Knowledge Graphs

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Semantic Search

Semantic Search

- Improve search accuracy by <u>understanding</u> user intent

- Improve relevance assessment by document <u>understanding</u>, including context

- Move towards providing answers (and not just result links)

Athens

Web   Maps   Images   News   Books   More ▾   Search tools

About 180,000,000 results (0.28 seconds)

Athens - Wikipedia, the free encyclopedia
en.wikipedia.org/wiki/**Athens** ▾ Wikipedia ▾
Athens is the capital and largest city of Greece. **Athens** dominates the Attica region and is one of the world's oldest cities, with its recorded history spanning ...
History of Athens - Acropolis of Athens - Classical Athens - Athens (disambiguation)

OpenAthens: Eduserv
www.open**athens**.net/ ▾
Related links. OpenAthens resources All OpenAthens enabled resources. More about Identity and Access Management Eduserv provides a range of products ...
OpenAthens - Login - OpenAthens Documentation - Service Status - Support

Greece-Athens.com - The Guide To Athens city, Greece
www.greece-**athens**.com/ ▾
The essential guide to the capital city of **Athens**, Greece. Our site offers a virtual tour in **athens** city & tourist information such as accommodation, restaraunts, ...

Visit Greece | Athens
www.visitgreece.gr/en/main.../athe... ▾ Greek National Tourism Organization ▾
Athens is the historical capital of Europe, with a long history, dating from the first settlement in the Neolithic age. In the 5th Century BC (the "Golden Age of ...

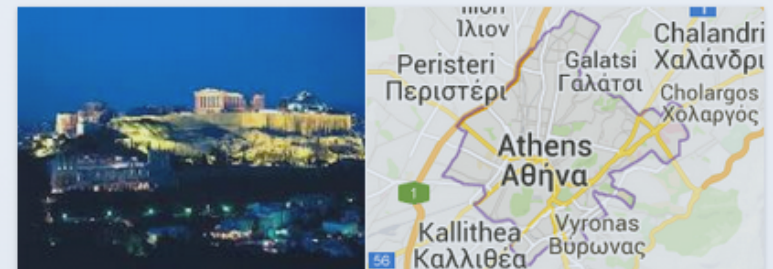**Images for Athens**   Report images

More images for Athens

Athens Georgia travel, vacation, events, hotels, music ...
www.visit**athens**ga.com/ ▾
Take a hip trip to **Athens**, Georgia! A vibrant, restored Victorian-era downtown teems with art galleries, trendy shops, world-renowned nightclubs and distinctive ...

Athens

Capital of Greece

Athens is the capital and largest city of Greece. Athens dominates the Attica region and is one of the world's oldest cities, with its recorded history spanning around 3,400 years and the earliest human presence around 11th–7th millennium BC,. Wikipedia

Area: 15.04 sq miles (38.96 km²)

Weather: 55°F (13°C), Wind 0 mph (0 km/h), 84% Humidity

Local time: Saturday 4:10 PM

Population: 789,166 (2001) UNdata

Points of interest   View 15+ more

Acropolis of Athens   Parthenon   Acropolis Museum   National Archaeol... Museum...   Plaka

Colleges and Universities   View 15+ more

National and...   National Technical...   Panteion University...   Athens University of...   Technolo... Educational...

🏠 Home   Mail   Search   News   Sports   Finance   Weather   Games   Answers   Screen   Flickr   Mobile   More ⌄   🌐 Upgrade to the faste

YAHOO!

barack obama   ✕   **Search**

👤 Sign In   ✉ Mail   ⚙

Web

Images

Video

News

Local

Answers

Shopping

More

Anytime

Past day

Past week

Past month

Barack Obama News

Obama, Republicans rejoin fight over closing Guantanamo
AFP via Yahoo! News 3 hours ago
US President Barack Obama this week renewed his pledge to shut
down the Guantanamo Bay military prison, despite strong objections
from Republicans who fear inmates could join jihadist battles...

Obama begins landmark visit to India
AFP via Yahoo! News 2 hours ago

Obama cuts short India visit to meet new Saudi king
AFP via Yahoo! News 12 hours ago

More Barack Obama Headlines

Barack Obama - Image Results

More Barack Obama images

Barack Obama - Official Site
www.barackobama.com Cached
Let's give this everything we've got. President Obama is fighting hard to make change in
his final two years in office. It's never been more important to take a stand ...

Barack Obama - Wikipedia, the free encyclopedia
en.wikipedia.org/wiki/Barack_Obama Cached
Barack Hussein Obama II (i / b ə ˈ r ɑː k h uː ˈ s eɪ n ə ˈ b ɑː m ə /; born August 4, 1961) is

Barack Obama
44th President of the United States
© Getty Images

Barack Hussein Obama II is the 44th
and current President of the United
States, and the first African American to
hold the office. wikipedia.org

Born: August 4, 1961 (age 53),
Honolulu, Hawaii, USA

Nationality: United States of America

Height: 6' 1" (1.85m)

Spouse: Michelle Obama (m. 1992-
present)

Parents: Barack Obama, Sr., Ann
Dunham

Children: Natasha Obama, Malia Ann
Obama

Feedback

PART 1: KNOWLEDGE GRAPHS

What is a knowledge graph?

Why (knowledge) graphs?

- We're surrounded by **entities**, which are connected by **relations**

- We need to store them somehow, e.g., using a **DB** or a **graph**

- **Graphs** can be processed **efficiently** and offer a convenient **abstraction**

Knowledge graphs

Freebase

yago
select knowledge

DBpedia

NELL: Never-Ending
Language Learning

Facebook's
Entity Graph

*OpenIE
(Reverb, OLLIE)*
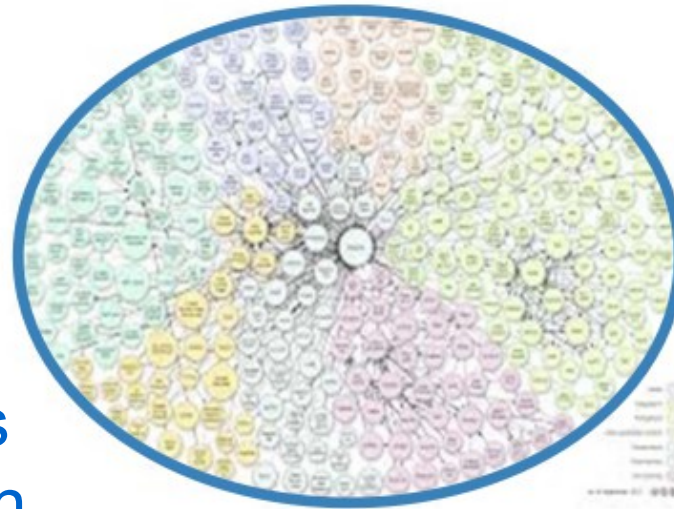
Microsoft's
Satori

Google's
Knowledge Graph

A sampler of research problems

- **Growth:** knowledge graphs are incomplete!
  - *Link prediction*: add relations
  - *Ontology matching*: connect graphs
  - *Knowledge extraction*: extract new entities and relations from web/text

