfiger, Armani and L'Oréal. In 2010,
wles at number two on its list of the 100 Most Powerful and Influential Celebrities in the world;[9][10] she was also listed
ul and influential musician in the world.[11] *Time* also included Knowles on its list of the "100 Most Influential People in the



Beyoncé Knowles

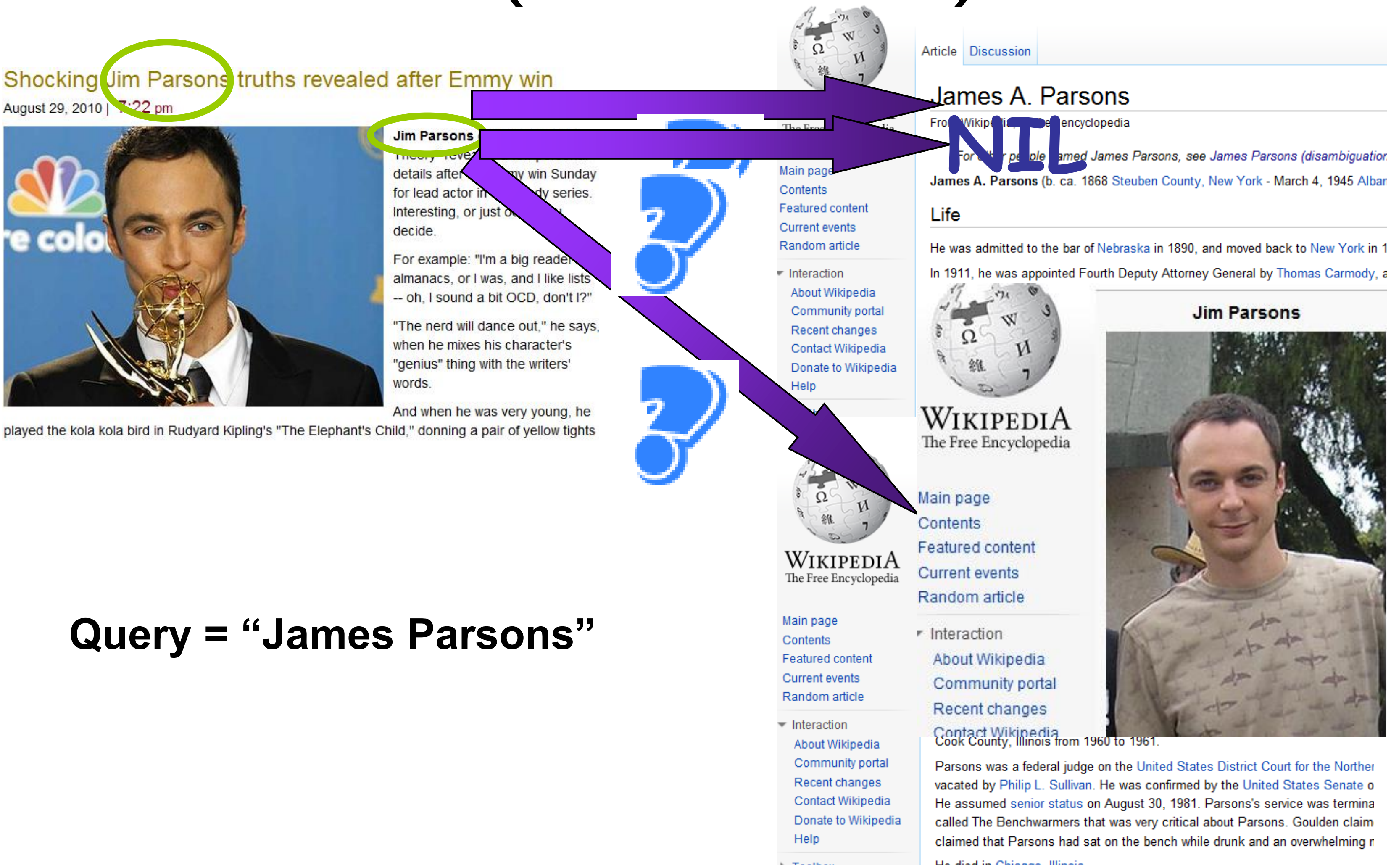
Knowles performing in 2007

Background information

Birth name	Beyoncé Giselle Knowles
Born	September 4, 1981 (age 29)[1]
Origin	Houston, Texas, United States
Genres	R&B, pop, soul
Occupations	Singer-songwriter, record producer, actress, dancer, choreographer, model, video director
Instruments	Vocals
Years active	1997–present

- Knowledge Base (KB)
  - Attributes (a.k.a., "slots") derived from Wikipedia infoboxes are used to create the reference KB
- Source Collection
  - A large corpus of unstructured texts

Knowledge Base Linking (Wikification)



Shocking Jim Parsons truths revealed after Emmy win

August 29, 2010 | 7:22 pm

Jim Parsons

details after …my win Sunday for lead actor in …dy series. Interesting, or just o… decide.

For example: "I'm a big reader … almanacs, or I was, and I like lists -- oh, I sound a bit OCD, don't I?"

"The nerd will dance out," he says, when he mixes his character's "genius" thing with the writers' words.

And when he was very young, he played the kola kola bird in Rudyard Kipling's "The Elephant's Child," donning a pair of yellow tights

Article Discussion

James A. Parsons

From Wikipedia, the free encyclopedia

For other people named James Parsons, see James Parsons (disambiguation

James A. Parsons (b. ca. 1868 Steuben County, New York - March 4, 1945 Alban

Life

He was admitted to the bar of Nebraska in 1890, and moved back to New York in 1

In 1911, he was appointed Fourth Deputy Attorney General by Thomas Carmody, a

Jim Parsons

Cook County, Illinois from 1960 to 1961.

Parsons was a federal judge on the United States District Court for the Norther vacated by Philip L. Sullivan. He was confirmed by the United States Senate o He assumed senior status on August 30, 1981. Parsons's service was termina called The Benchwarmers that was very critical about Parsons. Goulden claim claimed that Parsons had sat on the bench while drunk and an overwhelming r

Query = "James Parsons"

Knowledge Base Population (Slot Filling)

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                  per:city_of_birth</ignore>
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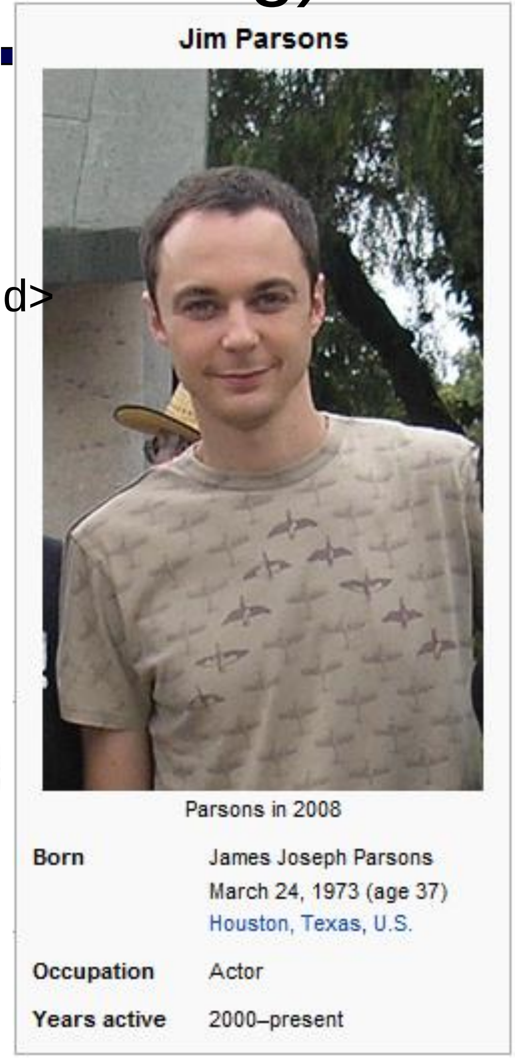
Jim Parsons, a graduate of the University of Houston School of Theater and Dance, won the Emmy on Sunday for Lead Actor in a Comedy Series for his work on The Big Bang Theory.

School Attended: University of Houston



Jim Parsons

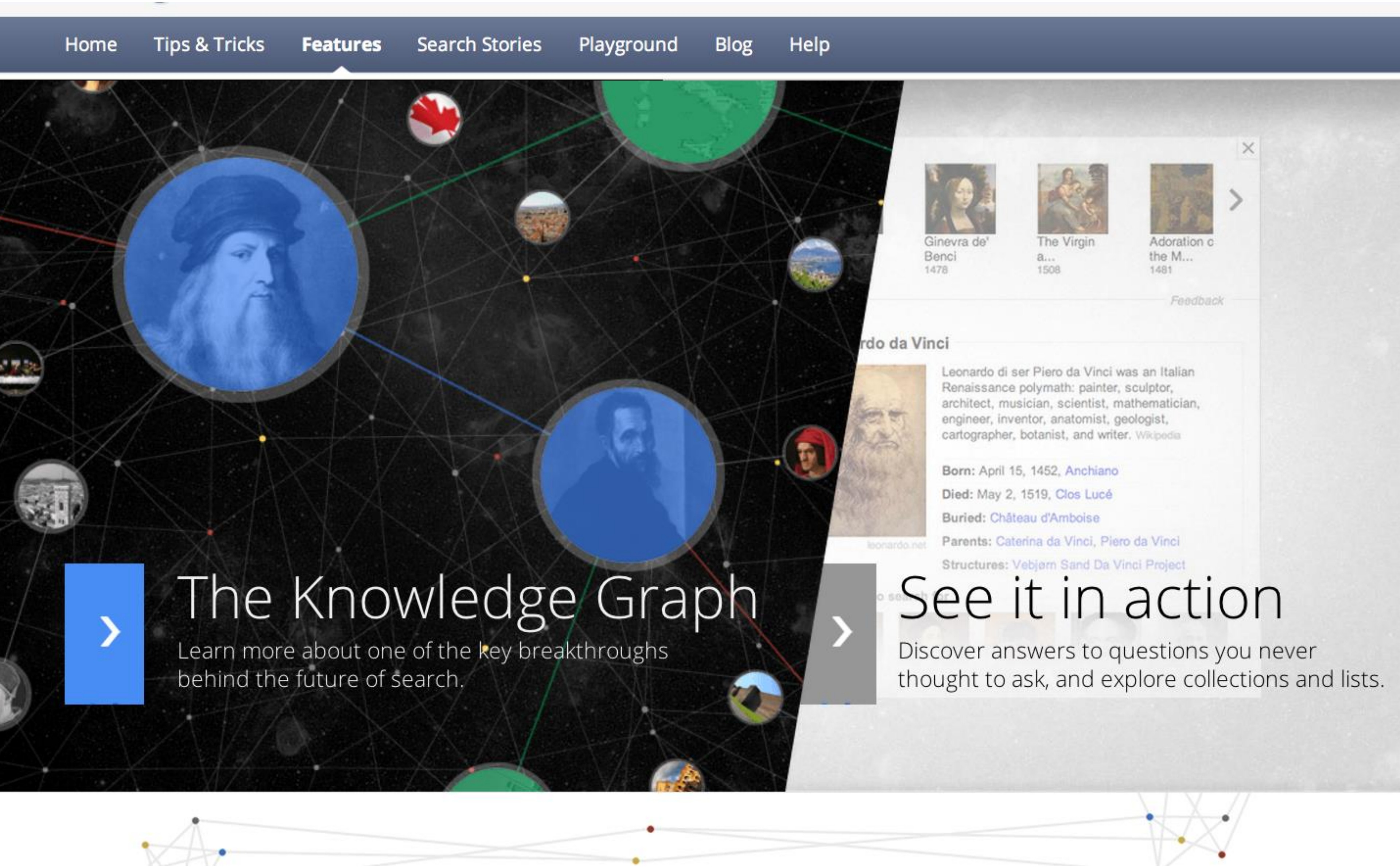
Parsons in 2008

Born	James Joseph Parsons March 24, 1973 (age 37) Houston, Texas, U.S.
Occupation	Actor
Years active	2000–present

