

Temporal Information Extraction

Helge Holzmann

Partially based on the tutorial:

'Temporal Information Extraction and Shallow Temporal Reasoning'

by *Dan Roth, Heng Ji, Taylor Cassidy, Quang Do.*

24th International Conference on Computational Linguistics (COLING), Mumbai, India, 2012.

- 1. Motivation and Applications**
- 2. Time in Text / Time Representation**
- 3. Temporal Information from Wikipedia**
- 4. Temporal Slot Filling**
- 5. Evaluation**
- 6. Demo / Experiments**

- 1. Motivation and Applications**
2. Time in Text / Time Representation
3. Temporal Information from Wikipedia
4. Temporal Slot Filling
5. Evaluation
6. Demo / Experiments

(Temporal) Information Extraction



- **Information Extraction**
 - Extraction of structured information from unstructured text
 - Relations, events, facts (e.g., <subject> <predicate> <object>)
 - Many relations and events are temporally bounded
 - a person's place of residence or employer
 - an organization's members
 - the duration of a war between two countries
 - the precise time at which a plane landed
 - ...

- **Temporal Information Extraction**
 - **Temporal Expressions**
 - Dates
 - Times
 - Relative expressions (e.g., yesterday)
 - **Temporal Information**
 - Information with time attached
 - **Temporal Slot Filling (TSF)**
 - Connecting existing information with time

Motivation: TIE in Temporal IR



- **Applications**
 - **Knowledge base population**
 - **Temporal knowledge bases**
 - **Disambiguation / Linking**
 - **Time-aware linking / disambiguation**
 - **Entity graphs**
 - **Evolving entity graphs**
 - **Entity based indexing**
 - **Temporal indexes / IR**
 - **Temporal query suggestions / diversification**
 - **Time travel queries**
 - ...

Web

Images

Shopping

Videos

News

More ▾

Search tools

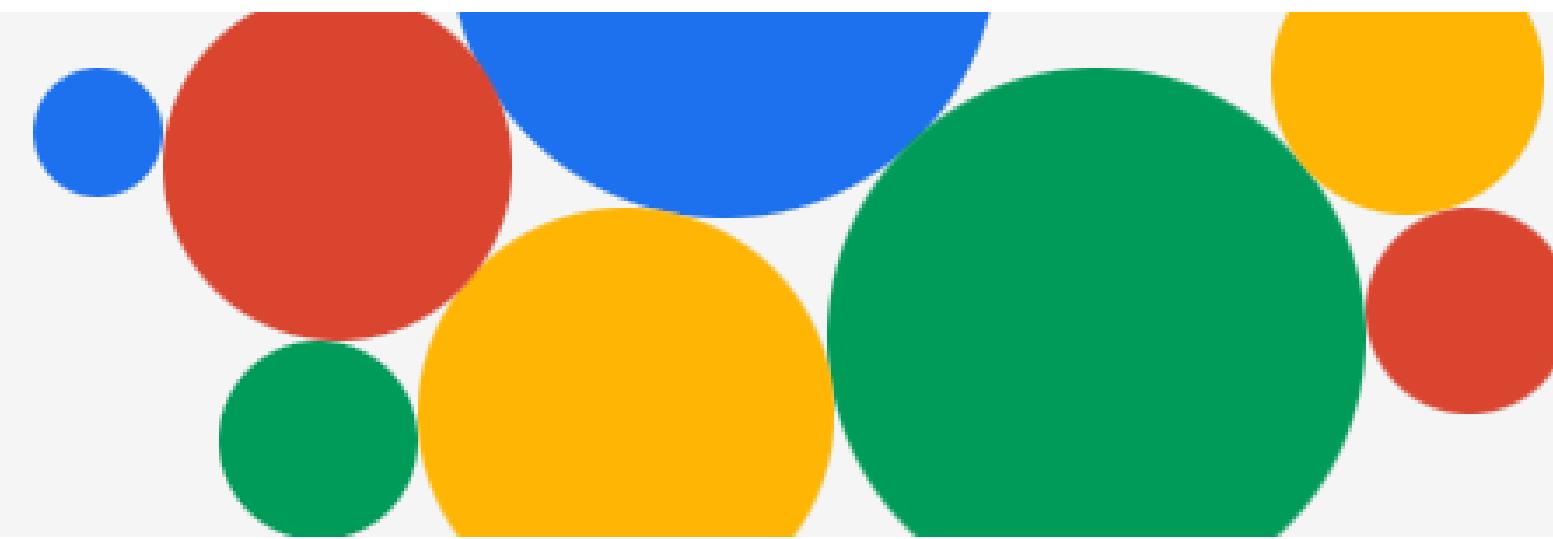
Politicians frequently mentioned on the web

**Barack Obama**
1961–**Franklin D.
Roosevelt**
1882–1945**John F. Kennedy**
1917–1963**George W. Bush**
1946–**Ronald Reagan**
1911–2004**Bill Clinton**
1946–**George
Washington**
1732–1799[The Presidents | The White House](#)www.whitehouse.gov/about/presidents ▾ White House ▾Short history of the U.S. Presidency, along with biographical sketches and portraits of all the **presidents** to date. From the official White House site.[The Presidents - Barack Obama - John Adams - George Washington](#)[List of Presidents of the United States - Wikipedia, the free ...](#)en.wikipedia.org/wiki/List_of_Presidents_of_the_United_States ▾ Wikipedia ▾

Under the United States Constitution, the President of the United States is the head of state and head of government of the United States. As chief of the ...

[Names - Whig - Federalist Party - Presidents Who Died In Office](#)[President of the United States - Wikipedia, the free ...](#)en.wikipedia.org/wiki/President_of_the_United_States ▾ Wikipedia ▾

The President of the United States of America (POTUS) is the head of state and head of government of the United States. The president leads the executive ...