- **Validation:** knowledge graphs are not always correct!
  - *Entity resolution*: merge duplicate entities, split wrongly merged ones
  - *Error detection*: remove false assertions

- **Interface:** how to make it easier to access knowledge?
  - *Semantic parsing*: interpret the meaning of queries
  - *Question answering*: compute answers using the knowledge graph

- **Intelligence:** can AI emerge from knowledge graphs?
  - *Automatic reasoning* and planning
  - Generalization and abstraction

A SAMPLER OF APPLICATIONS

OF KNOWLEDGE GRAPHS

Surfacing structured results in web search

Augmenting the presentation with relevant facts

Surfacing facts proactively

Exploratory search

Connecting people, places and things

Connecting people, places and things

Structured search within the graph

Question answering
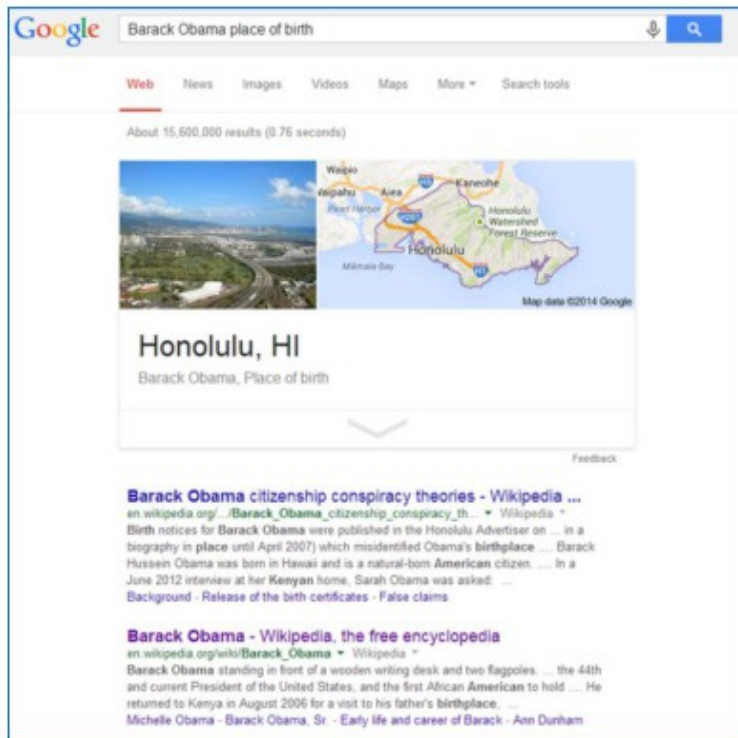
Google

EVI

(Amazon)
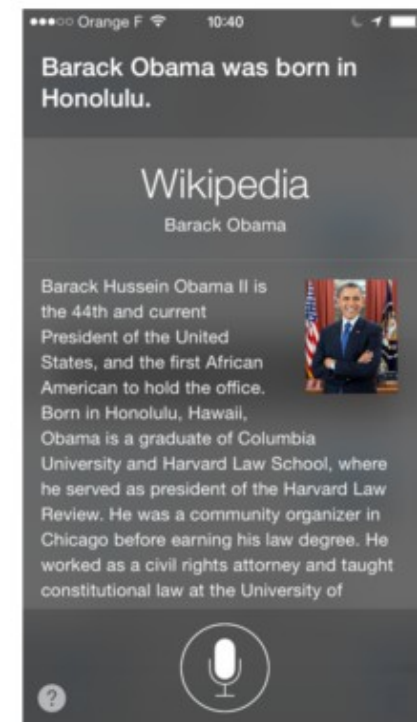
Siri

(Apple)

Towards a knowledge-powered digital assistant
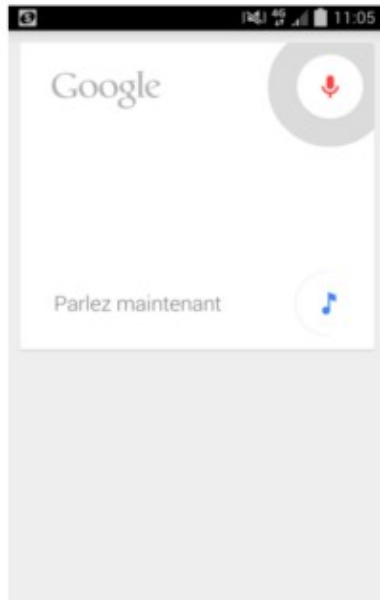
OK Google
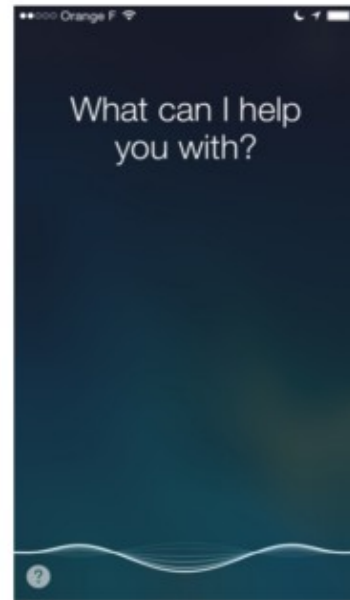
**Siri
(Apple)**
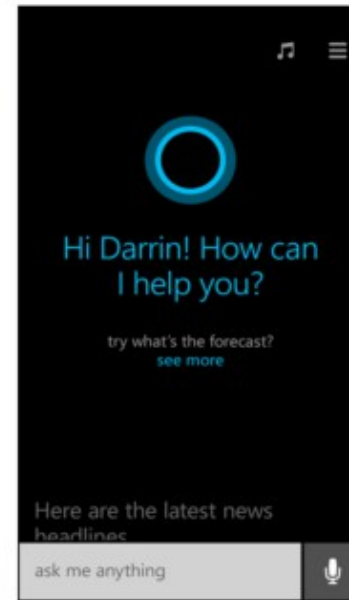
**Cortana
(Microsoft)**

- Natural way of accessing/storing knowledge
- Dialogue system
- Personalization
- Emotion

Interface revolution ◊

FREEBASE AS AN EXAMPLE OF A LARGE SCALE KNOWLEDGE REPOSITORY

Different approaches to knowledge representation

- Structured (e.g., Freebase or YAGO)

  - Both entities and relations come from a fixed lexicon

- Semi-structured

  - Predicates come from a fixed lexicon, but entities are strings

- Unstructured (Open IE)

Freebase

- **Freebase** is an open, Creative Commons licensed repository of structured data
- **Typed entities** rather than **strings**

Person Type

Key: /people/person **Includes:** Topic

A person is a human being (man, woman or child) known to have actually existed. Living persons, celebrities and politicians are persons.