KB Slots

Person		Organization
per:alternate_names	per:title	org:alternate_names
per:date_of_birth	per:member_of	org:political/religious_affiliation
per:age	per:employee_of	org:top_members/employees
per:country_of_birth	per:religion	org:number_of_employees/members
per:stateorprovince_of_birth	per:spouse	org:members
per:city_of_birth	per:children	org:member_of
per:origin	per:parents	org:subsidiaries
per:date_of_death	per:siblings	org:parents
per:country_of_death	per:other_family	org:founded_by
per:stateorprovince_of_death	per:charges	org:founded
per:city_of_death		org:dissolved
per:cause_of_death		org:country_of_headquarters
per:countries_of_residence		org:stateorprovince_of_headquarters
per:stateorprovinces_of_residence		org:city_of_headquarters
per:cities_of_residence		org:shareholders
per:schools_attended		org:website

Recently!



rdo da Vinci

Leonardo di ser Piero da Vinci was an Italian Renaissance polymath: painter, sculptor, architect, musician, scientist, mathematician, engineer, inventor, anatomist, geologist, cartographer, botanist, and writer. Wikipedia

Born: April 15, 1452, Anchiano

Died: May 2, 1519, Clos Lucé

Buried: Château d'Amboise

Parents: Caterina da Vinci, Piero da Vinci

Structures: Vebjørn Sand Da Vinci Project

The Knowledge Graph

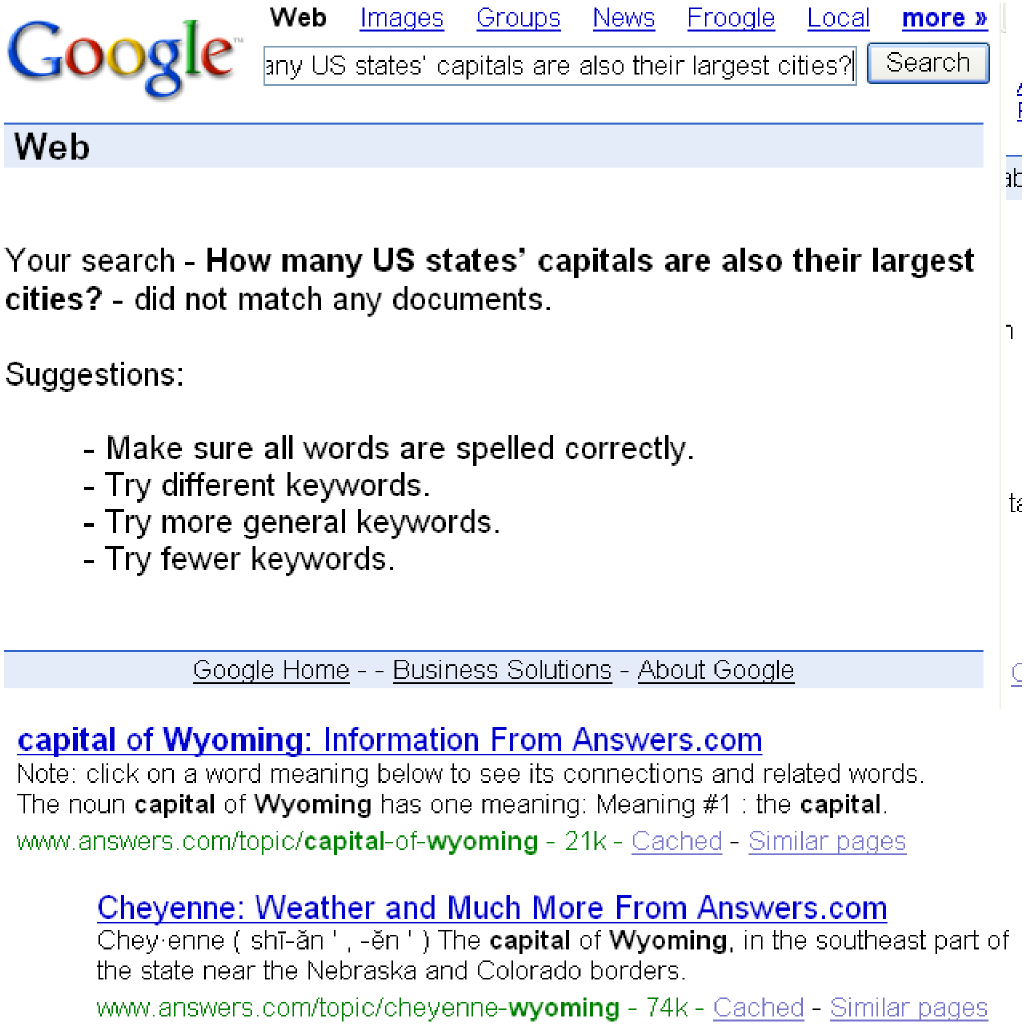
Learn more about one of the key breakthroughs behind the future of search.

See it in action

Discover answers to questions you never thought to ask, and explore collections and lists.

QA / NL Interaction

- Question Answering:
  - More than search
  - Can be really easy: “What’s the capital of Wyoming?”
  - Can be harder: “How many US states’ capitals are also their largest cities?”
  - Can be open ended: “What are the main issues in the global warming debate?”
- Natural Language Interaction:
  - Understand requests and act on them
  - “Make me a reservation for two at Quinn’s tonight’’


Google
Web
Images
Groups
News
Froogle
Local
more »
any US states' capitals are also their largest cities?
Search
Web

Your search - **How many US states’ capitals are also their largest cities?** - did not match any documents.

Suggestions:

- Make sure all words are spelled correctly.
- Try different keywords.
- Try more general keywords.
- Try fewer keywords.

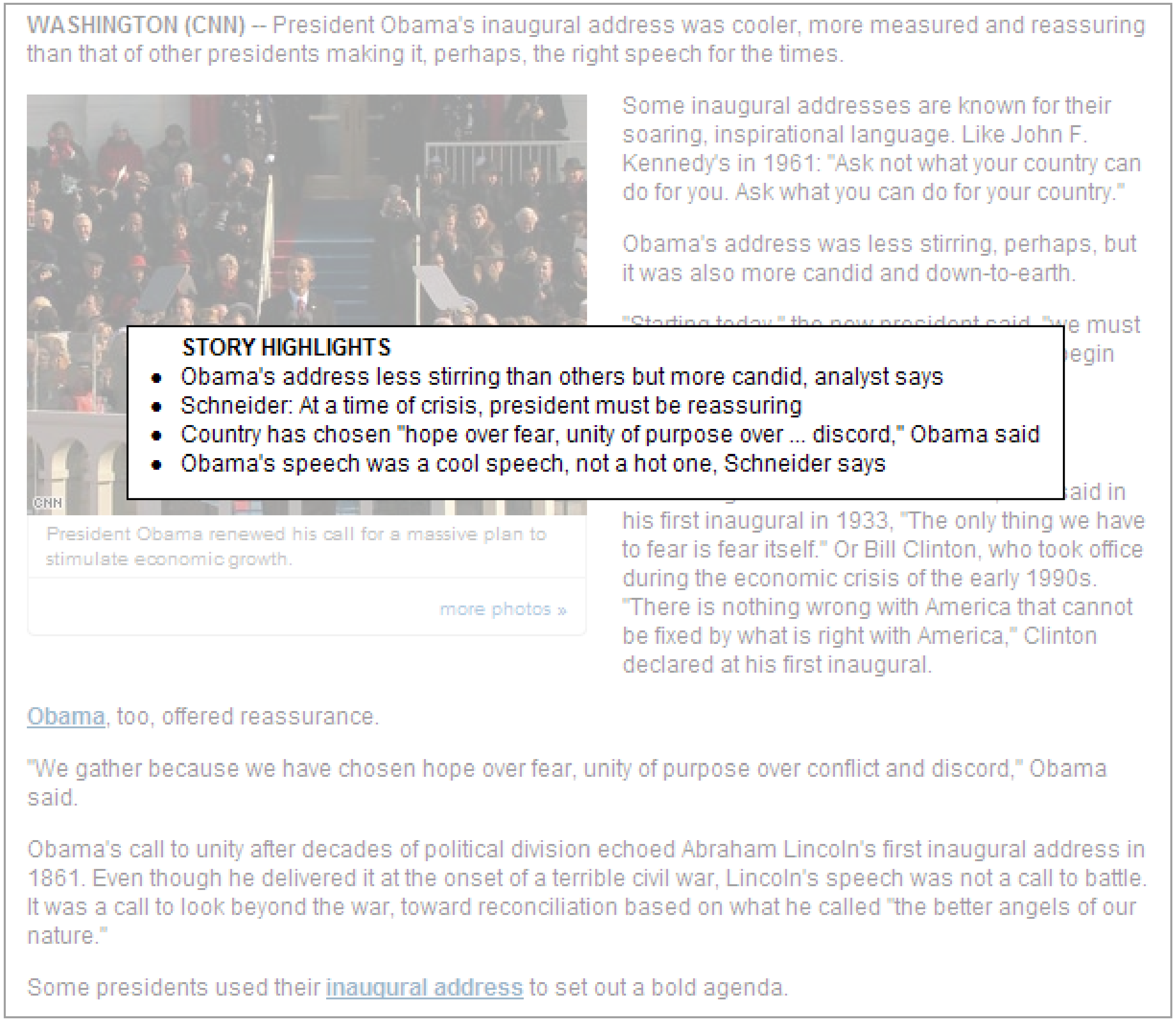
Google Home - - Business Solutions - About Google

capital of Wyoming: Information From Answers.com
Note: click on a word meaning below to see its connections and related words. The noun **capital** of **Wyoming** has one meaning: Meaning #1 : the **capital**.
www.answers.com/topic/**capital**-of-**wyoming** - 21k - Cached - Similar pages

Cheyenne: Weather and Much More From Answers.com
Chey·enne (shī-ăn ' , -ĕn ') The **capital** of **Wyoming**, in the southeast part of the state near the Nebraska and Colorado borders.
www.answers.com/topic/cheyenne-**wyoming** - 74k - Cached - Similar pages

Summarization

- Condensing documents
  - Single or multiple docs
  - Extractive or synthetic
  - Aggregative or representative
- Very context-dependent!
- An example of analysis with generation



WASHINGTON (CNN) -- President Obama's inaugural address was cooler, more measured and reassuring than that of other presidents making it, perhaps, the right speech for the times.