Introducing the Knowledge Graph: things, not strings

Posted: Wednesday, May 16, 2012

g+1

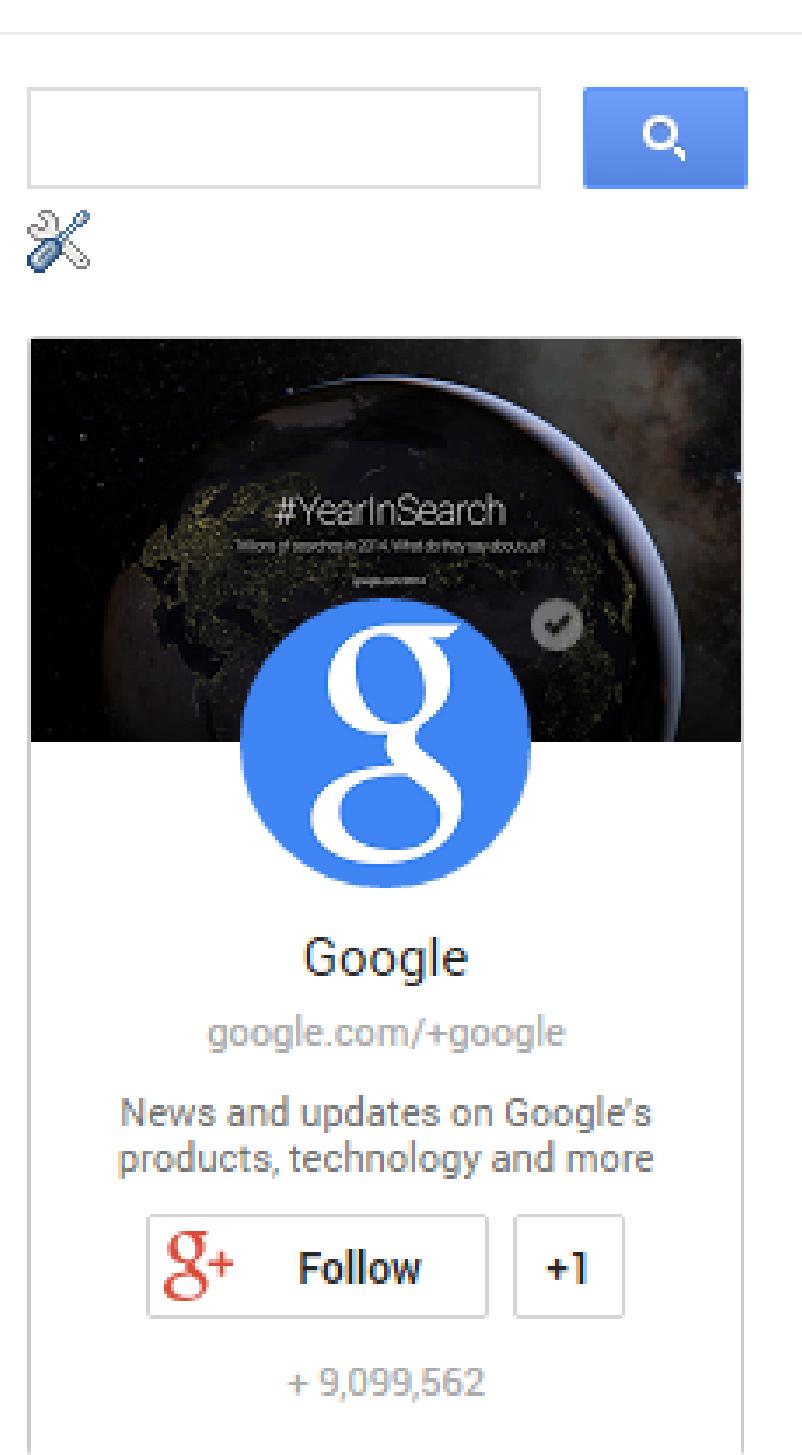
6.6k

Tweet

3,157

Like

3.1k



#YearInSearch
Trends of searching in 2014. What do they say about you?
#YearInSearch

g

Google

google.com/+google

News and updates on Google's products, technology and more

[Follow](#) [+1](#)

+ 9,099,562



Cross-posted on the [Inside Search Blog](#)

Search is a lot about discovery—the basic human need to learn and broaden your horizons. But searching still requires a lot of hard work by you, the user. So today I'm really excited to launch the Knowledge Graph, which will help you discover new information quickly and easily.

Take a query like [taj mahal]. For more than four decades, search has essentially been about matching keywords to queries. To a search engine the words [taj mahal] have been just that—two words.

But we all know that [taj mahal] has a much richer meaning. You might think of one of the world's most beautiful monuments, or a Grammy Award-winning musician, or possibly even a casino in Atlantic City, NJ. Or, depending on when you last ate, the nearest Indian restaurant. It's why we've been working on an intelligent model—in geek-speak, a "graph"—that understands real-world entities and their relationships to one another: things, not strings.

The Knowledge Graph enables you to search for things, people or places that Google knows about—landmarks, celebrities, cities, sports teams, buildings, geographical features, movies, celestial objects, works of art and more—and instantly get information that's relevant to your query. This is a critical first step towards building the next generation of search, which taps into the collective intelligence of the web and understands the world a bit more like people do.

[Web](#)[Images](#)[News](#)[Videos](#)[Shopping](#)[More](#) ▾[Search tools](#)

Brad Pitt > Spouse

Angelina Jolie (m. 2014)
Spouse



Jennifer Aniston (m. 2000–2005)
Former spouse



Cookies help us deliver our services. By using our services, you agree to our use of cookies.

[Learn more](#) [Got it](#)

[Brad Pitt - Wikipedia, the free encyclopedia](#)

en.wikipedia.org/wiki/Brad_Pitt ▾

Since that date, Pitt lives with actress Angelina Jolie in a relationship that has attracted earlier with Jennifer Aniston and Brad Grey, CEO of Paramount Pictures. ... between Pitt and Angelina Jolie, who played his character's wife Jane Smith.

[Filmography](#) - List of awards and ... - Plan B Entertainment - Jill Schoelen

[Brad Pitt - Biography - IMDb](#)

www.imdb.com/name/nm0000093/bio ▾

Jump to [Spouse](#) - Angelina Jolie, (23 August 2014 - present) (6 children). Jennifer Aniston, (29 July 2000 - 2 October 2005) (divorced)

[Brad Pitt reveals he was 'wasting' his life away while married ...](#)

www.dailymail.co.uk/.../Brad-Pitt-reveals-wasting-life-away-married-Jen... ▾

May 21, 2013 - 'I was a bit of a drifter': Brad Pitt revealed he felt his life had little meaning during his marriage to Jennifer Aniston in the new issue of Esquire ...

Brad Pitt

Actor

William Bradley "Brad" Pitt is an American filmmaker. He has received a Golden Globe Award, a Screen Actors Guild Award, and three Academy Award nominations in acting categories, a

... [Wikipedia](#)

Born: December 18, 1963 (age 51), Shawnee, Oklahoma, United States

Height: 1.80 m

Spouse: Angelina Jolie (m. 2014), Jennifer Aniston (m. 2000–2005)

Children: Shiloh Nouvel Jolie-Pitt, Vivienne Jolie-Pitt, Knox Leon Jolie-Pitt

Siblings: Doug Pitt, Julie Neal Pitt

Profiles



Facebook

[Web](#)[News](#)[Videos](#)[Images](#)[Books](#)[More ▾](#)[Search tools](#)

About 95,000,000 results (0.32 seconds)

Satya Nadella

Microsoft Corporation, CEO



[More about Satya Nadella](#)

[Feedback](#)

[Satya Nadella - Wikipedia, the free encyclopedia](#)

[en.wikipedia.org/wiki/Satya_Nadella](#) ▾ Wikipedia

Before becoming CEO of Microsoft, he was Executive Vice President of Microsoft's

"Challenges Facing Manipal Alumnus And Microsoft CEO, Satya Nadella".

[Steve Ballmer - University of Wisconsin - Indian Administrative Service](#)

[\\$84 million Microsoft CEO: We pay women equally - Oct. 21 ...](#)

[money.cnn.com/2014/.../microsoft-ceo-nadella-women-pay/](#) ▾ CNNMoney

Oct 21, 2014 - Microsoft CEO Satya Nadella says women are paid equally at

Microsoft, while taking home an \$84 million pay package.

In the news



[He's Making a List: Tuck Professor Highlights Best, Worst CEOs of the Year](#)

[Valley News](#) - 15 hours ago

In 2013, when former Microsoft CEO Steve Ballmer was named by Finkelstein as one of the ...

Web Images Videos News Shopping More ▾ Search tools

About 19,700,000 results (0.47 seconds)

Cookies help us deliver our services. By using our services, you agree to our use of cookies.

[Learn more](#) [Got it](#)

[Microsoft - Wikipedia, the free encyclopedia](#)

en.wikipedia.org/wiki/Microsoft ▾

Microsoft's logo, introduced in 2012 consists of a square divided into four sub-squares

.... Bill Gates handed over the CEO position on January 13, 2000, to Steve ...

[Paul Allen](#) - History of Microsoft - List of Microsoft software - John W. Thompson

[Steve Ballmer - Wikipedia, the free encyclopedia](#)

en.wikipedia.org/wiki/Steve_Ballmer ▾

Steven Anthony "Steve" Ballmer (born March 24, 1956) is an American businessman

who was the chief executive officer of Microsoft from January 2000 to ...

[Gates steps down as Microsoft CEO - Forbes](#)

www.forbes.com/2000/01/13/mu7.html ▾

Microsoft co-founder Bill Gates taps longtime pal and right-hand man Ballmer to take

over. Gates ... 1/13/2000 @ 5:50PM. Gates steps down as Microsoft CEO.

[Steve Ballmer | News Center - Microsoft](#)

news.microsoft.com/exec/steve-ballmer/ ▾

Microsoft Senior Leaders. Satya Nadella ... Other Microsoft sites. Windows · Office ·

Surface · Windows Phone · Nokia devices · Xbox · Skype · Bing · Microsoft ...

[Facts About Microsoft | News Center](#)

news.microsoft.com/facts-about-microsoft/ ▾

Founded in 1975, Microsoft (Nasdaq "MSFT") is the worldwide leader in ... 13, 2000,

Steve Ballmer named president and chief executive officer for Microsoft.