Table | Diagram

Properties

Property	ID	Expected Type
Date of birth	/people/person/date_of_birth	/type/datetime
Place of birth	/people/person/place_of_birth	/location/location
Country of nationality	/people/person/nationality	/location/country
Gender	/people/person/gender	/people/gender enumerated
Profession	/people/person/profession	/people/profession
Religion	/people/person/religion	/religion/religion
Ethnicity	/people/person/ethnicity	/people/ethnicity
Parents	/people/person/parents	/people/person
Children	/people/person/children	/people/person
Siblings	/people/person/sibling_s	/people/sibling_relationship
Spouse (or domestic partner)	/people/person/spouse_s	/people/marriage mediatc
Employment history	/people/person/employment_history	/business/employment_tenu
Education	/people/person/education	/education/education med

Relations are typed too!

Barack Obama - Freebase

https://www.freebase.com/m/02mjmr

Topic

Barack Obama en

mid: /m/02mjmr **notable type:** /government/us_pre...

Barack Hussein Obama II is the 44th and current Pre...
Honolulu, Hawaii, Obama is a graduate of Columbia ...
Review. He was a community organizer in Chicago b...
constitutional law at the University of Chicago Law S...
Illinois Senate from 1997 to 2004, running unsuccess...
received national attention during his campaign to re...
Party primary, his keynote address at the Democratic ...
his presidential campaign in 2007 and, after a close p...
delegates in the Democratic Party primaries to receiv...

Properties	I18n	Keys

View and edit specific domains, types, or properties..

Filter options: ☐ Show all domains and properties

Common /common

Topic /common/topic

Also known as /common/topic/alias

Also known as
Barack Hussein Obama, Jr.
Barack Hussein Obama
Obama
President Obama
Barack H. Obama II
Barack Hussein Obama II
Barack Obama II
President Barack Hussein Obama II
Sen. Barack Obama
Barak Obama
90 values total »

Description /common/topic/description

Barack Obama - Freebase

https://www.freebase.com/m/02mjmr

Person /people/person ✕

Date of birth /people/person/date_of_birth ✓ 2013-10-15
8/4/1961

Place of birth /people/person/place_of_birth ✓ 2014-03-12
Honolulu

Country of nationality /people/person/nationality ✓ 2013-10-15
United States of America

Gender /people/person/gender ✓ 2013-10-15
Male

Profession /people/person/profession
Profession
Politician
Lawyer
Writer
Author
Law professor

Religion /people/person/religion
Christianity

Ethnicity /people/person/ethnicity
Ethnicity
Kenyan American
English American
Irish American
Multiracial American

Parents /people/person/parents ✓ 2013-10-15
Parents
Barack Obama, Sr.
Ann Dunham

Children /people/person/children ✓ 2013-10-15
Children
Natasha Obama

The world changes, but we don't retract facts

We just add more facts!

Subject-Predicate-Object (SPO) triples

</m/0jcx,   /m/04m8,   /m/019xz9>
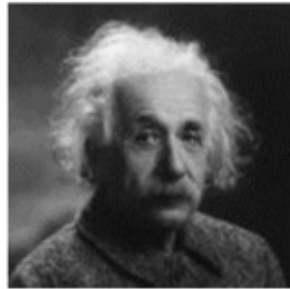
/en/albert_einstein

Albert Einstein

/en/ulm

Ulm

/people/person/place_of_birth

Place of birth

YAGO2 uses SPOTL tuples (SPO + Time and Location)

A graph of inter-related objects

KNOWLEDGE ACQUISITION FROM TEXT

Knowledge acquisition

- Relying on humans
  - Volunteer contributions at Freebase.com
  - Import of large datasets (e.g., IMDB)
  - **Head + torso**

- Automatic extraction
  - Extraction from web pages
  - **The long tail**
  - Learning patterns using known facts

"… **jumped from** X **into** Y …"

</en/tower_bridge,

/transportation/bridge/body_of_water_spanned,

/en/river_thames>

http://www.flickr.com/photos/sandreli/4691045841/
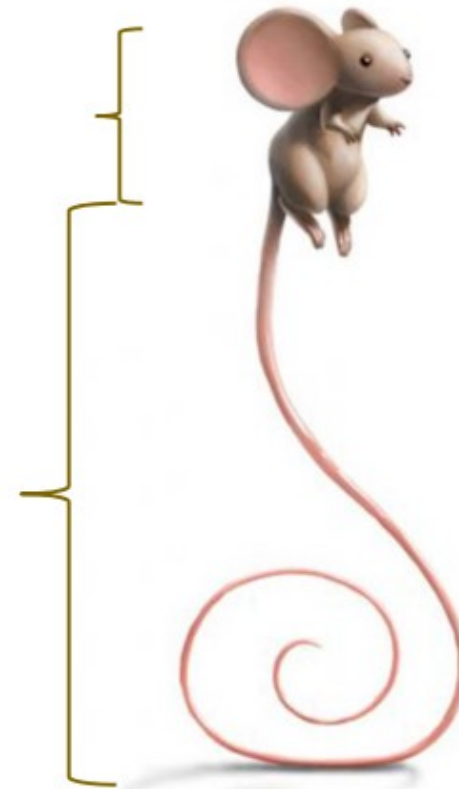
Limits of automatic extraction

- Freebase: **637M** (non-redundant) facts

- Knowledge Vault (automatically extracted):

  302M confident facts with **Prob(true)> 0.9**

  - Of those, 223M are in Freebase (**~ 35%**)

Relations that are rarely expressed in text

Relation	% entity pairs not found	Notes
/people/person/gender	30%	Pronouns
/people/person/profession	18%	
/people/person/children and /people/person/parents	36%	
/medicine/drug_formulation/ manufactured_forms	99.9%	**Sample object:** "Biaxin 250 film coated tablet" (/m/0jxc5vb)
/medicine/manufactured_drug _form/available_in	99.4%	**Sample subject:** "Fluocinolone Acetonide 0.25 cream" (/m/0jxlbx9)
/book/author/works_written and /book/written_work/author	37%	**Sample book title:** "The birth day: a brief narrative of Eliza Reynolds, who died on Sunday, Oct 19, 1834" (/m/0ydpbtq)

Implicitly stated information

People /people

Person /people/person

Date of birth /people/person/date_of_birth

➡ 4004 BCE

Place of birth /people/person/place_of_birth

➡ Garden of Eden

Country of nationality /people/person/nationality

> This property has been flagged as having values, but those values are unknown. Remove this flag to add specific values.

Gender /people/person/gender

➡ Male

Profession /people/person/profession

Religion /people/person/religion

Ethnicity /people/person/ethnicity

Parents /people/person/parents

> This property has been flagged as having no values. Remove this flag to add new values.

Children /people/person/children

Children
Azura
Seth
Cain
Abel
Awan

Siblings /people/person/sibling_s

Sibling

> This property has been flagged as having no values. Remove this flag to add new values.

Spouse (or domestic partner) /peo

Spouse   From
➡ Eve — — — — — — — — —

Employment history /people/person/e

Employer

20 And **Adam called his wife's name Eve**; because she was the mother of all living.   *(Genesis 3:20)*

Implicitly stated information

People /people

Person /people/person

Date of birth /people/person/date_of_birth

4004 BCE

Place of birth /people/person/place_of_birth

Garden of Eden

Country of nationality /people/person/nationality

This prop

Gender /people/person/gender

Male

Profession /people/person/profession

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Ethnicity /people/person/ethnicity

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Sibling

Spouse (or domestic partner) /peo

Spouse   From

Eve

Employment history /people/person/e

Employer

(Genesis 1)

1 **In the beginning** God created the heaven and the earth.
2 And the earth was without form, and void; and darkness was upon the face of the deep. And the Spirit of God moved upon the face of the waters.
3 And God said, Let there be light: and there was light.
...