CNN

President Obama renewed his call for a massive plan to stimulate economic growth.

more photos »

Some inaugural addresses are known for their soaring, inspirational language. Like John F. Kennedy's in 1961: "Ask not what your country can do for you. Ask what you can do for your country."

Obama's address was less stirring, perhaps, but it was also more candid and down-to-earth.

"Starting today," the new president said, "we must ... egin

STORY HIGHLIGHTS

- Obama's address less stirring than others but more candid, analyst says
- Schneider: At a time of crisis, president must be reassuring
- Country has chosen "hope over fear, unity of purpose over ... discord," Obama said
- Obama's speech was a cool speech, not a hot one, Schneider says

... aid in his first inaugural in 1933, "The only thing we have to fear is fear itself." Or Bill Clinton, who took office during the economic crisis of the early 1990s. "There is nothing wrong with America that cannot be fixed by what is right with America," Clinton declared at his first inaugural.

Obama, too, offered reassurance.

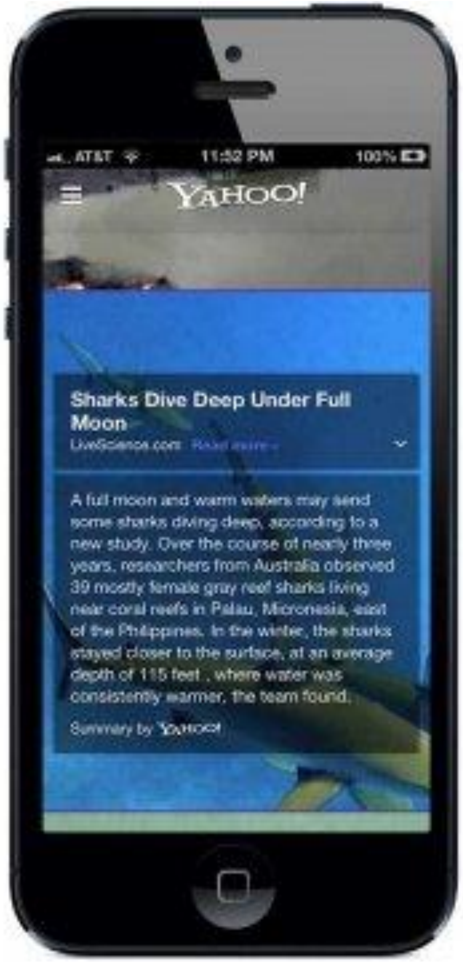
"We gather because we have chosen hope over fear, unity of purpose over conflict and discord," Obama said.

Obama's call to unity after decades of political division echoed Abraham Lincoln's first inaugural address in 1861. Even though he delivered it at the onset of a terrible civil war, Lincoln's speech was not a call to battle. It was a call to look beyond the war, toward reconciliation based on what he called "the better angels of our nature."

Some presidents used their inaugural address to set out a bold agenda.

2013: Summly → Yahoo!

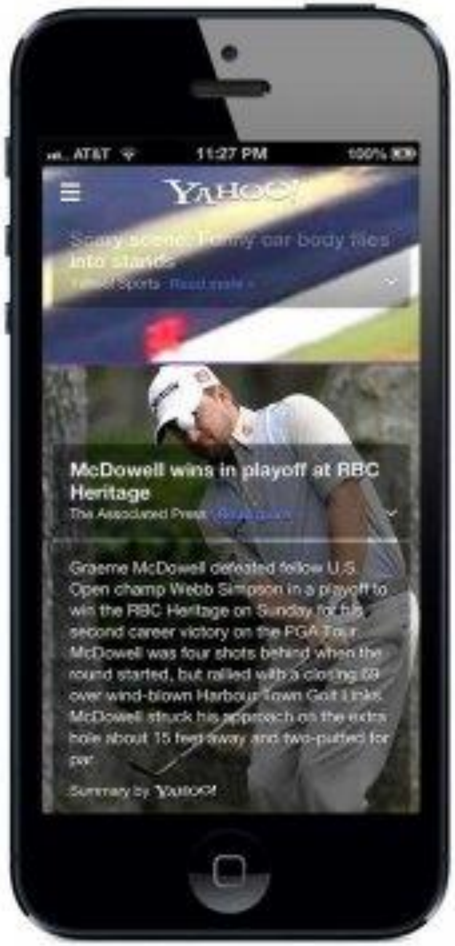
CEO Marissa Mayer announced an update to the app in a blog post, saying, "The new Yahoo! mobile app is also smarter, using Summly’s natural-language algorithms and machine learning to deliver quick story summaries. We acquired Summly less than a month ago, and we’re thrilled to introduce this game-changing technology in our first mobile application.”



Sharks Dive Deep Under Full Moon
LiveScience.com · Read more »

A full moon and warm waters may send some sharks diving deep, according to a new study. Over the course of nearly three years, researchers from Australia observed 39 mostly female gray reef sharks living near coral reefs in Palau, Micronesia, east of the Philippines. In the winter, the sharks stayed closer to the surface, at an average depth of 115 feet , where water was consistently warmer, the team found.

Summary by YAHOO!



Scary scene: Funny car body flies into stands
Yahoo! Sports · Read more »

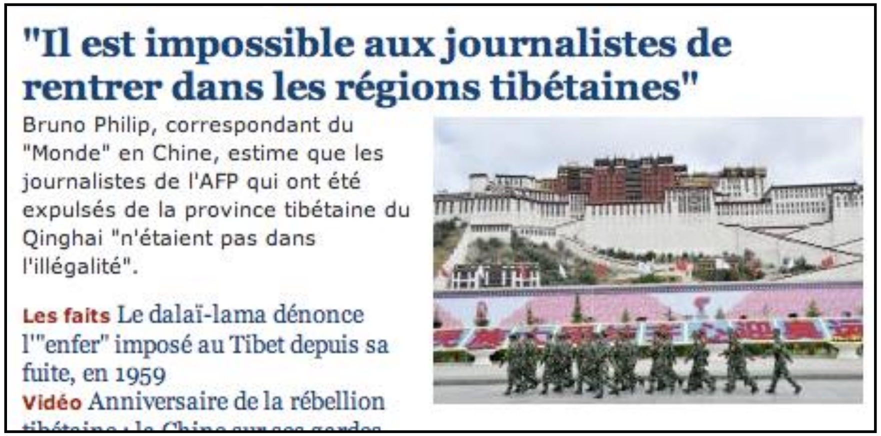
McDowell wins in playoff at RBC Heritage
The Associated Press · Read more »

Graeme McDowell defeated fellow U.S. Open champ Webb Simpson in a playoff to win the RBC Heritage on Sunday for his second career victory on the PGA Tour. McDowell was four shots behind when the round started, but rallied with a closing 69 over wind-blown Harbour Town Golf Links. McDowell struck his approach on the extra hole about 15 feet away and two-putted for par.

Summary by YAHOO!

Launched 2011, Acquired 2013 for $30M

Machine Translation

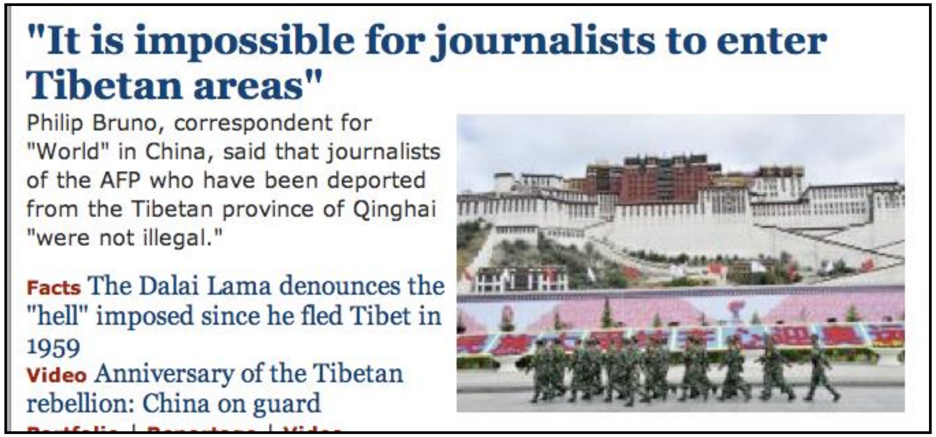


"Il est impossible aux journalistes de rentrer dans les régions tibétaines"

Bruno Philip, correspondant du "Monde" en Chine, estime que les journalistes de l'AFP qui ont été expulsés de la province tibétaine du Qinghai "n'étaient pas dans l'illégalité".

Les faits Le dalaï-lama dénonce l'"enfer" imposé au Tibet depuis sa fuite, en 1959

Vidéo Anniversaire de la rébellion tibétaine : la Chine sur ses gardes



"It is impossible for journalists to enter Tibetan areas"

Philip Bruno, correspondent for "World" in China, said that journalists of the AFP who have been deported from the Tibetan province of Qinghai "were not illegal."