[Web](#)[News](#)[Shopping](#)[Images](#)[Videos](#)[More ▾](#)[Search tools](#)

About 114,000 results (0.46 seconds)

German reunification (Deutsche Wiedervereinigung) took place on **October 3, 1990**, when the areas of the former German Democratic Republic (GDR, in English commonly called "East Germany") were incorporated into the Federal Republic of Germany (FRG, in English commonly called "West Germany"), both formed in 1949, after ...

German reunification - New World Encyclopedia
www.newworldencyclopedia.org/entry/German_reunification

[Feedback](#)

German reunification - Wikipedia, the free encyclopedia
en.wikipedia.org/wiki/German_reunification ▾ Wikipedia ▾
The consensus opinion was that reunification, if it must occur, should not occur until at least 1995 However, German separation did not result in another war.
City Palace, Berlin - Removal of Hungary's border ... - Palace of the Republic (Berlin)

German reunification - New World Encyclopedia
www.newworldencyclopedia.org/entry/German_reunification ▾
Dec 11, 2013 - German reunification (Deutsche Wiedervereinigung) took place on **October 3, 1990**, when the areas of the former German Democratic Republic (GDR, in English commonly called "East Germany") were incorporated into the Federal Republic of Germany (FRG, in English commonly called "West Germany"), both formed in 1949, after ...

Reunification of Germany 3 October 1990 | ICV
icv.vlada.cz/en/tema/reunification-of-germany-3-october.../tmpid-676/ ▾
Oct 3, 1990 - The reunification of Germany in 1990 is one of the most important historical ... At that time Kohl did not believe that he would ever negotiate with Mikhail ... Further important shift in opinion took place during the visit of Helmut ...



Web

Images

Videos

Maps

News

More

16,700,000 RESULTS

Any time ▾

Obama was re-elected president in November 2012, defeating Republican nominee Mitt Romney, and was sworn in for a second term on January 20, 2013.

Reference: en.wikipedia.org/wiki/President_Barack_Obama

[Barack Obama - Wikipedia, the free encyclopedia](#)

en.wikipedia.org/wiki/President_Barack_Obama ▾

The inauguration of **Barack Obama** as the 44th **President** took place on ... **Obama became** the first **President of the United States** to address both houses of the UK ...
[Early life and career](#) · [Legislative career](#) ... · [Presidential campaigns](#)

[President Barack Obama | The White House](#)

www.whitehouse.gov/administration/president-obama ▾

Official biography of **President Barack Obama**.

[How Barack Obama Became the Anti-President - US News](#)

www.usnews.com/.../12/05/how-barack-obama-became-the-anti-president ▾

Dec 05, 2014 · **President Barack Obama's** aloof style is responsible for the cruel slide from hope and change to partisan gridlock.

[Barack Obama elected 44th president - NBC News - ...](#)

www.nbcnews.com/.../t/barack-obama-elected-th-president ▾

Barack Obama shattered more than 200 years of history ... **President-elect Barack Obama** walks on stage at his ... was seeking to **become** the nation's ...

Barack Obama



Barack Hussein Obama
President of the United States
American to hold the office
Hawaii, Obama is a graduate of Columbia University and Harvard Law School

en.wikipedia.org

en.wikipedia.org

Twitter Facebook

Born: Aug 04, 1961 (age 53) · Honolulu, Hawaii

Net worth: \$12.20 million USD (2014)

Spouse: Michelle Obama (Since 1992)

Children: Malia Ann Obama · Natasha Calis

Office: President of the United States (2009 - present)

Previous offices: United States Senator · State Senator (1997 - 2004)

Listen to audio

- Barack Obama elected president
- Obama signs Health Insurance Reform
- President Obama on Osama Bin Laden

Knowledge Bases



About: Arnold Schwarzenegger

An Entity of Type : [office holder](#), from Named Graph : <http://dbpedia.org>, within Data Space : [dbpedia.org](#)

Arnold Alois Schwarzenegger (/ʃwɔrtzən̩eɡər/; German: [ˈaɐ̯noːlt ˈalb̩s ˈʃvaɛtsən̩eɡə]; born July 30, 1947) is an Austrian-born American actor, film producer, businessman, investor, writer, philanthropist, former professional bodybuilder and politician. Schwarzenegger served two terms as the 38th Governor of California from 2003 until 2011. Schwarzenegger began weight training at the age of 15. He won the Mr. Universe title at age 20 and went on to win the Mr. Olympia contest seven times.

Property	Value
dbpedia-owl:abstract	<ul style="list-style-type: none">Arnold Alois Schwarzenegger (/ʃwɔrtzən̩eɡər/; German: [ˈaɐ̯noːlt ˈalb̩s ˈʃvaɛtsən̩eɡə]; born July 30, 1947) is an Austrian-born American actor, film producer, businessman, investor, writer, philanthropist, former professional bodybuilder and politician. Schwarzenegger served two terms as the 38th Governor of California from 2003 until 2011. Schwarzenegger began weight training at the age of 15. He won the Mr. Universe title at age 20 and went on to win the Mr. Olympia contest seven times. Schwarzenegger has remained a prominent presence in bodybuilding and has written many books and articles on the sport. Schwarzenegger gained worldwide fame as a Hollywood action film icon. He was nicknamed the "Austrian Oak" and the "Styrian Oak" in his bodybuilding days, "Arnie" during his acting career and more recently "The Governator" (a portmanteau of "Governor" and "The Terminator" – one of his best-known movie roles). As a Republican, he was first elected on October 7, 2003, in a special recall election to replace then-Governor Gray Davis. Schwarzenegger was sworn in on November 17, 2003, to serve the remainder of Davis's term. Schwarzenegger was then re-elected on November 7, 2006, in California's 2006 gubernatorial election, to serve a full term as governor, defeating Democrat Phil Angelides, who was California State Treasurer at the time. Schwarzenegger was sworn in for his second term on January 5, 2007. In 2011, Schwarzenegger completed his second term as governor, and it was announced that he had separated from Maria Shriver, his wife for the last 25 years; she is a member of the influential Kennedy family, as a niece of the late Democratic US President John F. Kennedy.Arnold Alois Schwarzenegger (* 30. Juli 1947 in Thal, Steiermark) ist ein austroamerikanischer Schauspieler sowie US-amerikanischer Politiker. Er war von November 2003 bis Januar 2011 der 38. Gouverneur Kaliforniens. Vor seiner politischen Laufbahn ist Schwarzenegger international bekannt geworden als der weltweit erfolgreichste Bodybuilder mit anschließender Karriere als Filmschauspieler, insbesondere durch seine Verkörperung des Terminators.
dbpedia-owl:activeYearsEndDate	<ul style="list-style-type: none">2011-01-03 (xsd:date)
dbpedia-owl:activeYearsStartDate	<ul style="list-style-type: none">2003-11-17 (xsd:date)
dbpedia-owl:alias	<ul style="list-style-type: none">Schwarzenegger, Arnold Alois
dbpedia-owl:almaMater	<ul style="list-style-type: none">dbpedia:Santa_Monica_Collegedbpedia:University_of_Wisconsin-Superior
dbpedia-owl:birthDate	<ul style="list-style-type: none">1947-07-30 (xsd:date)
dbpedia-owl:birthName	<ul style="list-style-type: none">Arnold Alois Schwarzenegger
dbpedia-owl:birthPlace	<ul style="list-style-type: none">dbpedia:Austriadbpedia:Styriadbpedia:Thal,_Styria
dbpedia-owl:birthYear	<ul style="list-style-type: none">1947-01-01 (xsd:date)
dbpedia-owl:child	<ul style="list-style-type: none">dbpedia:Katherine_Schwarzeneggerdbpedia:Patrick_Schwarzenegger
dbpedia-owl:lieutenant	<ul style="list-style-type: none">dbpedia:Abel_Maldonadodbpedia:Cruz_Bustamantedbpedia:John_Garamendidbpedia:Mona_Pasquil
dbpedia-owl:militaryBranch	<ul style="list-style-type: none">dbpedia:Austrian_Armed_Forces
dbpedia-owl:occupation	<ul style="list-style-type: none">dbpedia:Bodybuilding
dbpedia-owl:office	<ul style="list-style-type: none">Governor of California
dbpedia-owl:orderInOffice	<ul style="list-style-type: none">38th
dbpedia-owl:party	<ul style="list-style-type: none">dbpedia:Republican_Party_(United_States)
dbpedia-owl:profession	<ul style="list-style-type: none">dbpedia:Bodybuilding
dbpedia-owl:relation	<ul style="list-style-type: none">dbpedia:Gustav_Schwarzenegger
dbpedia-owl:religion	<ul style="list-style-type: none">dbpedia:Catholic_Church
dbpedia-owl:residence	<ul style="list-style-type: none">dbpedia:Californiadbpedia:Brentwood,_Los_Angeles
dbpedia-owl:serviceEndYear	<ul style="list-style-type: none">1965-01-01 (xsd:date)
dbpedia-owl:serviceStartYear	<ul style="list-style-type: none">1965-01-01 (xsd:date)
dbpedia-owl:successor	<ul style="list-style-type: none">dbpedia:Jerry_Brown
dbpedia-owl:termPeriod	<ul style="list-style-type: none">dbpedia:Arnold_Schwarzenegger_1dbpedia:Arnold_Schwarzenegger_2
dbpedia-owl:thumbnail	<ul style="list-style-type: none">http://commons.wikimedia.org/wiki/Special:FilePathArnold_Schwarzenegger_in_Sydney,_2013.jpg?width=300
dbpedia-owl:viafId	<ul style="list-style-type: none">64196027
dbpedia-owl:wikiPageExternalLink	<ul style="list-style-type: none">http://gov38.ca.gov/http://www.arnieslife.com/http://www.life.com/gallery/60601/arnold-schwarzenegger-wild-years#index/0