(Genesis 2)

7 And the LORD God **formed man** of the dust of the ground, and breathed into his nostrils the breath of life; and man became a living soul.
8 And the LORD God **planted a garden eastward in Eden; and there he put the man whom he had formed**.
...

19 And out of the ground the LORD God formed every beast of the field, and every fowl of the air; and brought them unto **Adam** to see what he would call them: and whatsoever **Adam** called every living creature, that was the name thereof.

20 And A
mother o

Knowledge discovery: the long tail of challenges

- Errors in extraction (e.g., parsing errors, overly general patterns)

- Noisy / unreliable / conflicting information

- Disparity of opinion (*Who invented the radio ?*)

- Quantifying completeness of coverage

Knowledge discovery: the long tail of challenges

- Errors in extraction (e.g., parsing errors, overly general patterns)

- Noisy / unreliable / conflicting information

- Disparity of opinion (*Who invented the radio ?*)

- Quantifying completeness of coverage

- Fictional contexts

  </en/abraham_lincoln,

  /people/person/profession,

  /en/vampire_hunter> ?

Knowledge fusion

(b) Knowledge fusion input

[Dong et al., VLDB '14]

Should we trust all sources equally ?

Entity resolution / de-duplication

- Multiple mentions of the same entity is wrong and confusing.

Entity resolution / de-duplication

• Multiple mentions of the same entity is wrong and confusing.

Entity resolution / de-duplication

• Multiple mentions of the same entity is

Commonsense knowledge

"Bananas are yellow."

"Balls bounce."

"Jasmine flowers smell good."

- Commonsense information is hard to collect (*too obvious*)

- Yet commonsense reasoning is often crucial

Multiple modalities

Text

Video

Images

How to jointly acquire knowledge from all these sources?

Speech/sounds

Artificial worlds?

PART 2: METHODS AND TECHNIQUES

A sampler of research problems

- **Growth:** knowledge graphs are incomplete!
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- **Intelligence:** can AI emerge from knowledge graphs?
  - *Automatic reasoning* and planning
  - Generalization and abstraction

Methods and techniques

1. Relation extraction:

   - Supervised models

   - Semi-supervised models

   - Distant supervision

2. Entity resolution

   - Single entity methods

   - Relational methods

3. Link prediction

   - Rule-based methods

   - Probabilistic models

   - Factorization methods

   - Embedding models

RELATION EXTRACTION

Relation Extraction

pl**?**For

Kobe Bryant → LA Lakers

"Kobe Bryant, the franchise player of the Lakers"

"Kobe once again saved his team"

"Kobe Bryant man of the match for Los Angeles"
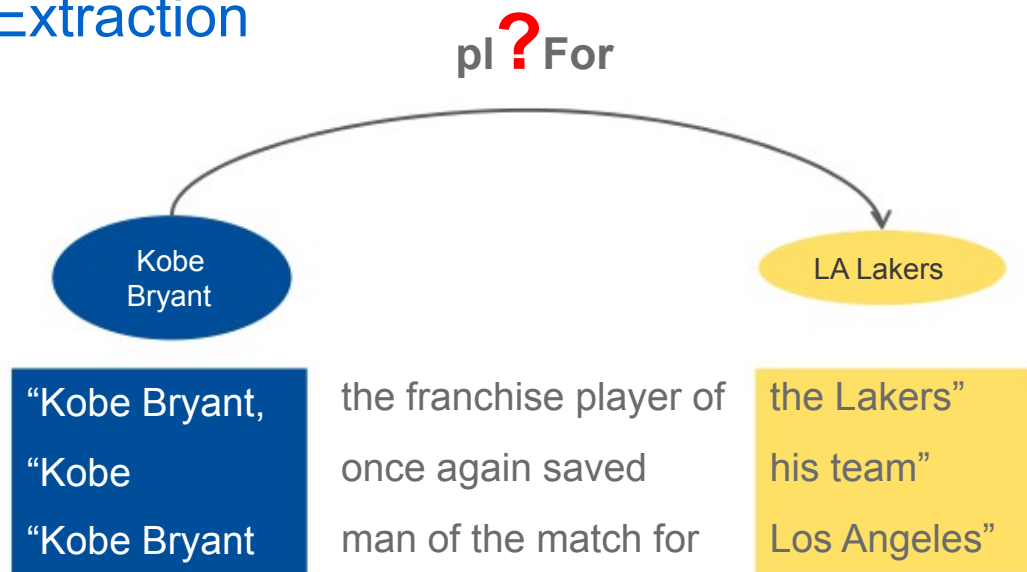
- Extracting semantic relations between sets of [grounded] entities

- Numerous variants:
    - Undefined vs pre-determined set of relations
    - Binary vs n-ary relations, facet discovery
    - Extracting temporal information
    - Supervision: {fully, un, semi, distant}-supervision
    - Cues used: only lexical vs full linguistic features

Supervised relation extraction

- Sentence-level labels of relation mentions
  - "**Apple** CEO **Steve Jobs** said.." => (SteveJobs, CEO, Apple)
  - "**Steve Jobs** said that **Apple** will.." => NIL

- Traditional relation extraction datasets
  - ACE 2004
  - MUC-7
  - Biomedical datasets (e.g BioNLP clallenges)

- Learn classifiers from +/- examples

- Typical features: context words + POS, dependency path between entities, named entity tags, token/parse-path/entity distance

Examples of features
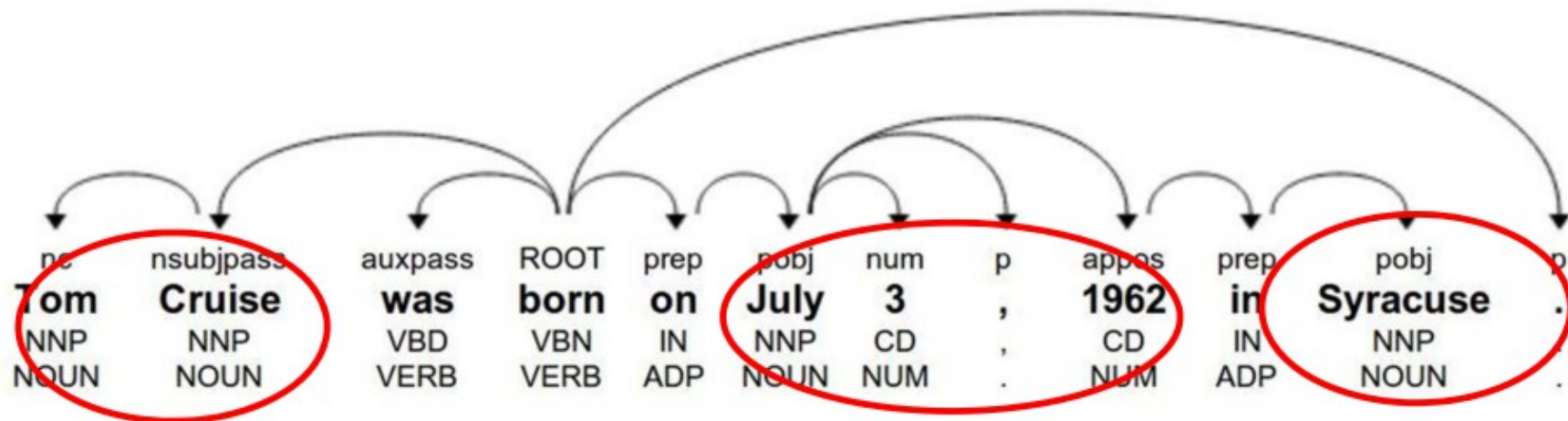
X was born on DDDD in Y
- DEP: X *<nsubjpass* / born *prep>* on *pobj>* DATE *prep>* in *pobj>* Y
- NER: X = PER, Y = LOC
- POS: X = NOUN, NNP; Y = NOUN, NNP
- Context: born, on, in , "born on"