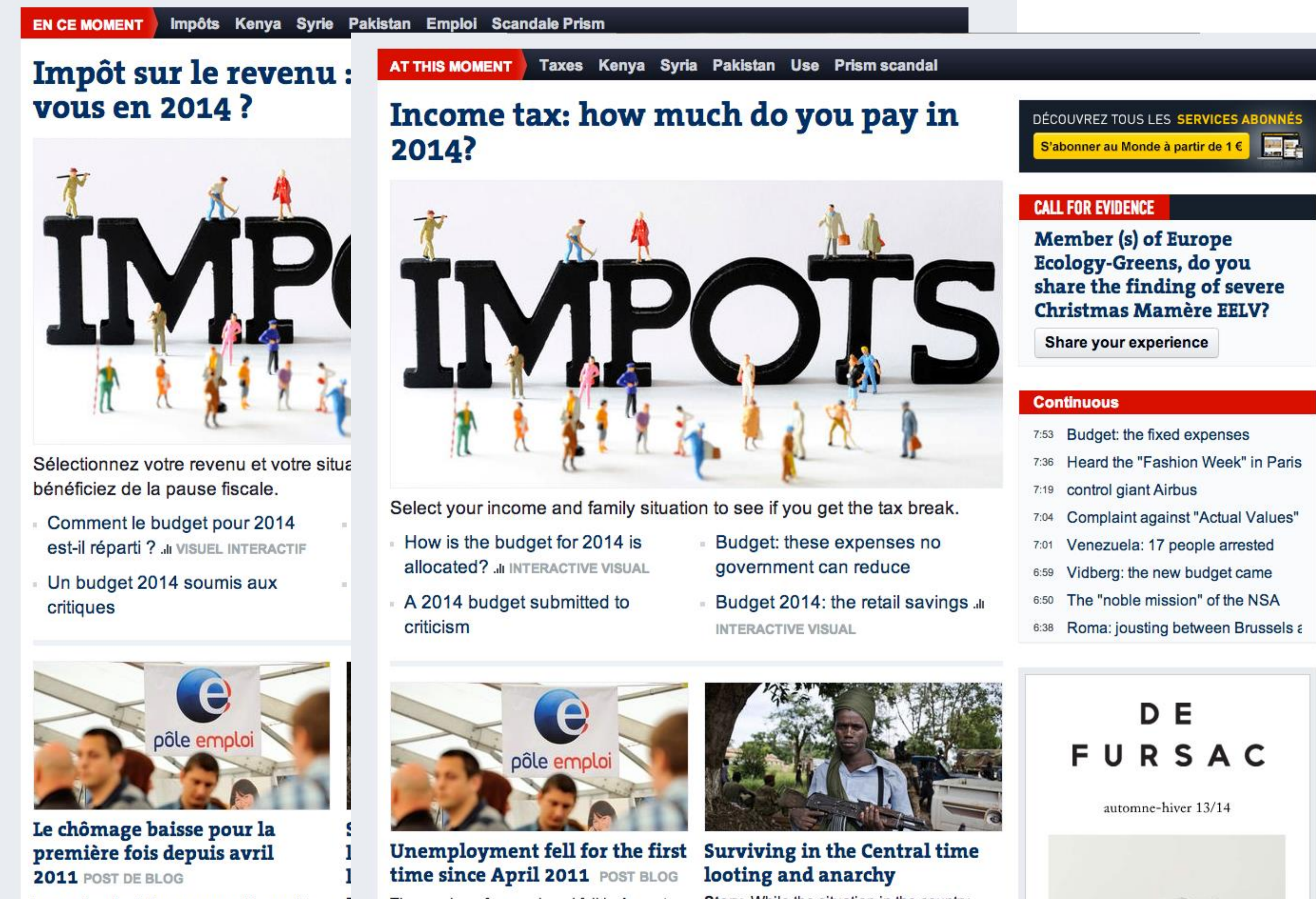
Facts The Dalai Lama denounces the "hell" imposed since he fled Tibet in 1959

Video Anniversary of the Tibetan rebellion: China on guard

Portfolio | Reportage | Video

- Translate text from one language to another
- Recombines fragments of example translations
- Challenges:
  - What fragments? [learning to translate]
  - How to make efficient? [fast translation search]
  - Fluency vs fidelity

2013 Google Translate: French



EN CE MOMENT | Impôts | Kenya | Syrie | Pakistan | Emploi | Scandale Prism

Impôt sur le revenu : vous en 2014 ?

Sélectionnez votre revenu et votre situa bénéficiez de la pause fiscale.

- Comment le budget pour 2014 est-il réparti ? VISUEL INTERACTIF
- Un budget 2014 soumis aux critiques

Le chômage baisse pour la première fois depuis avril 2011 POST DE BLOG

AT THIS MOMENT | Taxes | Kenya | Syria | Pakistan | Use | Prism scandal

Income tax: how much do you pay in 2014?

Select your income and family situation to see if you get the tax break.

- How is the budget for 2014 is allocated? INTERACTIVE VISUAL
- A 2014 budget submitted to criticism
- Budget: these expenses no government can reduce
- Budget 2014: the retail savings INTERACTIVE VISUAL

Unemployment fell for the first time since April 2011 POST BLOG

Surviving in the Central time looting and anarchy

CALL FOR EVIDENCE

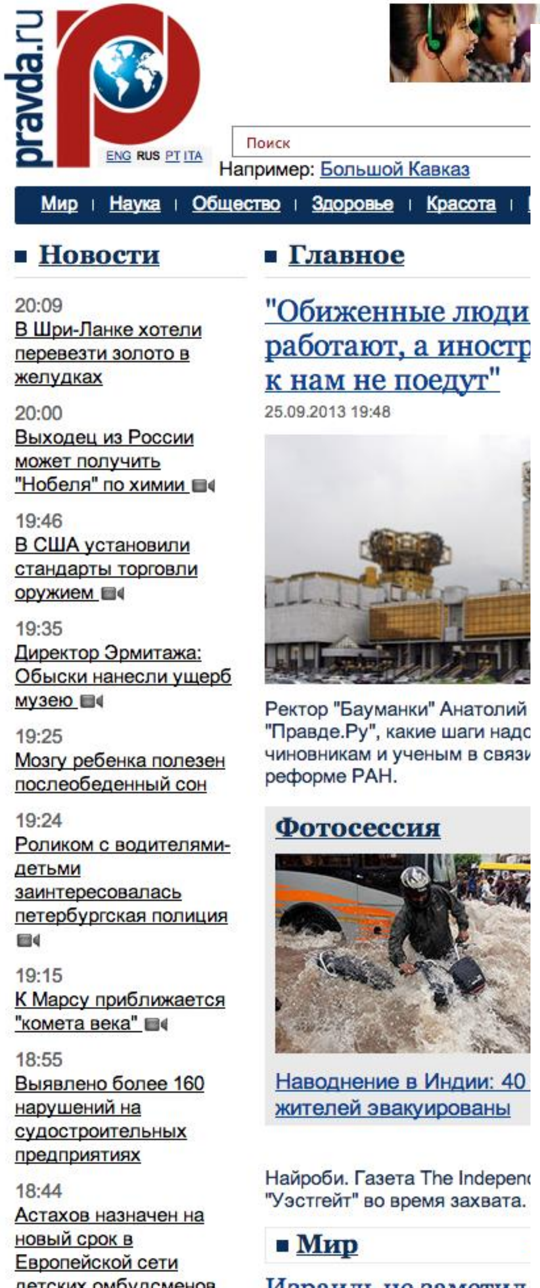
Member (s) of Europe Ecology-Greens, do you share the finding of severe Christmas Mamère EELV?

Share your experience

Continuous

7:53 Budget: the fixed expenses
7:36 Heard the "Fashion Week" in Paris
7:19 control giant Airbus
7:04 Complaint against "Actual Values"
7:01 Venezuela: 17 people arrested
6:59 Vidberg: the new budget came
6:50 The "noble mission" of the NSA
6:38 Roma: jousting between Brussels a

2013 Google Translate: Russian



pravda.ru

ENG RUS PT ITA

Поиск

Например: Большой Кавказ

Мир | Наука | Общество | Здоровье | Красота |

■ Новости

20:09
В Шри-Ланке хотели перевезти золото в желудках

20:00
Выходец из России может получить "Нобеля" по химии

19:46
В США установили стандарты торговли оружием

19:35
Директор Эрмитажа: Обыски нанесли ущерб музею

19:25
Мозгу ребенка полезен послеобеденный сон

19:24
Роликом с водителями-детьми заинтересовалась петербургская полиция

19:15
К Марсу приближается "комета века"

18:55
Выявлено более 160 нарушений на судостроительных предприятиях

18:44
Астахов назначен на новый срок в Европейской сети детских омбудсменов

■ Главное

"Обиженные люди работают, а иностр к нам не поедут"

25.09.2013 19:48

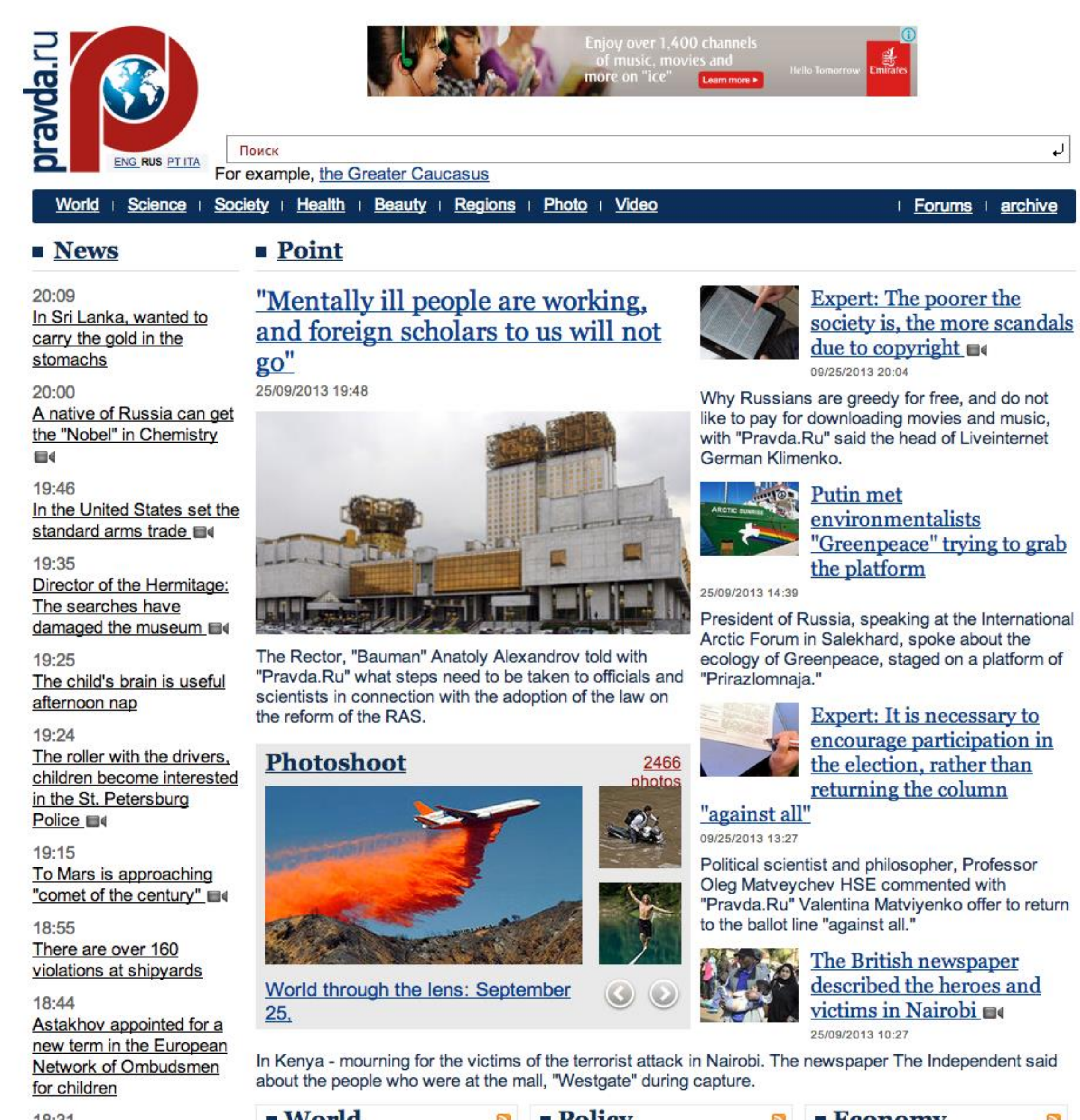
Ректор "Бауманки" Анатолий "Правде.Ру", какие шаги надс чиновникам и ученым в связи реформе РАН.