Schwarzenegger at the 2012 Comic-Con in San Diego

38th Governor of California

In office

November 17, 2003 – January 3, 2011

Lieutenant	Cruz Bustamante (2003–07) John Garamendi (2007–09)
	Mona Pasquil (acting) (2009–10) Abel Maldonado (2010–11)

Preceded by	Gray Davis
Succeeded by	Jerry Brown

Personal details

Born	Arnold Alois Schwarzenegger July 30, 1947 (age 67) Thal, Styria, Austria
Citizenship	Austria United States
Political party	Republican
Occupation	Bodybuilder, actor, filmmaker, businessman, investor, politician, writer, activist, philanthropist
Religion	Roman Catholicism ^[1]

Signature

Website schwarzenegger.com

Military service

Service/branch	Austrian Armed Forces
Years of service	1965

(Temporal) Knowledge

Freebase Find... Browse Query Help

Arnold Schwarzenegger en

mid: /m/0tc7 notable type: /celebrities/celebrity notable for: /celebrities/celebrity on the web: W wikipedia.org

Arnold Alois Schwarzenegger is an Austrian-born American actor, filmmaker, activist, businessman, investor, writer, philanthropist, former professional bodybuilder, and politician. Schwarzenegger served from 2003 until 2011. Schwarzenegger began weight training at the age of 15. He won the Mr. Universe title at age 20 and went on to win the Mr. Olympia contest seven times. Schwarzenegger has remained active in politics, running for Governor of California in 2003 and 2006, and serving as Governor of California from 2003 until 2011. Schwarzenegger has written many books and articles on the sport. Schwarzenegger gained worldwide fame as a Hollywood action film icon. He was nicknamed the "Austrian Oak" and the "Styrian Oak" in his bodybuilding days. He was also known as "The Governator" since the start of his political career. As a Republican, he was first elected on October 7, 2003, in a special recall election to replace then-Governor Gray Davis. Schwarzenegger was sworn in on January 3, 2004, and served until January 3, 2011, when he was succeeded by Jerry Brown.

Properties I18n Keys Links

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

Filter options: Show all domains and properties

Sports /sports

Athlete /sports/pro_athlete

Sports played /sports/pro_athlete/sports_played_professionally

Sport ▾ From: 1968 To: 1980

Bodybuilding

Football

Teams /sports/pro_athlete/teams

dbpedia-owl:militaryBranch ▾ From: To:

- dbpedia:Austrian_Armed_Forces
- dbpedia:Bodybuilding
- Governor of California
- 38th
- dbpedia:Republican_Party_(United_States)
- dbpedia:Bodybuilding
- dhneria:Gustav_Schwarzenegger

dbpedia-owl:occupation

dbpedia-owl:office

dbpedia-owl:orderInOffice

dbpedia-owl:party

dbpedia-owl:profession

dhneria-owl:relation

dbpprop:nickname

dbpprop:occupation

dbpprop:office

dbpprop:order

dbpprop:party

dhnnrn:percentage

dbpprop:profession

dhnnrn:relations

dhneria:Arnold_Schwarzenegger

The Austrian Oak

Bodybuilder, actor, director, producer, businessman, investor, politician, writer, philanthropist

Governor of California

38 (xsd:integer)

dbpedia:Republican_Party_(United_States)

Democratic Party

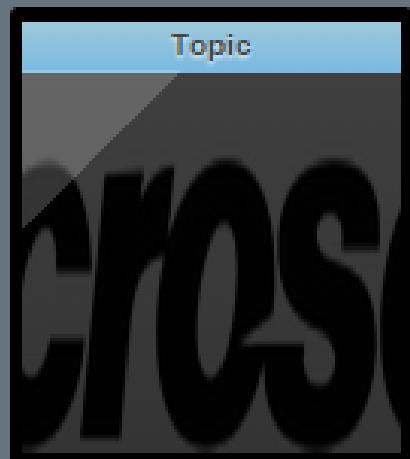
Green Party

Republican Party

2.300000 (xsd:double)

dhneria:Gustav_Schwarzenegger

This topic has been flagged. Vote on this issue here.



Topic

Microsoft Corporation en

mid: /m/04sv4 notable type: /venture_capital/vent

Microsoft Corporation or is an American multinational best known software products are the Microsoft Wir the world's largest software maker measured by rev dominate the personal computer operating system 12,000 millionaires from Microsoft employees. Since

Properties

I18n

Keys

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

Filter options: Show all domains and properties

Organization /organization

Organization /organization/organization

Leadership /organization/organization/leadership

Person	Role	Title	From	To
Robert J. Bach	-	President, Entertainment Div.		Some values flag. Remove. 2010
Chris Liddell	Chief Financial Officer	Chief Financial Officer		Some values flag. Remove. 12/31/2009
Frank H Brod	Chief Accounting Officer	Chief Accounting Officer	5/1/2006	
Craig Mundie	-	Chief ResearchStrategy Officer		Some values flag. Remove. Soon
Steve Ballmer	Chief Executive Officer	Chief Executive Officer	1/13/2000	2/4/2014
Bill Gates	Chief Executive Officer	Chief Executive Officer vi	4/4/1975	1/12/2000
Peter Klein	Chief Financial Officer	Chief Financial Officer	2009	2013
Stephen Elop	Executive Vice President	Executive Vice President, Devices & Services	2013	Now
Satya Nadella	Chief Executive Officer	Chief Executive Officer	2/4/2014	Now
Amy Hood	Chief Financial Officer	Chief Financial Officer	5/8/2013	Now



Topic

Brad Pitt en

mid: /m/0c6qh notable type: /celebrities/celebrity on the web: W wikipedia.org

William Bradley "Brad" Pitt is an American actor and filmmaker. He has received a Golden Globe Award, a Screen Actors Guild Award, winning one, for productions of his film production company Plan B Entertainment. He has been described as one of the world's most hitchhiker in the road movie *Thelma & Louise*. His first leading roles in big-budget productions came with *A River Runs Through It*, and the science fiction film *12 Monkeys*, the latter earning him a Golden Globe Award for Best Supporting Actor and an Academy Award nomination for Best Actor. He has also received Oscar nominations for his performances in *Ocean's Twelve* and *Ocean's Thirteen*. His greatest commercial successes have been *Troy*, *Mr. & Mrs. Smith*, and *World War Z*. [-]

Properties

I18n

Keys

Links

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

Filter options: Show all domains and properties

People /people

Person /people/person

Spouse (or domestic partner) /people/person/spouse_s

Spouse	From	To	Type of union
Jennifer Aniston	7/29/2000	10/2/2005	Marriage
Angelina Jolie	2005 May	8/23/2014	Domestic partnership
Angelina Jolie	8/23/2014	No values flag. Remove.	Marriage

From	To	
	Some values flag. Remove.	
	Some values flag. Remove.	12/31/2009
5/1/2006		
	Some values flag. Remove.	Soon
1/13/2000	2/4/2014	
4/4/1975	1/12/2000	
2009	2013	
2013		Now
2/4/2014		Now
5/8/2013		Now

Renamings and Temporal Translation

Example: Exxon Valdez Oil Spill 1989

- Right after the spill *Exxon Valdez* was renamed:
 - *Exxon Mediterranean*
- Ever since, 5 more times:
 - *Sea River Mediterranean*
 - *S/R Mediterranean*
 - *Mediterranean*
 - *Dong Fang Ocean*
 - *Oriental Nicety*

dbpprop:shipRenamed

- *Mediterranean*
- *Dong Fang Ocean*
- *Exxon Mediterranean Sea River Mediterranean"*
- *Exxon Valdez "*
- *Oriental Nicety*
- *S/R Mediterranean*

→ You want to search for *Oriental Nicety* today



Google
Images

Exxon Valdez

vs.