Supervised relation extraction

- Used to be the "traditional" setting [Riloff et al., 06; Soderland et al., 99]

- **Pros**
  - High quality supervision
  - Explicit negative examples

- **Cons**
  - Very expensive to generate supervision
  - Not easy to add more relations
  - Cannot generalize to text from different domains

Semi-supervised relation extraction

- **Generic algorithm**
  1. Start with seed triples / golden seed patterns
  2. Extract patterns that match seed triples/patterns
  3. Take the top-k extracted patterns/triples
  4. Add to seed patterns/triples
  5. Go to 2

- Many published approaches in this category:
  - Dual Iterative Pattern Relation Extractor [Brin, 98]
  - Snowball [Agichtein & Gravano, 00]
  - TextRunner [Banko et al., 07] - almost unsupervised

- Differ in pattern definition and selection

TextRunner [Banko et al., 07]

- **Almost unsupervised**
  - **Relations not fixed:** does not follow Knowledge Graph schema (~~growing~~)
  - No labeled data
  - Mostly unlabeled text
  - Uses heuristics to **self-label** a starting corpora (using a parser), such as
    - Path length < k
    - Path does not cross sentence-like boundaries like relative clauses
    - Neither entity is a pronoun

- **Self-training**
  - Generate +/- examples ◊ learn classifier
  - **Extract new relation mentions** using this classifier
  - **Generate triples from aggregated mentions**, assign probabilistic score using [Downey et. al., 2005]

- Later improved in Reverb [Fader et al., 11]

Distantly-supervised relation extraction

- Existing knowledge base + unlabeled text ◊ generate examples
  - Locate pairs of related entities in text
  - Hypothesizes that the relation is expressed
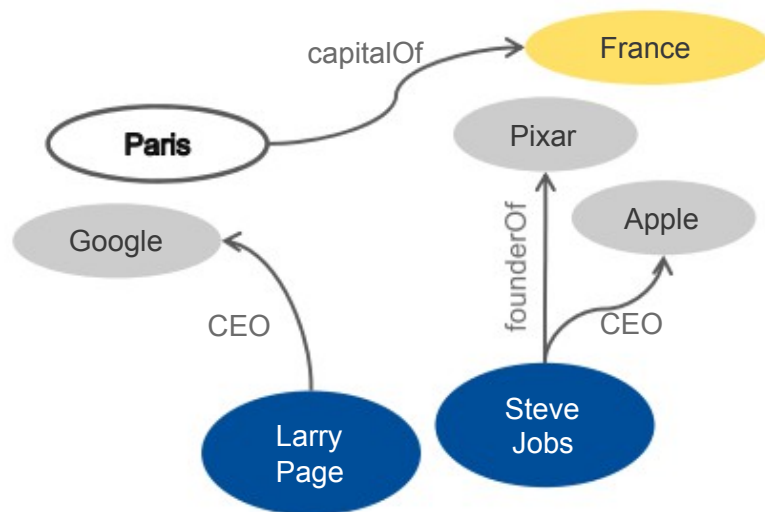
Google CEO Larry Page announced that...

Steve Jobs has been Apple for a while...

Pixar lost its co-founder Steve Jobs...

I went to Paris, France for the summer...

Distant supervision

- **Pros**
  - Can scale to the web, as no supervision required
  - Generalizes to text from different domains
  - Generates a lot more supervision in one iteration

- **Cons**
  - Needs high quality entity-matching
  - Relation-expression hypothesis can be wrong
    - ♣ Can be compensated by the extraction model, redundancy, language model
  - Does not generate negative examples
    - ♣ Partially tackled by matching unrelated entities