Фотосессия

Наводнение в Индии: 40 жителей эвакуированы

Найроби. Газета The Indepen "Уэстгейт" во время захвата.

■ Мир



pravda.ru

ENG RUS PT ITA

Поиск

For example, the Greater Caucasus

World | Science | Society | Health | Beauty | Regions | Photo | Video | Forums | archive

■ News

20:09
In Sri Lanka, wanted to carry the gold in the stomachs

20:00
A native of Russia can get the "Nobel" in Chemistry

19:46
In the United States set the standard arms trade

19:35
Director of the Hermitage: The searches have damaged the museum

19:25
The child's brain is useful afternoon nap

19:24
The roller with the drivers, children become interested in the St. Petersburg Police

19:15
To Mars is approaching "comet of the century"

18:55
There are over 160 violations at shipyards

18:44
Astakhov appointed for a new term in the European Network of Ombudsmen for children

■ Point

"Mentally ill people are working, and foreign scholars to us will not go"

25/09/2013 19:48

The Rector, "Bauman" Anatoly Alexandrov told with "Pravda.Ru" what steps need to be taken to officials and scientists in connection with the adoption of the law on the reform of the RAS.

Photoshoot

2466 photos

World through the lens: September 25.

Expert: The poorer the society is, the more scandals due to copyright

09/25/2013 20:04

Why Russians are greedy for free, and do not like to pay for downloading movies and music, with "Pravda.Ru" said the head of Liveinternet German Klimenko.

Putin met environmentalists "Greenpeace" trying to grab the platform

25/09/2013 14:39

President of Russia, speaking at the International Arctic Forum in Salekhard, spoke about the ecology of Greenpeace, staged on a platform of "Prirazlomnaja."

Expert: It is necessary to encourage participation in the election, rather than returning the column "against all"

09/25/2013 13:27

Political scientist and philosopher, Professor Oleg Matveychev HSE commented with "Pravda.Ru" Valentina Matviyenko offer to return to the ballot line "against all."

The British newspaper described the heroes and victims in Nairobi

25/09/2013 10:27

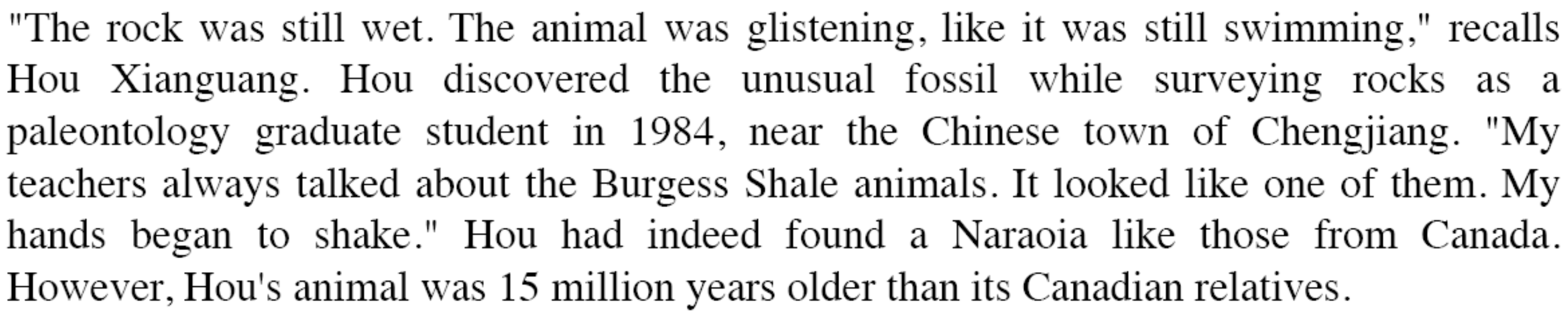
In Kenya - mourning for the victims of the terrorist attack in Nairobi. The newspaper The Independent said about the people who were at the mall, "Westgate" during capture.

■ World ■ Policy ■ Economy

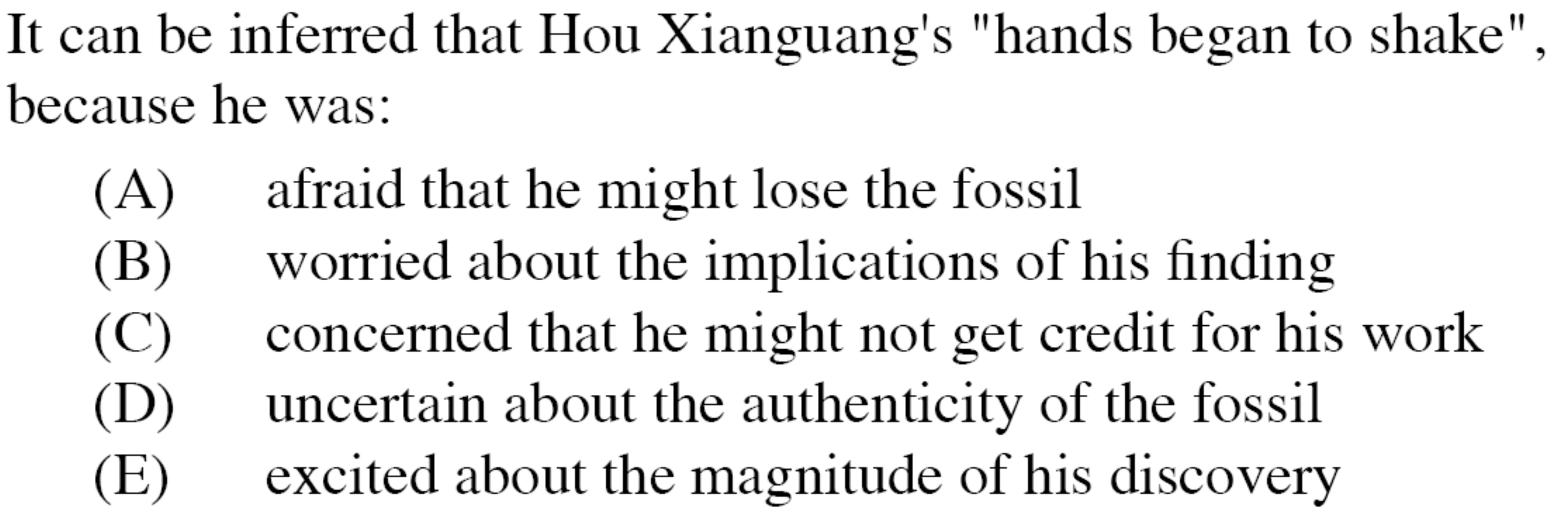
English -- Russian

- ***The spirit is willing but the flesh is weak. (English)***
- ***The vodka is good but the meat is rotten. (Russian)***

Language Comprehension?



"The rock was still wet. The animal was glistening, like it was still swimming," recalls Hou Xianguang. Hou discovered the unusual fossil while surveying rocks as a paleontology graduate student in 1984, near the Chinese town of Chengjiang. "My teachers always talked about the Burgess Shale animals. It looked like one of them. My hands began to shake." Hou had indeed found a Naraoia like those from Canada. However, Hou's animal was 15 million years older than its Canadian relatives.



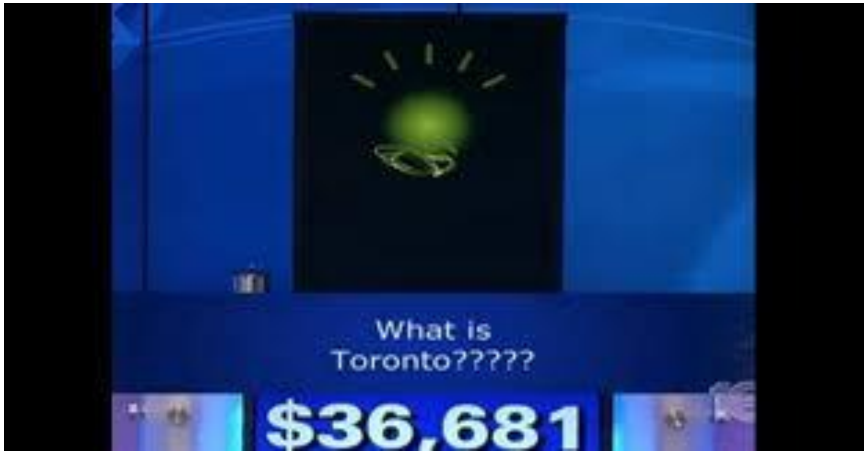
It can be inferred that Hou Xianguang's "hands began to shake", because he was:

(A) afraid that he might lose the fossil
(B) worried about the implications of his finding
(C) concerned that he might not get credit for his work
(D) uncertain about the authenticity of the fossil
(E) excited about the magnitude of his discovery