Oriental Nicety



Agenda

1. Motivation and Applications
2. Time in Text / Time Representation
3. Temporal Information from Wikipedia
4. Temporal Slot Filling
5. Evaluation
6. Demo / Experiments

- **Temporal Expressions**
 - in 1992; 1990's; on Dec. 8th, 1992; at 8:00 am
 - from Monday to Friday; between 9 and 10 am
 - this/next Century; year; day; hour; minute; second, ...
 - before 1992; until next year; for (about) one year;
 - tomorrow; after 8:00;
 - Tuesdays; first of the month; several times per week;

- Denote intervals and points at varying granularity and specificity
 - Now (December 8th, 2012, 3:00pm)
 - 2012-12-08-T15:00
 - December 8th, 2012
 - 2012-12-08-TXX:XX
 - (2012-12-08T00:00, 2012-12-08-T11:59)
 - December 8th
 - xxxx-12-08-Txx:xx
 - Set of all December 8th's
 - Each is an interval: { (xxxx-12-08:T00:00, xxxx-12-08:T11:59) }

Temporal Expressions



- Reference Date: January 5, 2015
 - E.g., document creation date, publication date, upload date, ...

<i>Expression</i>	<i>Value</i>
January 5, 2015	2015-01-05
Friday	2015-01-02
today	2015-01-05
1993	1993
the 1990's	199X
midnight, December 8, 2012	2012-12-08T00:00:00
5pm	2015-01-05T17:00
the previous day	2015-01-04
last October	2014-10
last autumn	2014-FA
last week	2014-W52
Thursday evening	2015-01-01TEV
two months ago	2014-11

Temporal Expression Extraction

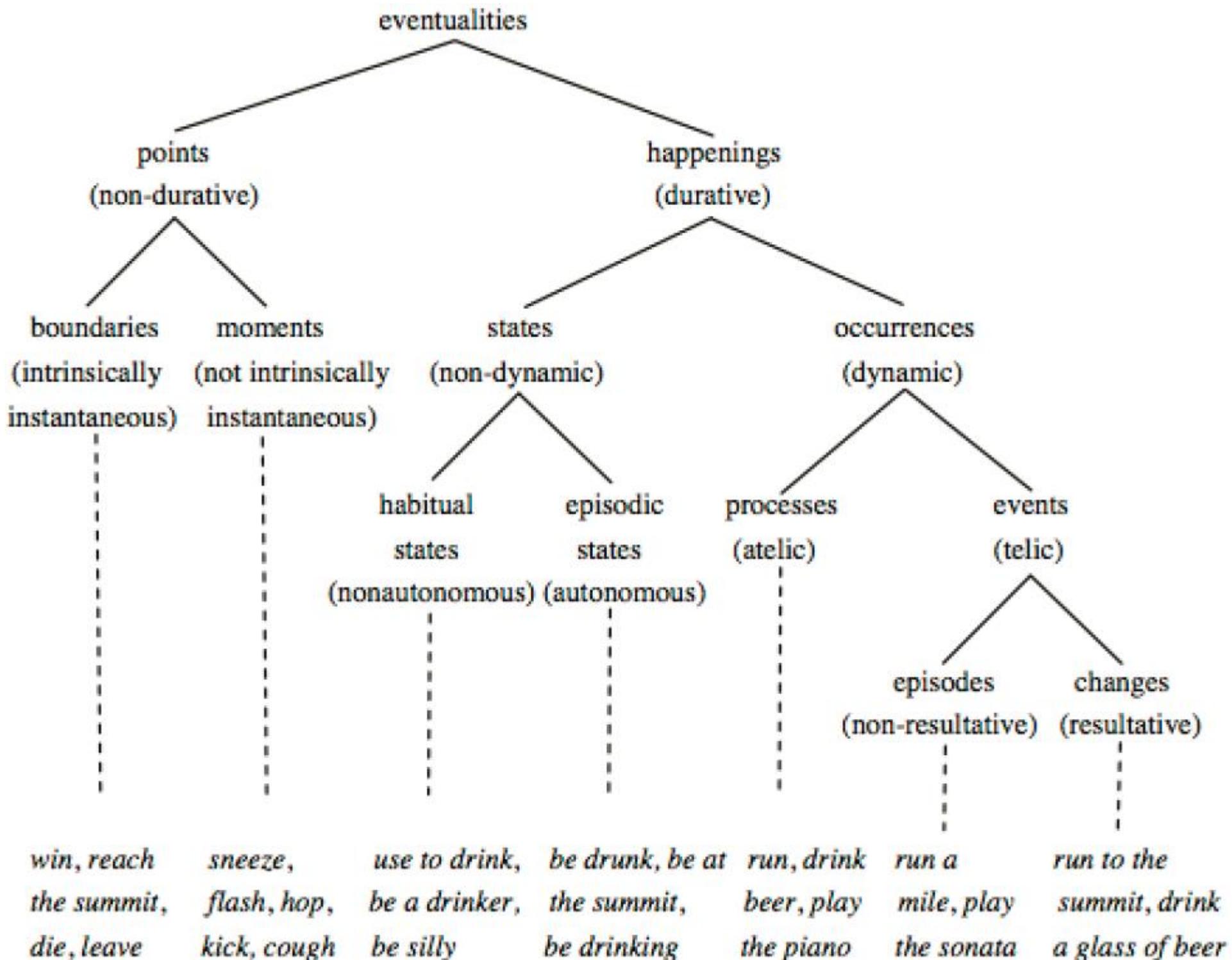


- Rule-based [Strötgen and Gertz, 2010; Chang and Manning, 2012; Do et al., 2012]
- Machine Learning
 - Risk Minimization Model [Boguraev and Ando, 2005]
 - Conditional Random Fields [Ahn et al., 2005; UzZaman and Allen, 2010]

- HeidelTime [Strötgen and Gertz, 2010]
 - Three ways to describe temporal expressions [Schilder and Habel, 2001]
 - explicitly
 - e.g., January 5, 2015 → 2015-01-05
 - implicitly
 - e.g., Christmas Eve 2014 → 2014-12-24
 - relatively
 - e.g., last June → (YYYY-06-01, YYYY-06-30)
 - YYYY depends on the reference time, either:
 - document creation time (dct)
 - previously mentioned date
 - ...