ENTITY RESOLUTION
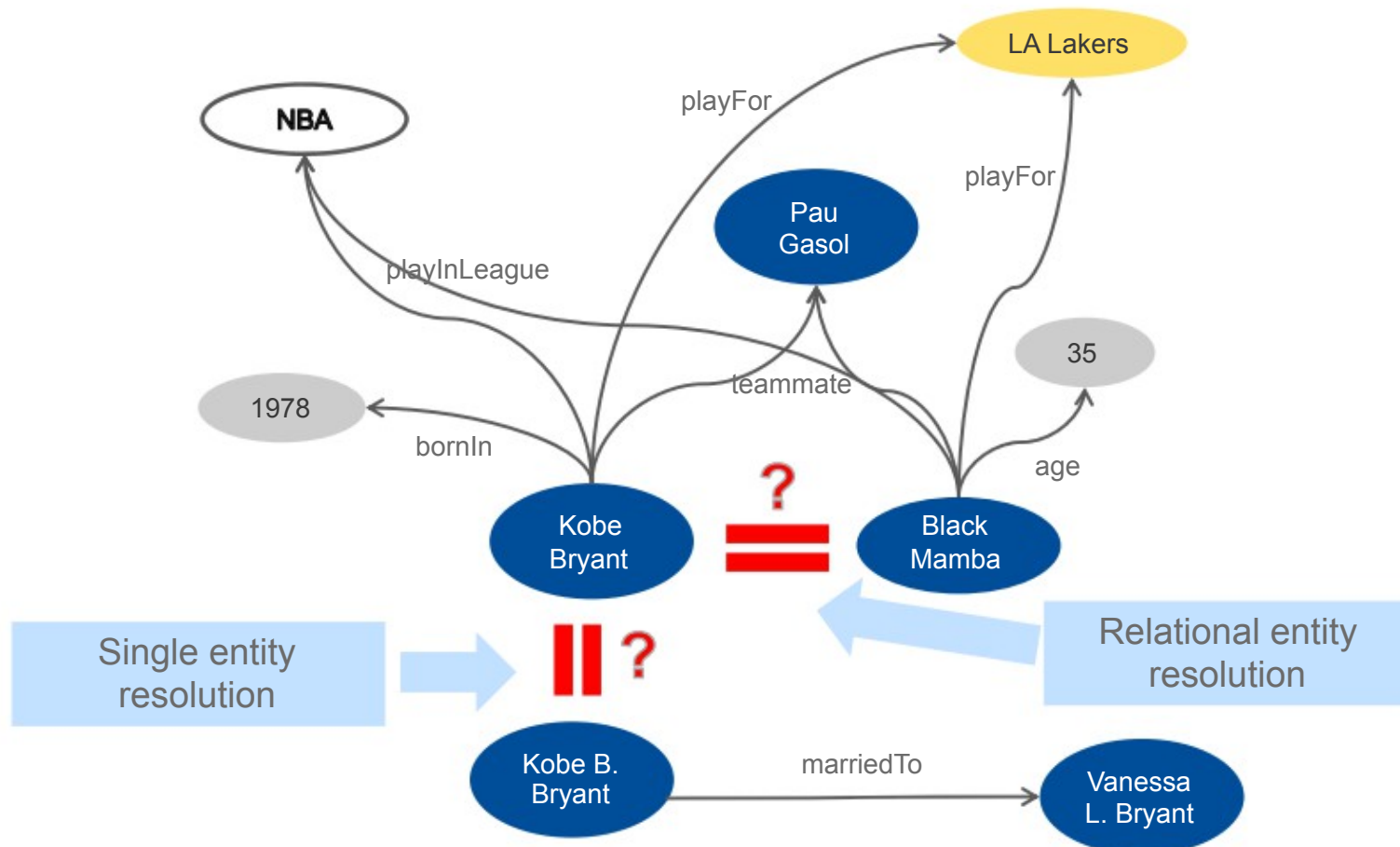
Entity resolution

Single entity resolution

- Entity resolution without using the relational context of entities

- Many distances/similarities for single-entity entity resolution:
  - Edit distance (Levenshtein, etc.)
  - Set similarity (TF-IDF, etc.)
  - Alignment-based
  - Numeric distance between values
  - Phonetic Similarity
  - Equality on a boolean predicate
  - Translation-based
  - Domain-specific

Entity resolution
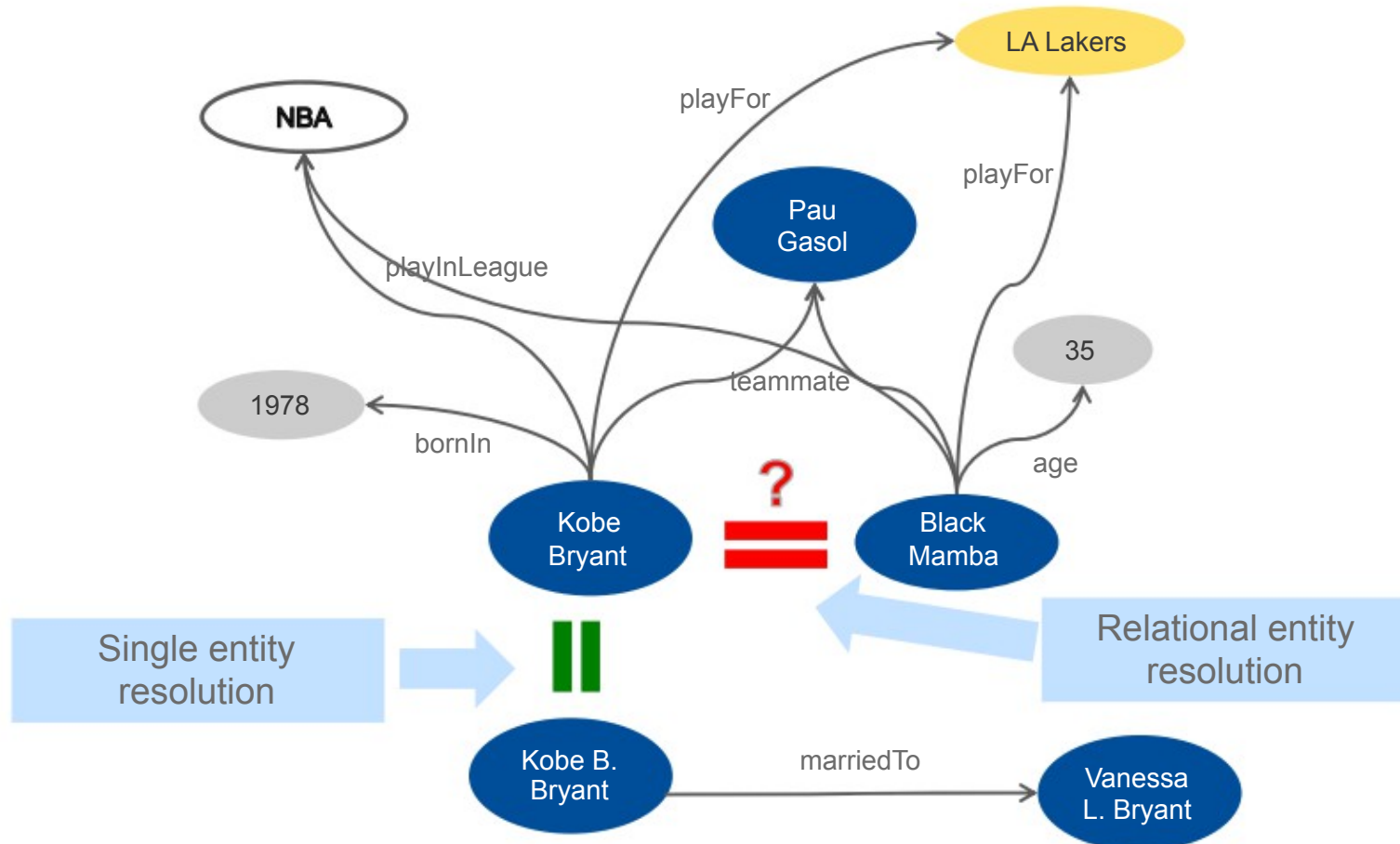
Relational entity resolution - Simple strategies

- Enrich model with **relational features** ◊ **richer context** for matching
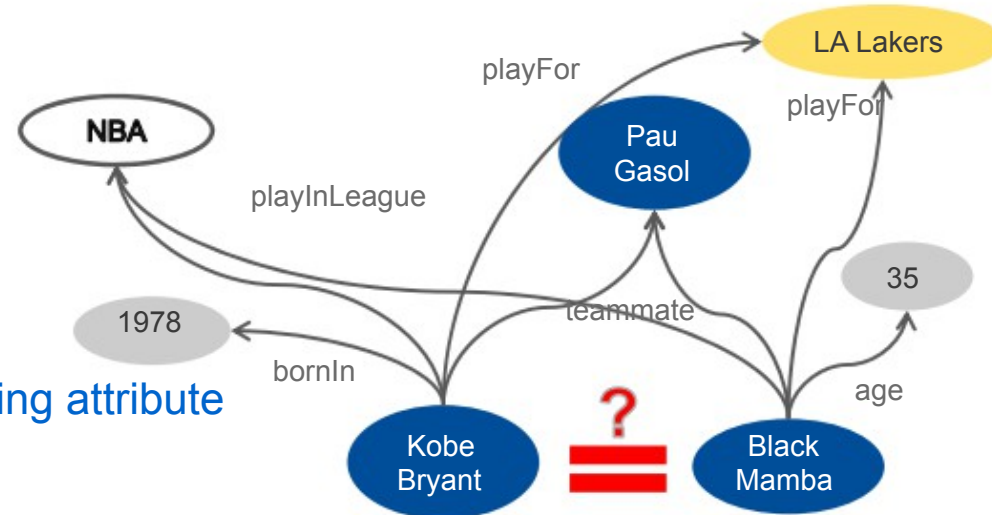
- **Relational features**:

  - Value of **edge or neighboring attribute**

  - Set **similarity measures**

    - *Overlap/Jaccard*

    - *Average similarity* between set members

    - *Adamic/Adar*: two entities are more similar if they share more items that are overall less frequent

    - *SimRank*: two entities are similar if they are related to similar objects

    - *Katz score:* two entities are similar if they are connected by shorter paths

Relational entity resolution - Advanced strategies
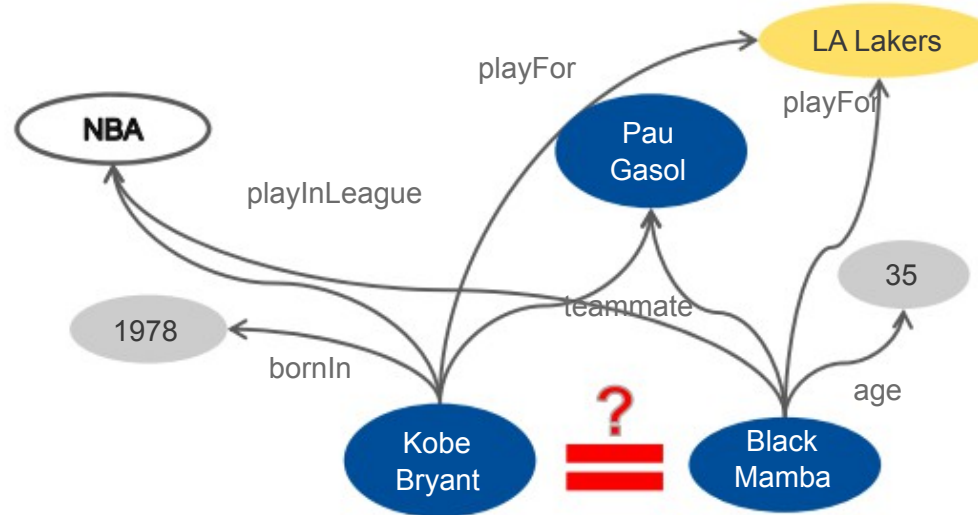
- Dependency graph approaches [Dong et al., 05]

- Relational clustering [Bhattacharya & Getoor, 07]

- **Probabilistic Relational Models** [Pasula et al., 03]

- **Markov Logic Networks** [Singla & Domingos, 06]

- **Probabilistic Soft Logic** [Broecheler & Getoor, 10]

LINK PREDICTION

Link prediction
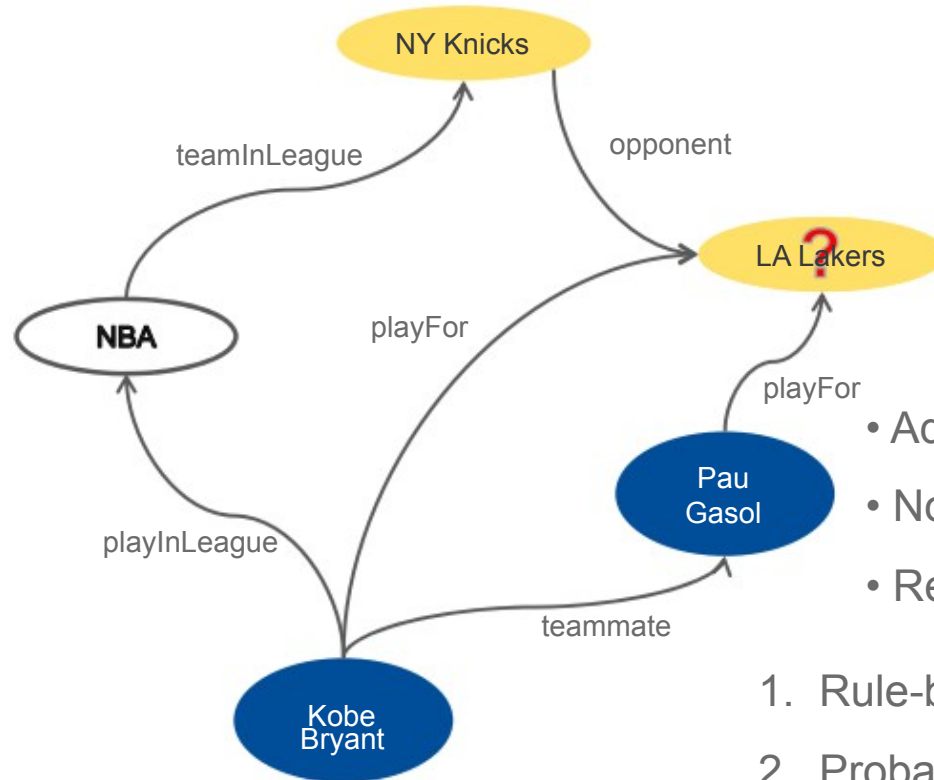
- Add knowledge from existing graph
- No external source
- Reasoning within the graph

1. Rule-based methods
2. Probabilistic models
3. Factorization models
4. Embedding models

PART 3: ACCESS KNOWLEDGE BY ENTITY LINKING

Entity Linking Documents

- Disambiguate every mention (=entity reference) on the Web
- Link token spans in documents to knowledge graph (e.g. Freebase, Wikipedia) entities

Wikifier Demo

fewer concepts   more concepts

wikify!   clear

* If you wish to cite this work, please cite the following pub

The Chiefs...
...game manager who wouldn't kill their offe...
they needed a quarterback who knows how...
what he's done for most of this season: thr...
necessary and use his feet to keep the chain...
These days it...
lost to San Diego -- that he can elevate his...

Alex Smith

Smith

Quarterback of the Kansas City Chief

Tight End of the Cincinnati Bengals

San Diego: **The San Diego Chargers (A Football team)**

Contextual decision on **what is mean**t by a given entity or concept. **WSD** with Wikipedia titles as categories.

Wikifier Demo

fewer concepts   more concepts

the following publications: (1) Retinov et. al. and (2) Cheng and Roth.

...als tight...e for the season.The
...wrist injury in the third quarter during the regular season
...ngals head coach Marvin Lewis described the injury as a "wrist
...g the post...interview on 700 WLW with Dave
...g an eventuality. More will be
... of on declaring him done.On the other hand, Lewis confirmed
... tight end Tyler Eifert and Jermaine Gresham for the next
...y against the Ravens.