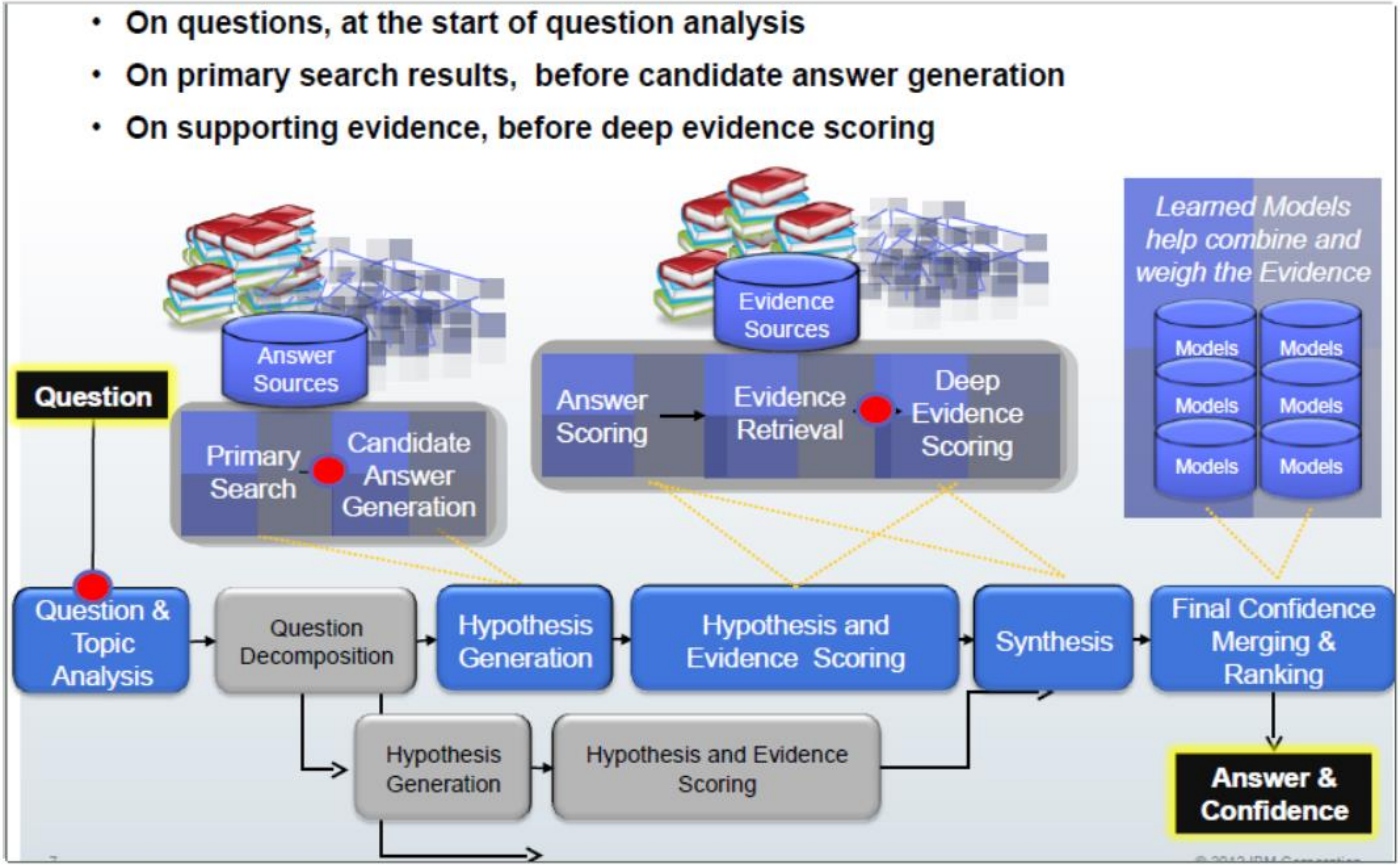
Jeopardy! World Champion

US Cities: Its largest airport is named for a World War II hero; its second largest, for a World War II battle.

http://www.youtube.com/watch?v=qpKoIfTukrA



NLP in Watson



- On questions, at the start of question analysis
- On primary search results, before candidate answer generation
- On supporting evidence, before deep evidence scoring

Weblog and Tweet Analytics

- Data-mining of Weblogs, discussion forums, message boards, user groups, tweets, other social media
  - Product marketing information
  - Political opinion tracking
  - Social network analysis
  - Buzz analysis (what’s hot, what topics are people talking about right now).

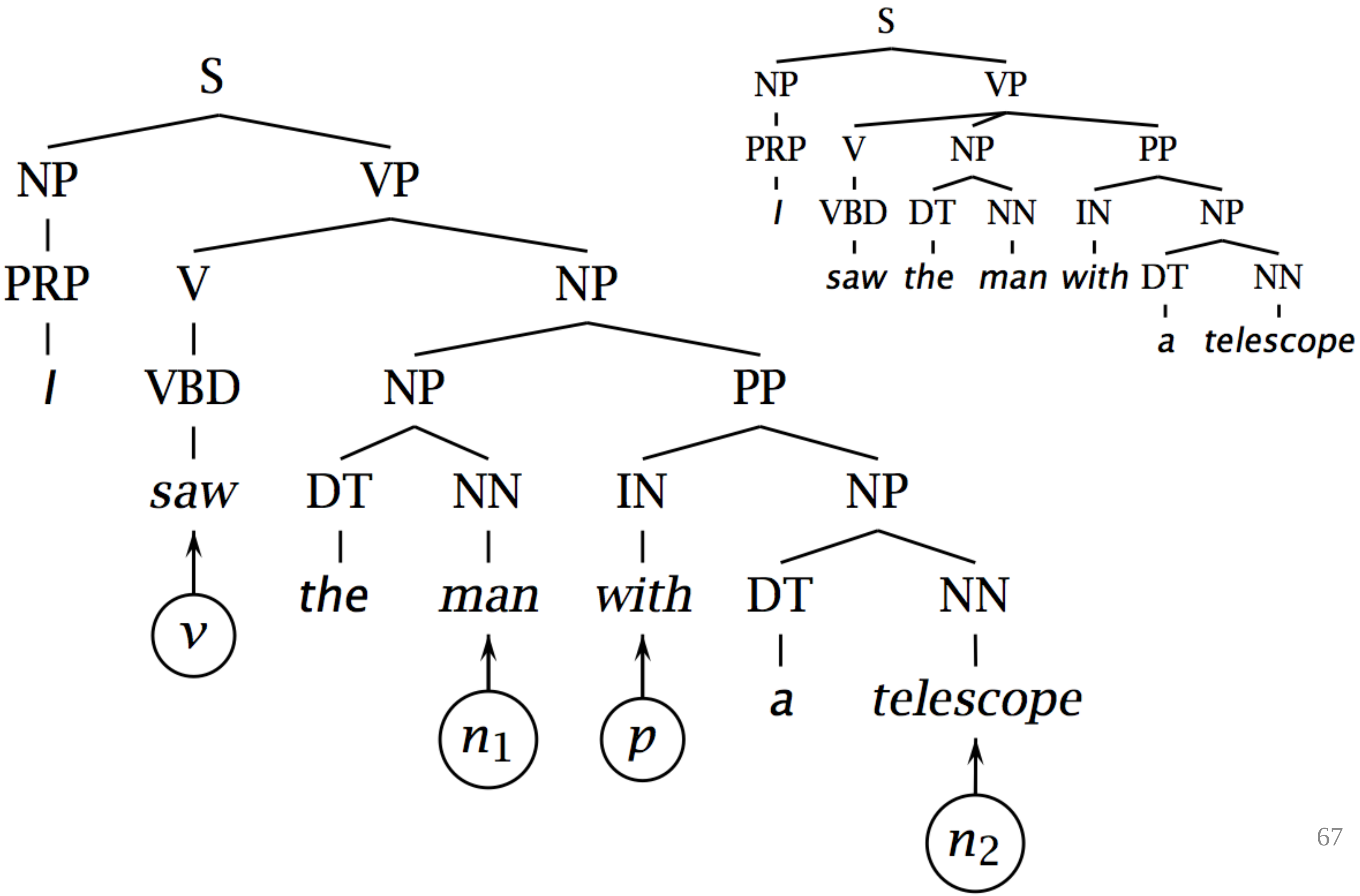
Why is NLP hard?

- Ambiguity
- Ambiguity
- Ambiguity
- Sparsity

Ambiguities

- Headlines: Why are these funny?
  - Ban on Nude Dancing on Governor's Desk
  - Iraqi Head Seeks Arms
  - Juvenile Court to Try Shooting Defendant
  - Teacher Strikes Idle Kids
  - Stolen Painting Found by Tree
  - Local High School Dropouts Cut in Half
  - Red Tape Holds Up New Bridges
  - Clinton Wins on Budget, but More Lies Ahead
  - Hospitals Are Sued by 7 Foot Doctors
  - Kids Make Nutritious Snacks

Syntactic Ambiguity



Semantic Ambiguity

At last, a computer that understands you like your mother.

- Direct Meanings:
  - It understands you like your mother (does) [presumably well]
  - It understands (that) you like your mother
  - It understands you like (it understands) your mother
- But there are other possibilities, e.g. mother could mean:
  - a woman who has given birth to a child
  - a stringy slimy substance consisting of yeast cells and bacteria; is added to cider or wine to produce vinegar
- Context matters, e.g. what if previous sentence was:
  - Wow, Amazon predicted that you would need to order a big batch of new vinegar brewing ingredients. ☺

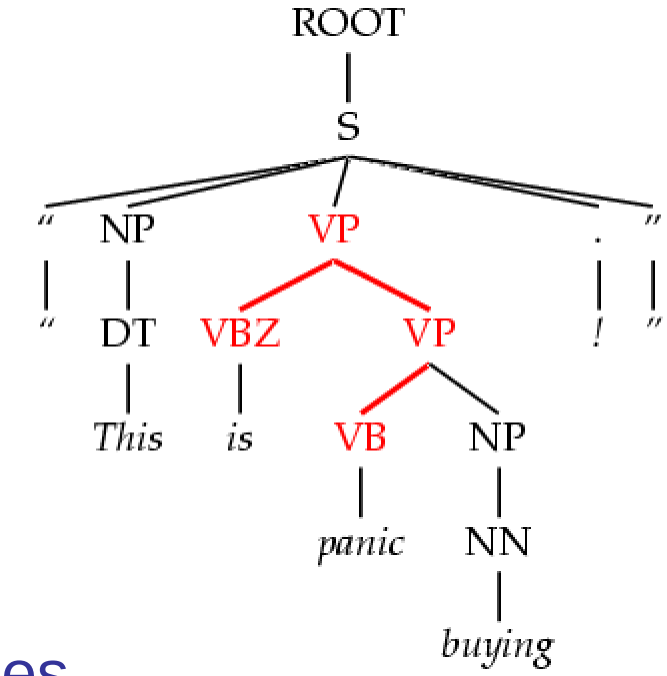
[Example from L. Lee]

Dark Ambiguities

- *Dark ambiguities*: most structurally permitted analyses are so bad that you can't get your mind to produce them