Eventualities

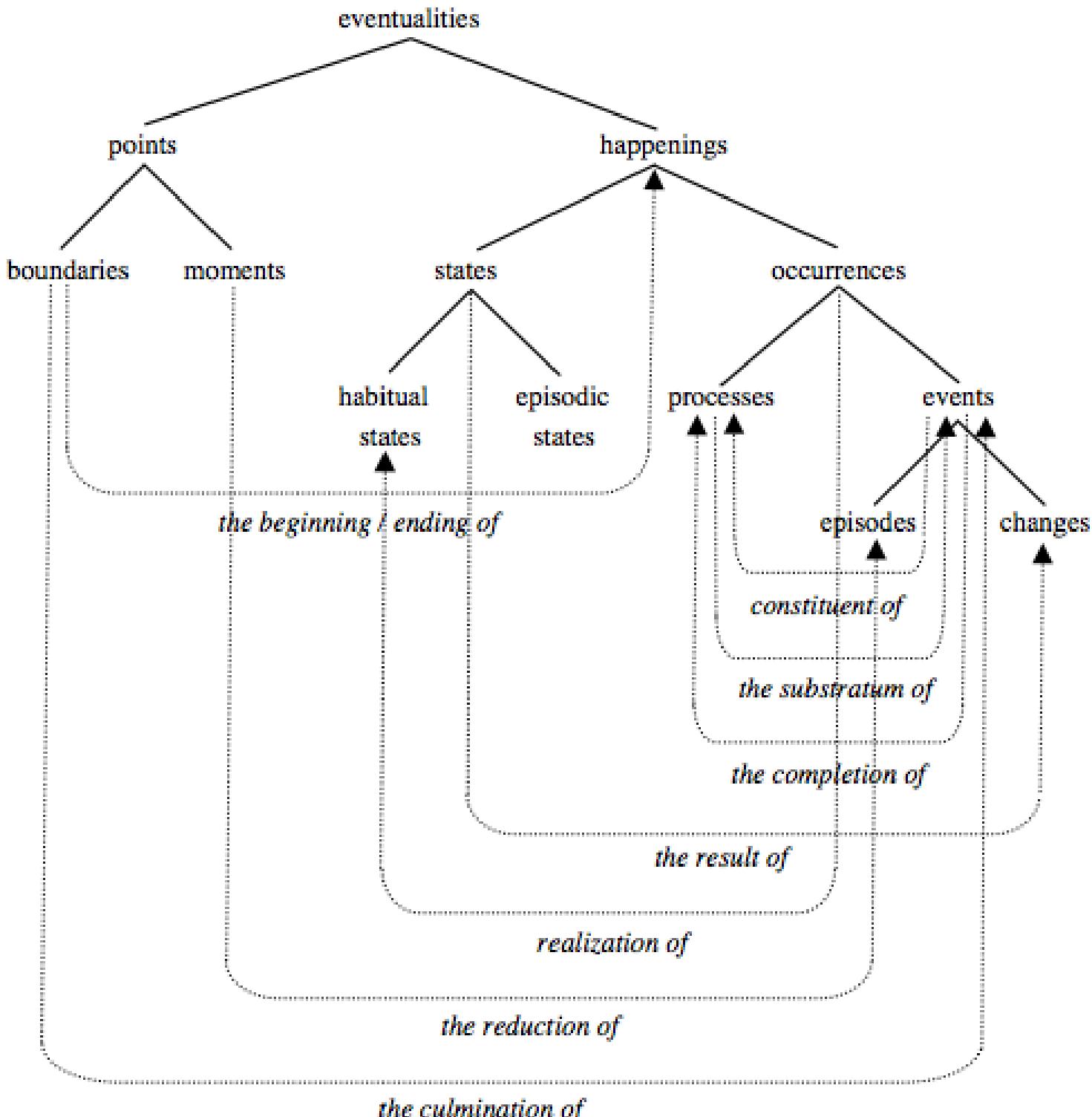
- Temporal expressions describe temporal information / eventualities
 - events, processes, states, happenings, changes, episodes, etc.
- Types of eventualities [Dölling, 2011]



Relations of Eventualities

- **Types of eventualities [Dölling, 2011]**

- A boundary begins/ends a happening
- A boundary culminates an event
- A moment is the reduction of an episode
- A state is the result of a change
- A habitual state is realized by a class of occurrences
- A process is made of event constituents



- **Task: connect eventualities in text with temporal expressions**

1. Motivation and Applications
2. Time in Text / Time Representation
- 3. Temporal Information from Wikipedia**
4. Temporal Slot Filling
5. Evaluation
6. Demo / Experiments

Temporal Information from Wikipedia



- YAGO2: A spatially and temporally enhanced knowledge base from Wikipedia [Hoffart et al., 2013]
 - Temporal information for entities and facts
 - Entities: existence
 - *people, groups, artifacts, events*
 - Facts: time points for events, time spans for validity
 - e.g., *was born in, holds political position* (e.g., president)
 - Resolution: one day or less
 - Format: **YYYY-MM-DD, YYYY-##-##**
 - Wikipedia as source
 - Infoboxes: e.g., birth date
 - Categories: e.g., '*82nd Academy Awards*' in '*2009 Film Awards*'
 - Already known dates of subject or object of a fact: e.g.,
 - *Bob Dylan wasBornIn Duluth*, birth date of Bob Dylan
 - *ElvisPresley diedIn Memphis*, death date of Elvis Presley
 - *Bob Dylan created BlondeOnBlonde*, creation date of 'Blonde On Blonde'

YAGO, <http://www.yago-knowledge.org>

- Three kinds of existence relations
 - *startsExistingOnDate*
 - *endsExistingOnDate*
 - *happenedOnDate*
- Existence of different entity types
 - People
 - from *birth* to *death*
 - Groups (music band, football clubs, universities, companies, etc.)
 - from *creation* to *destruction*
 - Artifacts (buildings, paintings, books, music songs, etc.)
 - from *creation* to *destruction*
 - Events (wars, sports competitions, named epochs, etc.)
 - from *started* to *ended*
 - *happened* if started and ended at the same day

Steve Jobs	
 A photograph of Steve Jobs, co-founder of Apple, smiling and holding up an iPhone 4 in his right hand. He is wearing a dark turtleneck sweater.	
Jobs holding an iPhone 4 at Worldwide Developers Conference 2010	
Born	Steven Paul Jobs February 24, 1955 San Francisco, California, US
Died	October 5, 2011 (aged 56) Palo Alto, California, US
Residence	Palo Alto, California, US

82nd Academy Awards

From Wikipedia, the free encyclopedia

Categories: Academy Awards ceremonies | 2009 film awards | 2010 in California | 21st century in Los Angeles, California

Facts in YAGO2

- Three kinds of occurrence relations
 - *occursSince*
 - *occursUntil*
 - *occursOnDate*
- Facts are assigned #IDs and used as subject
 - #1: *BarackObama wasInauguratedAs PresidentOfTheUnitedStates*
 - #1 *occursOnDate* 2009-01-20
 - #1 *occursSince* 2009-01-20
 - #1 *occursUntil* 2009-01-20
 - #2: *BobDylan hasWonPrize GrammyAward*
 - #2 *occursOnDate* 1973-##-##
 - #3: *BobDylan hasWonPrize GrammyAward*
 - #3 *occursOnDate* 1979-##-##
 - #4: *BradPitt spouse JenniferAniston*
 - #4 *occursSince* 2000-##-##
 - #4 *occursUntil* 2005-##-##
 - #5: *BradPitt spouse AngelinaJolie*
 - #5 *occursSince* 2014-##-##



Brad Pitt

Pitt at Sydney's red carpet for *World War Z* premiere in 2013

Born	William Bradley Pitt December 18, 1963 (age 51) Shawnee, Oklahoma, United States
Occupation	Actor, producer
Years active	1987–present
Spouse(s)	Jennifer Aniston (m. 2000–05) Angelina Jolie (m. 2014)
Children	6

Facts with a deduced time in YAGO2



- Temporal information are deduced from existence of subject or object of a fact
- Based on rules
 - Permanent relations
 - identifying attributes, like ID numbers or types (e.g., *sb isA person*)

```
$id: $s $p $o;  
$p type permanentRelation;  
$s startsExistingOnDate $b;  
$s endsExistingOnDate $e  
_____  
$id occursSince $b;  
$id occursUntil $e
```

- Creation relations
 - e.g., *ElvisPresley wasBornIn Tupelo*, birth date of Elvis Presley (subject)
 - e.g., *LeonardCohen created Suzanne(song)*, creation date of Suzanne

```
$id: $s $p $o;  
$p type objectStartRelation;  
$o startsExistingOn $b  
_____  
$id occursSince $b;  
$id occursUntil $b
```