Alex Smith

Smith

Ravens: **The Baltimore Ravens (A Football team)**

Cognitive Computation Group ▷ Demos ▷ Wikifier

Wikifier Demo

fewer concepts — more concepts

🗩 wikify!   ✕ clear

If you wish to cite this work, please cite the following publications: (1) Retinov et. al. and (2) Cheng and Roth.

Over and over again I'd hear these perorations from c... that there is no difference between Fatah and Hamas, or be... d Khaled Maashal. I would cringe at such comments, while knowing f... hardly the perfect interlocutor. I'm a strong beli... in iden... without pulling any punches. But La... ve that it is important to give peace a chance, to search for signs that th... ans are open to change from the d... tructive and self-destructive p... ursued for decades. Hamas was and is a ... eless proposition. ... e on extremist religious grounds ... is anti-Semitic to ... e the "Protocols of the Learned ... of Zion," blaming ... e French Revolution. Its lead... denied the Holocaust and blamed the financial crisis on Jewish control.

Mahmoud Abbas

Abu Mazen

Mahmoud Abbas: http://en.wikipedia.org/wiki/Mahmoud_Abbas

Abu Mazen: http://en.wikipedia.org/wiki/Mahmoud_Abbas
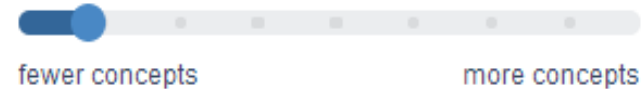
Getting away from **surface representations.**
Co-reference resolution within and across documents, **with grounding**

Wikifier Demo

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Human immunodeficiency virus (HIV) is the primary etiologic agent responsible for the AIDS pandemic. We constructed a fusion of the gp41 membrane-proximal external region (MPER) peptide along with a variable-length (Gly4Ser)x linker (where x is 4 or 8) between the C terminus of the former and N terminus of the latter. The His-tagged recombinant proteins, expressed in BL21(DE3)pLysS cells and purified by immobilized metal affinity chromatography followed by gel filtration, were found to display a nanomolar efficacy in blocking BaL-pseudotyped HIV-1 infection of HOS.T4.R5 cells. This antiviral activity was HIV-1 specific, since it did not inhibit cell infection by vesicular stomatitis virus (VSV). The chimeric proteins were found to release intraviral p24 protein from both BaL-pseudotyped HIV-1 and fully infectious BaL HIV-1 in a dose-dependent manner in the absence of host cells. The addition of either MPER or CVN was found to outcompete this virolytic effect, indicating that both components of the chimera are required for virolysis. The finding that engaging the Env protein spike and membrane using a chimeric ligand can destabilize the virus and lead to inactivation opens up a means to investigate virus particle metastability and to evaluate this approach for inactivation at the earliest stages of exposure to virus and before host cell encounter.

**Chimeric Cyano[...]
Engineered Pro[...]
HIV-1**

Mark Contarino[a], Arang[...]

Ramalingam Venkat Ka[...]

Vamshi Gangupomu[d], [...]

+ Author Affiliations

ABSTRACT

Human immunodeficien[...] the AIDS pandemic. In th[...] to test the possibility of [...] that simultaneously bind[...] fusion of the lectin cyan[...] region (MPER) peptide w[...] between the C terminus [...] recombinant proteins, e[...] immobilized metal affin[...] to display a nanomolar [...] HOS.T4.R5 cells. This ar[...] cell infection by vesicula[...] virus. Importantly, the c[...] protein from both BaL-p[...] dose-dependent manne[...] or CVN was found to ou[...] components of the chim[...] the Env protein spike ar[...] virus and lead to inactiv[...] metastability and to eva[...] exposure to virus and b[...]

Cognitive Computation G[...]

Wikifier De[...]

wikify!   X clear

* If you wish to cite this work, please [...]

Human immunodeficiency [...] AIDS pandemic. We const[...] (MPER) peptide along wit[...] between the C terminus of [...] recombinant proteins, exp[...] metal affinity chromatogra[...] nanomolar efficacy in bloc[...] antiviral activity was HIV-[...] stomatitis virus (VSV). The [...] from both BaL-pseudotype[...] manner in the absence of h[...] outcompete this virolytic e[...] required for virolysis. The [...] using a chimeric ligand ca[...] to investigate virus particl[...] the earliest stages of expos[...]

Article | Talk

Fusion protein

From Wikipedia, the free encyclopedia

This article is about chimeric fusion proteins. For proteins involved in memb[...]

Fusion proteins or **chimeric proteins** (literally, made of parts from different so[...] originally coded for separate proteins. Translation of this *fusion gene* results in a[...]

Article | Talk   Read | E[...]

Gp41

From Wikipedia, the free encyclopedia

Gp41 also known as **glycoprotein 41** is a subunit of the envelope protein complex of retroviruses. *Human immunodeficiency virus* (HIV). Gp41 is a transmembrane protein that contains several site[...] ectodomain that are required for infection of host cells.

Article | Talk

Affinity chromatography

From Wikipedia, the free encyclopedia

Affinity chromatography is a method of separating biochemical mixtures based on antibody, enzyme and substrate, or receptor and ligand.

Educational Applications: Unfamiliar domains may contain terms unknown to a reader.
The Wikifier can supply the necessary background knowledge even when the relevant article titles are not identical to what appears in the text, dealing with both **ambiguity and variability.**

clinical presentation is identical to the very important foot and mouth disease virus.

Wikify System

1. Determine "linkable" phrases

   – mention detection

2. Rank/select candidate entity links

   – link generation

3. Use "context" to disambiguate/filter/improve

   – disambiguation

A sampler of research problems

- **Growth:** knowledge graphs are incomplete!
  - *Link prediction*: add relations
  - *Ontology matching*: connect graphs
  - *Knowledge extraction*: extract new entities and relations from web/text

- **Validation:** knowledge graphs are not always correct!
  - *Entity resolution*: merge duplicate entities, split wrongly merged ones
  - *Error detection*: remove false assertions

- **Interface:** how to make it easier to access knowledge?
  - Semantic parsing: interpret the meaning of queries
  - *Question answering*: compute answers using the knowledge graph

- **Intelligence:** can AI emerge from knowledge graphs?
  - *Automatic reasoning* and planning
  - Generalization and abstraction

SUMMARY

Knowledge is crucial yet difficult to acquire

- Knowledge is crucial for many AI tasks

- Knowledge acquisition

  - From experts: slow and mostly reliable

  - From non-experts: faster and not always reliable

  - Automated: fastest and most scalable, yet noisiest

- Knowledge availability

  - A lot can be found online

  - A lot cannot be found

  - A lot cannot be extracted using today's methods

Where we are today

- We can extract a lot of knowledge from text and model its correctness

- Enforcing structure makes the extraction problem easier yet imposes limitations

- Leveraging existing knowledge repositories helps a lot

Next steps

- We need new extraction methods, from new sources

- Extracting from modalities other than text appears promising yet mostly unexplored

Plenty to be learned, problems are far from solved!

- ¬ Vibrant research area

- ¬ Numerous open research questions