This analysis corresponds to the correct parse of

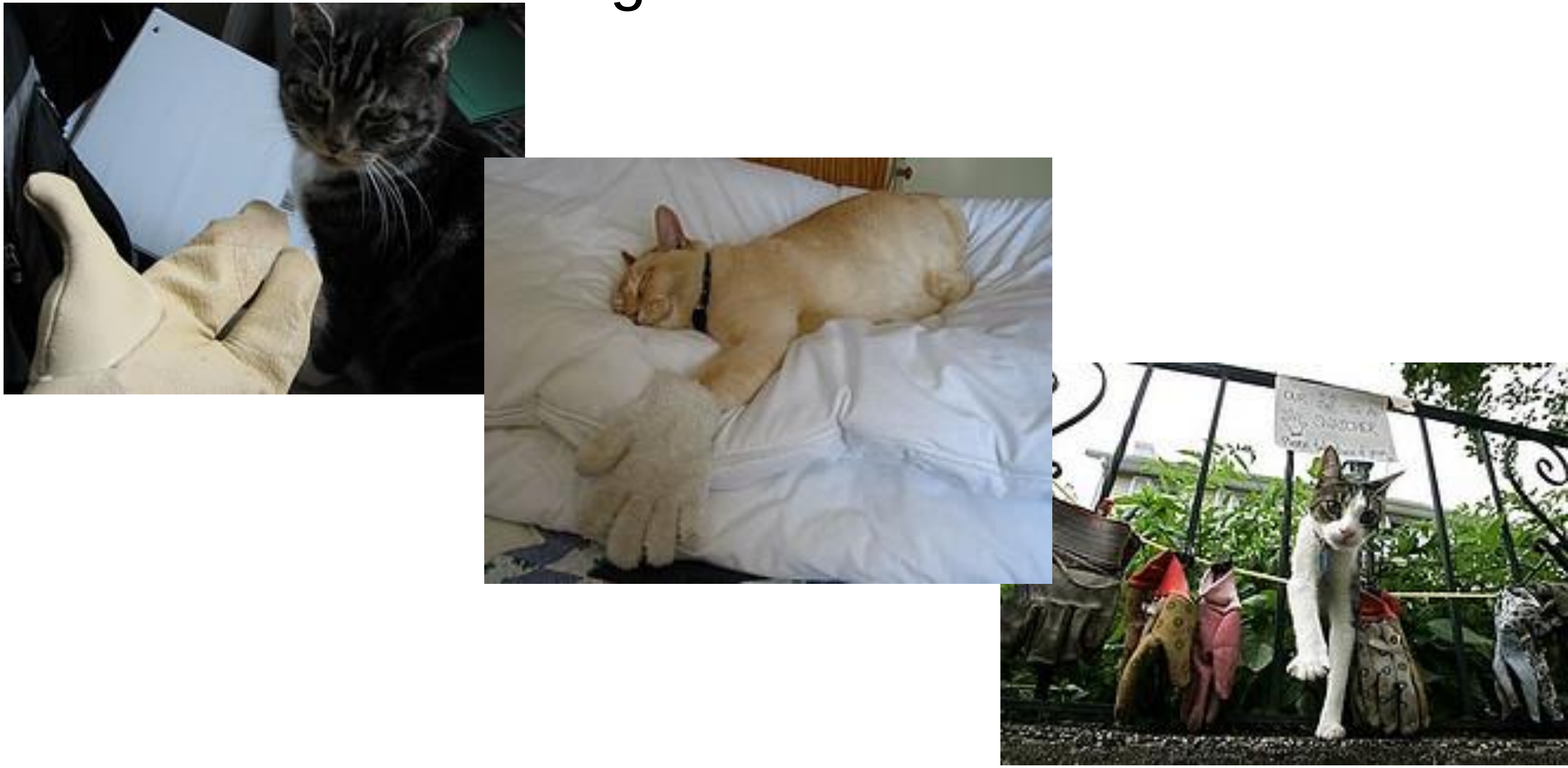
"This will panic buyers ! "



- Unknown words and new usages
- Solution: We need mechanisms to focus attention on the best ones, probabilistic techniques do this

Ambiguities (contd)

- Get the cat with the gloves.



Ambiguity

- Find at least 5 meanings of this sentence:
  - I made her duck

Ambiguity

- Find at least 5 meanings of this sentence:
  - I made her duck
- I cooked waterfowl for her benefit (to eat)
- I cooked waterfowl belonging to her
- I created the (plaster?) duck she owns
- I caused her to quickly lower her head or body
- I waved my magic wand and turned her into undifferentiated waterfowl

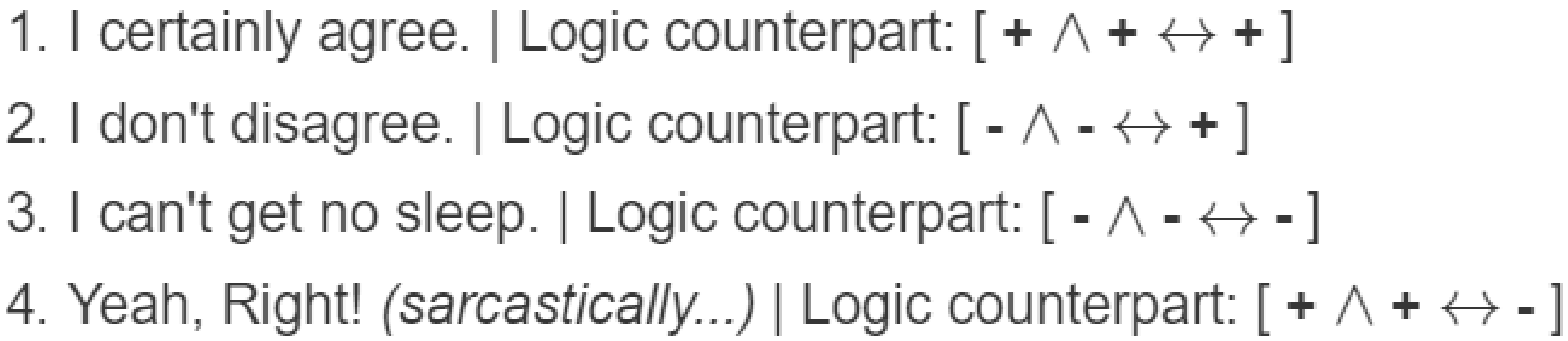
Ambiguity is Pervasive

- I caused her to quickly lower her head or body
  - **Lexical category**: “duck” can be a N or V
- I cooked waterfowl belonging to her.
  - **Lexical category:** “her” can be a possessive (“of her”) or dative (“for her”) pronoun
- I made the (plaster) duck statue she owns
  - **Lexical Semantics:** “make” can mean “create” or “cook”

Ambiguity is Pervasive

- **Grammar**: Make can be:
  - **Transitive: (verb has a noun direct object)**
    - I cooked [waterfowl belonging to her]
  - **Ditransitive: (verb has 2 noun objects)**
    - I made [her] (into) [undifferentiated waterfowl]
  - **Action-transitive (verb has a direct object and another verb)**
  - I caused [her] [to move her body]

Semantic Ambiguity



1. I certainly agree. | Logic counterpart: [**+** ∧ **+** ↔ **+**]

2. I don't disagree. | Logic counterpart: [**-** ∧ **-** ↔ **+**]

3. I can't get no sleep. | Logic counterpart: [**-** ∧ **-** ↔ **-**]

4. Yeah, Right! *(sarcastically...)* | Logic counterpart: [**+** ∧ **+** ↔ **-**]

Ambiguity is Pervasive

- **Phonetics!**
  - I mate or duck
  - I'm eight or duck
  - Eye maid; her duck
  - Aye mate, her duck
  - I maid her duck
  - I'm aid her duck
  - I mate her duck
  - I'm ate her duck
  - I'm ate or duck
  - I mate or duck

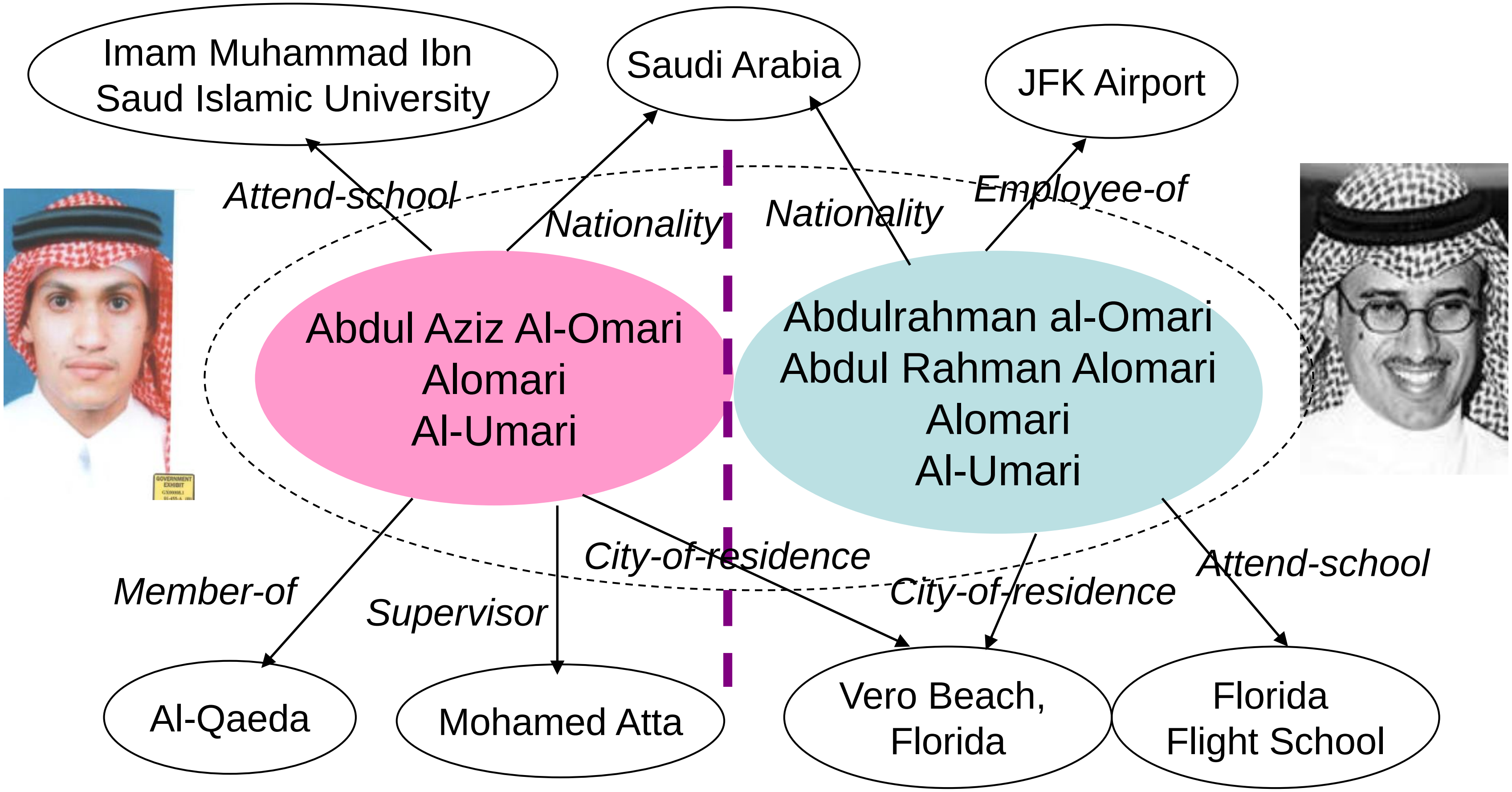
Abbrevations out of context

- Medical Domain: 33% of abbreviations are ambiguous (Liu et al., 2001), major source of errors in medical NLP (Friedman et al., 2001)

RA	“rheumatoid arthritis”, “renal artery”, “right atrium”, “right atrial”, “refractory anemia”, “radioactive”, “right arm”, “rheumatic arthritis”, …
PN	“Penicillin”; “Pneumonia”; “Polyarteritis”; “Nodosa”; “Peripheral neuropathy”; “Peripheral nerve”; “Polyneuropathy”; “Pyelonephritis”; “Polyneuritis”; “Parenteral nutrition”; “Positional Nystagmus”; “Periarteritis nodosa”, …

- Military Domain
  - *“GA ADT 1, USDA, USAID, Turkish PRT, and the DAIL staff met to create the Wardak Agricultural Steering Committee. “*
  - “*DST*” = “*District Stability Team*” or “*District Sanitation Technician*”?