- Destruction relations
 - e.g., *Taliban destroyed BuddhasOfBamyan*, destruction date of Buddhas

```
$id: $s $p $o;  
$p type subjectEndRelation;  
$s endsExistingOn $e  
_____  
$id occursSince $e;  
$id occursUntil $e
```

1. Motivation and Applications
2. Time in Text / Time Representation
3. Temporal Information from Wikipedia
- 4. Temporal Slot Filling**
5. Evaluation
6. Demo / Experiments

Incomplete / Fuzzy Times



- **Challenge**
 - Times are incomplete
 - Times are mentioned with different granularities
 - Uncertainty in time information
- **Solution: 4-tuple representation [Ji et al., 2011]**
 - $\langle t_1, t_2, t_3, t_4 \rangle$
 - $t_1 < t_{\text{start}} < t_2$
 - $t_3 < t_{\text{end}} < t_4$

Document text (2001-01-01)	t_1	t_2	t_3	t_4
Chairman Smith	-infinite	2001-01-01	2001-01-01	+infinite
Smith, who has been chairman for two years	-infinite	1999-01-01	2001-01-01	+infinite
Smith, who was named chairman two years ago	1999-01-01	1999-01-01	1999-01-01	+infinite
Smith, who resigned last October	-infinite	2000-10-01	2000-10-01	2000-10-31
Smith served as chairman for 7 years before leaving in 1991	1984-01-01	1984-12-31	1991-01-01	1991-12-31
Smith was named chairman in 1980	1980-01-01	1980-12-31	1980-01-01	+infinite

Temporal Slot Filling (TSF)



- “Given a query entity, a knowledge base (KB) and a source corpus, a system must return slot fills and temporal information must be gathered across the entire corpus” [Ji et al., 2013]

- Example:
 - <Google> <CEO> <Eric Schmidt>
 - “Schmidt joined Google's board of directors as chairman in March 2001, and became the company's CEO in August 2001.” (Wikipedia)
 - Start: August 2001 (2001-08-01, 2001-08-31)
 - “Schmidt is one of a few people who became billionaires (in United States dollars) based on stock options received as employees in corporations of which they were neither the founders nor relatives of the founders. In its 2011 'World's Billionaires' list, Forbes ranked Schmidt as the 136th-richest person in the world, with an estimated wealth of \$7 billion. Google gave him a \$100 million equity award in 2011 when he stepped down as CEO.” (Wikipedia)
 - End: 2011 (2011-01-01, 2011-12-31)
 - 4-tuple: <2001-08-01, 2001-08-31, 2011-01-01, 2011-12-31>
 - Two steps: Temporal Classification, Temporal Aggregation

Temporal Classification



- Identify text instances containing
 - Information, e.g., fact: <subject> <predicate> <object>
 - Temporal expression
- Classify as
 - START, END, HOLDS, RANGE, NONE

- Examples
 - 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.

Temporal Aggregation



- **Normalization**
 - E.g., '*he got married in 2014*'
 - certain: marriage in (2014-01-01, 2014-12-31) = (t_a, t_b)
 - Uncertainty
 - divorce already at t_a ? Unlikely, but we do not know
 - maybe still married → +INF
- **Creating 4-tuple corresponding to the identified classes**
 - **START:** $\langle t_a, t_b, t_a, +\text{INF} \rangle$
 - **END:** $\langle -\text{INF}, t_b, t_a, t_b \rangle$
 - **HOLDS:** $\langle -\text{INF}, t_a, t_b, +\text{INF} \rangle$
 - **RANGE:** $\langle t_a, t_b, t_a, t_b \rangle$
 - **NONE:** $\langle -\text{INF}, +\text{INF}, -\text{INF}, +\text{INF} \rangle$

- **Aggregation by combining every two pairs of tuples T and T'**
- **Iterative aggregation [Li et al., 2012]**

$$T \wedge T' = \langle \max(t_1, t_1'), \min(t_2, t_2'), \max(t_3, t_3'), \min(t_4, t_4') \rangle$$

- Extract temporal expressions, normalize
 - ‘In 1981, Makoni was moved to the position of minister of industry and energy development, where he remained until 1983.’
 - Entity: Makoni
 - Attribute / value: position / minister of industry and energy development
 - Target temporal expression: 1983
 - ‘In DATE, TE was moved to the position of TA, where he remained until TD.’
 - Extract window
 - Incorporate dependency features (dependency parsing)

Feature	Value
TE Win	be, move, to, in, DATE, the
TA Win	of, to, remain, position, the, where, until, he
TD Win	remain, where, until, he
TE Governs	-
TA Governs	-
TD Governs	-
TE Governed by	move
TA Governed by	position
TD Governed by	remain

[Li et al., 2012]

- Biggest TSF challenge
 - Sentences cover more than one information / fact
 - Facts span more than one sentence
 - Temporal information are not always close to the facts

'In August 2000, as a result of the conclusion of arbitration with the International Chamber of Commerce, Andersen Consulting broke all contractual ties with AWSC and Arthur Andersen. As part of the arbitration settlement, Andersen Consulting paid the sum held in escrow (then \$1.2 billion) to Arthur Andersen, and was required to change its name, resulting in the entity being renamed Accenture.'

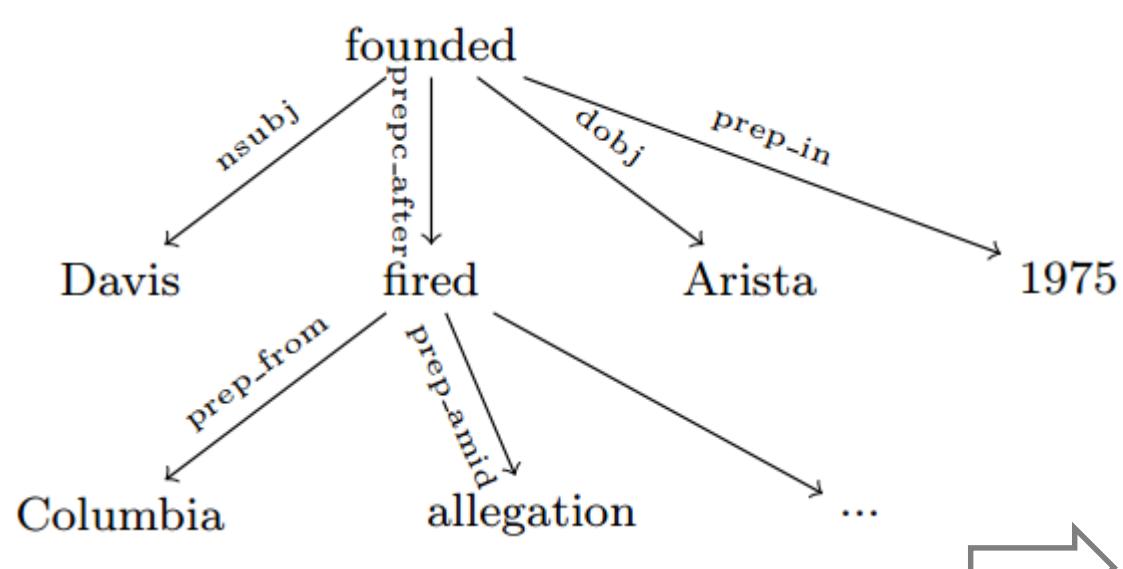
- Solution
 - Use parsing structures to compress long contexts
 - Dependency parsing / co-reference resolution
 - Far from perfect, not robust enough
 - Combine structured and flat approaches [Li et al., 2012]

Structured Approach

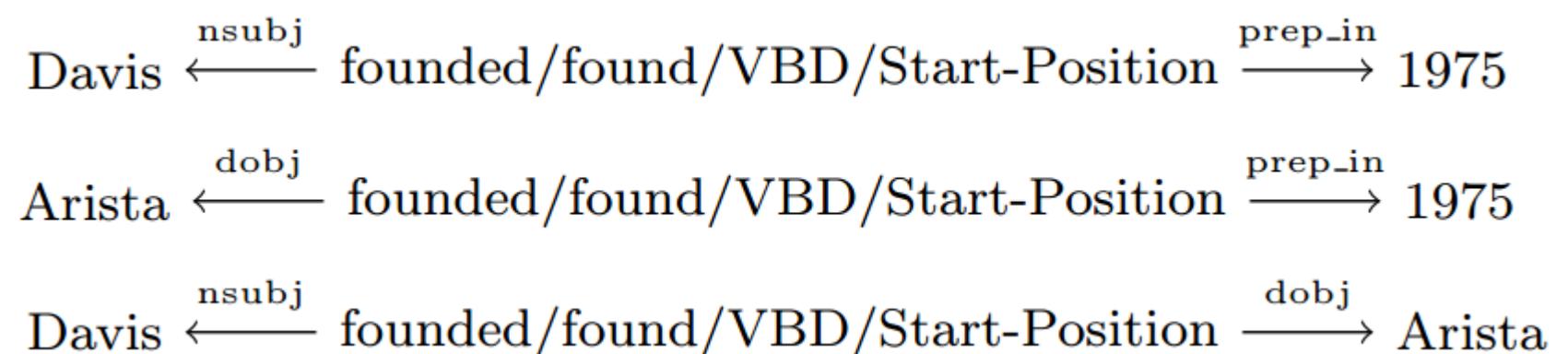
- Representation based on three shortest dependency paths

'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.'