Uncertainty: Ambiguity Example



Imam Muhammad Ibn Saud Islamic University

Saudi Arabia

JFK Airport

Attend-school

Nationality

Nationality

Employee-of

Abdul Aziz Al-Omari
Alomari
Al-Umari

Abdulrahman al-Omari
Abdul Rahman Alomari
Alomari
Al-Umari

Member-of

Supervisor

City-of-residence

City-of-residence

Attend-school

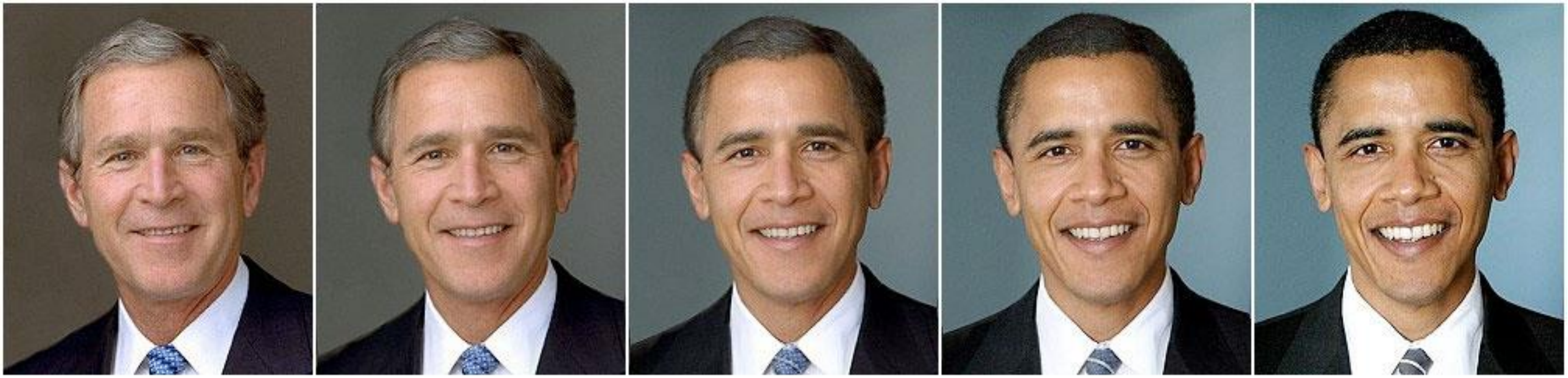
Al-Qaeda

Mohamed Atta

Vero Beach, Florida

Florida Flight School

Even More Uncertainty: “Morphing” in Vision



Morphing in Texts

To Ramzi bin al-Shibh

“The first semester commences in t on September 11

World Trade Center and Pentagon and Capitol

This summer will surely be hot ...

19 hijackers for private education and four planes.

Regards to Bin Laden

Goodbye.

Abu Abdul Rahman

Morphs in Social Media

“Conquer West King”
(平西王)

=

“Bo Xilai”
(薄熙来)

“Baby”
(宝宝)

=

“Wen Jiabao”
(温家宝)

Morph	Target	Motivation
Blind Man (瞎子)	Chen Guangcheng(陈光诚)	Sensitive
First Emperor (元祖)	Mao Zedong (毛泽东)	Vivid
Kimchi Country (泡菜国)	Korea (韩国)	Vivid
Rice Country (米国)	United States (美国)	Pronunciation
Kim Third Fat (金三胖)	Kim Jong-un (金正恩)	Negative
Miracle Brother (奇迹哥)	Wang Yongping (王勇平)	Irony

Dealing with Ambiguity

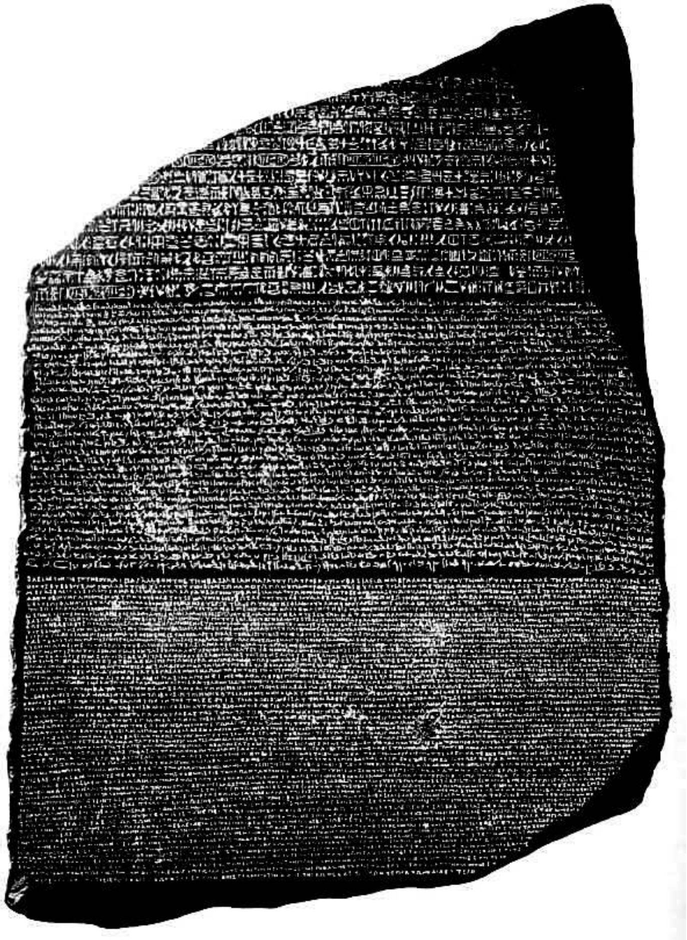
- Four possible approaches:
  1. Tightly coupled interaction among processing levels; knowledge from other levels can help decide among choices at ambiguous levels.
  2. Pipeline processing that ignores ambiguity as it occurs and hopes that other levels can eliminate incorrect structures.

Dealing with Ambiguity

3. Probabilistic approaches based on making the most likely choices

4. Don’t do anything, maybe it won’t matter
    1. *We’ll leave when the duck is ready to eat.*
    2. *The duck is ready to eat now.*
        - Does the “duck” ambiguity matter with respect to whether we can leave?

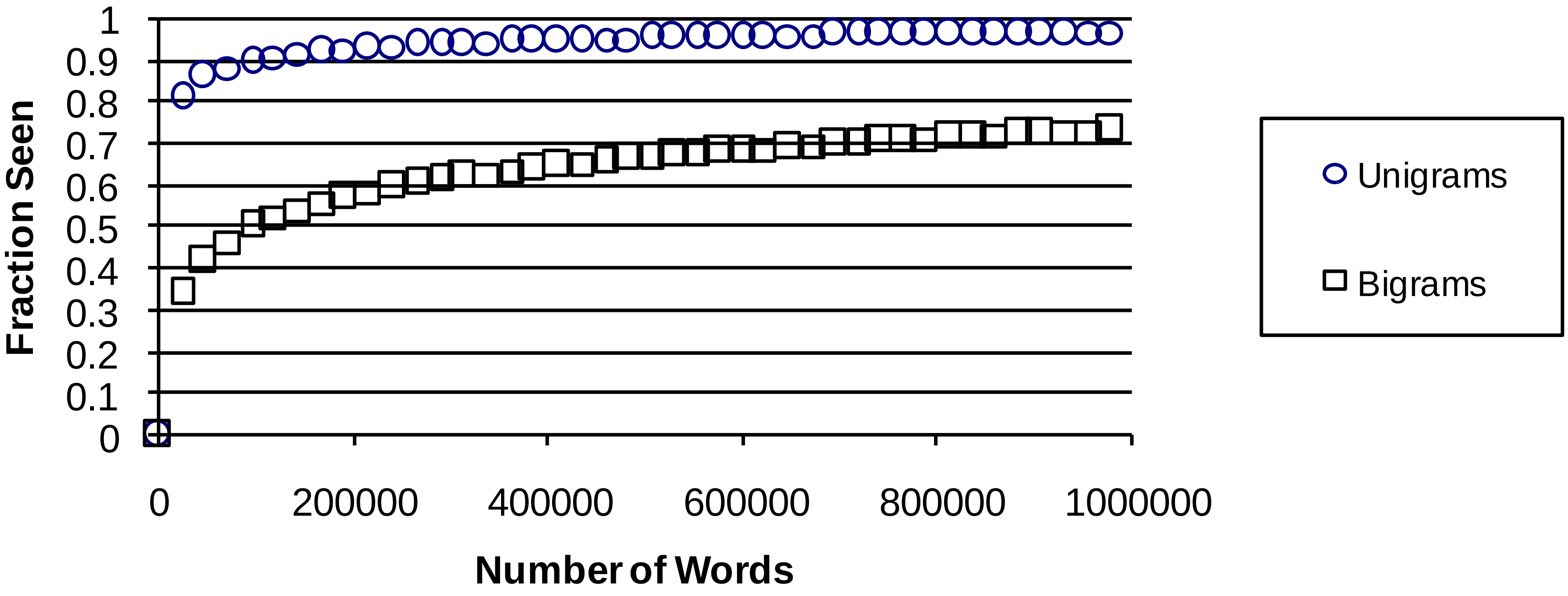
Corpora



- A corpus is a collection of text
  - Often annotated in some way
  - Sometimes just lots of text
  - Balanced vs. uniform corpora
- Examples
  - Newswire collections: 500M+ words
  - Brown corpus: 1M words of tagged "balanced" text
  - Penn Treebank: 1M words of parsed WSJ
  - Canadian Hansards: 10M+ words of aligned French / English sentences
  - The Web: billions of words of who knows what

Problem: Sparsity

- However: sparsity is always a problem
  - New unigram (word), bigram (word pair)



The Challenge

- Patrick Suppes, eminent philosopher, in his 1978 autobiography:

  > "…the challenge to psychological theory made by linguists to provide an adequate theory of language learning may well be regarded as the most significant intellectual challenge to theoretical psychology in this century."

- So far, this challenge is still unmet in the 21st century
- Natural language processing (NLP) is the discipline in which we study the tools that bring us closer to meeting this challenge

NLP Topics in the Course

- tokenization,
- language models,
- part of speech tagging,
- noun phrase chunking,
- named entity recognition,
- coreference resolution,
- parsing,
- information extraction,
- sentiment analysis,
- question answering,
- text classification,
- document clustering,
- document summarization,

ML Topics in the Course

- Naive Bayes,
- Hidden Markov Models,
- Expectation Maximization,
- Conditional Random Fields,
- MaxEnt Classifiers,
- Probabilistic Context Free Grammars,
- Neural Language Models
- Sequence to Sequence models

Disclaimer

- This course will be highly biased
  - won‘t focus much on linguistics
  - won‘t focus much on historical perspectives
  - won‘t be all deep learning

- This course will be highly biased
  - I will teach you what I like
  - I will teach what I can easily learn … ☺