- Surface sentence
 - Long distance between 1975 and Davis founded Arista
 - Some words in between cause ambiguity: fired
- Dependency paths
 - Help remove irrelevant information
 - Build syntactic and semantic links from long distance
 - Requires text analysis / Natural Language Processing (NLP)

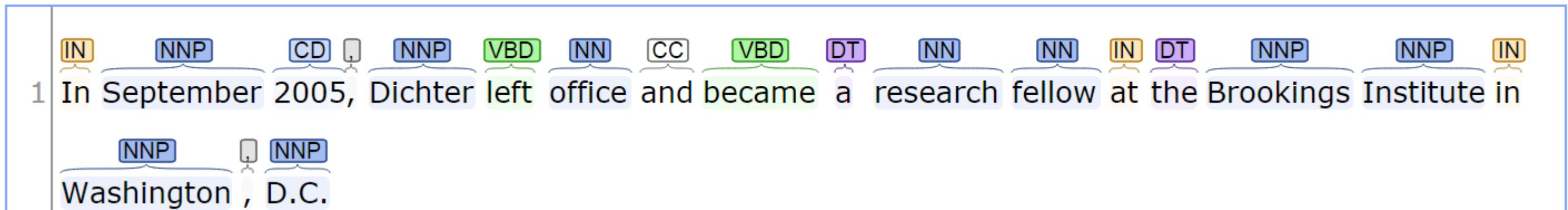


[Li et al., 2012]

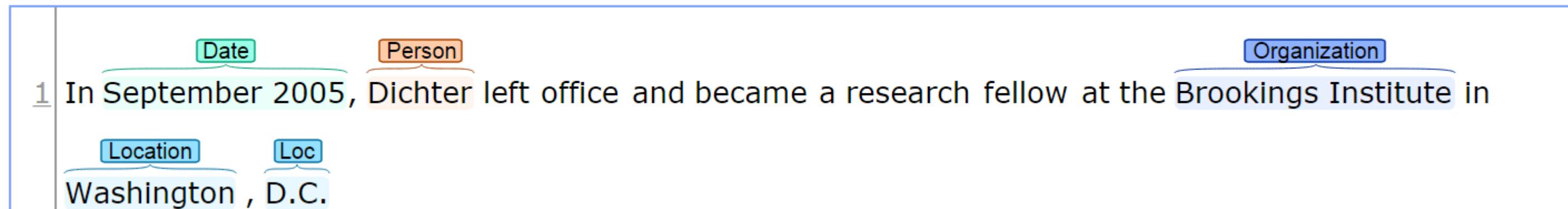


'In September 2005, Dichter left office and became a research fellow at the Brookings Institute in Washington, D.C.'

Part-of-Speech:

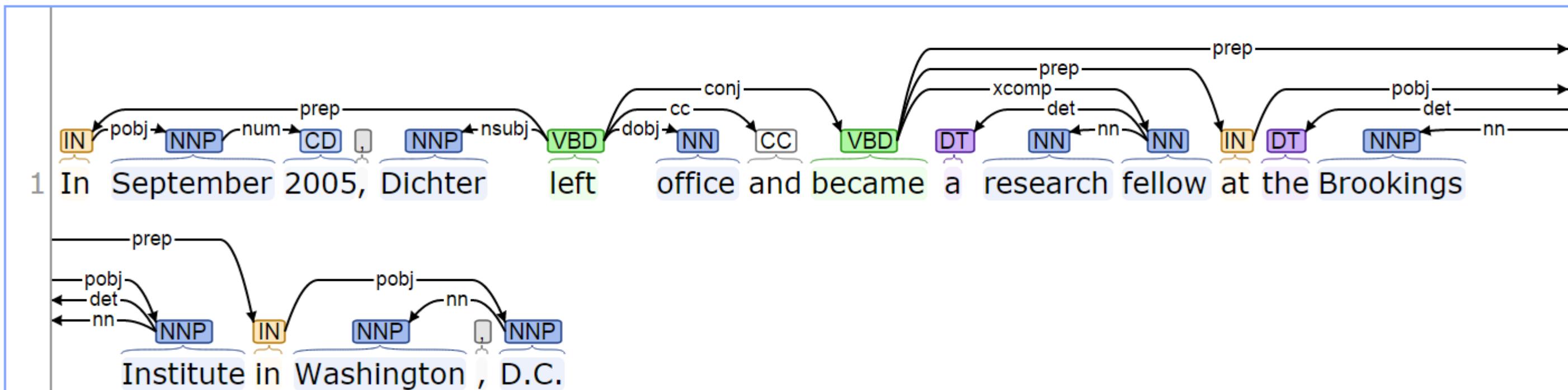


Named Entity Recognition:



'In September 2005, Dichter left office and became a research fellow at the Brookings Institute in Washington, D.C.'

Basic dependencies:



- No connection between *September 2005* and *Brookings Institute Washington*
 - Flat approach works, but structured does not
 - However, with long contexts, structured often works better
 - Combine flat and structured approach [Li et al., 2012]

Training Set Creation



- **Manual annotation**
 - Requires experts
 - Much effort, very time-consuming task
 - Explicit information is very sparse
 - Scattered across documents
- **Alternative: Distant Supervision [Mintz et al., 2009]**
 - Retrieve temporal information from a Knowledge Base (KB)
 - Spouse: <John, Mary, (1997, 2003)>
 - Collect top web search results for '*John Mary*'
 - www.mary-and-john.com
 - www.mymarriage.com/john33/
 - www.wedding-photos.com/joma/
 - ...
 - Collect all sentences that mention both entities
 - '*On 1997, John and Mary renewed their vows in Florida.*'
 - Compare with KB, label expressions
 - START: 1997 – HOLDS -- END: 2003
 - Sentence: 1997 → START

Distant Supervision



Leadership /organization/organization/leadership		✓ 2013-10-14	
Person	Role	Title	From
Betsy Rafael	-	VP, Controller and PAO	Some values flag. Remove.
Ron Johnson	-	Senior Vice President	Some values flag. Remove.
Bertrand Serlet	-	Senior Vice President	Some values flag. Remove.
Scott Forstall	-	Senior Vice President	Some values flag. Remove.
Daniel Cooperman	-	SVP, Gen'l Counsel, Secretary	Some values flag. Remove.
Tim Cook	Chief Executive Officer	CEO	8/24/2011
Michael Scott	Chief Executive Officer	CEO	1977 February
Mike Markkula	Chief Executive Officer	CEO	1981
John Sculley	Chief Executive Officer	CEO	4/8/1983
Michael Spindler	Chief Executive Officer	CEO	1993 June
14 values total »			2/2/1996
		No values flag. Remove.	

→ <Tim Cook, CEO, Apple, (2011-08-01, 2011-08-31, 2011-08-01, +INF), START>

bing apple tim cook

Web Images Videos Maps News More

0 Sign in

4,700,000 RESULTS Any time ▾

[Apple - Press Info - Apple Leadership - Tim Cook](#)
www.apple.com › Press Info › Apple Leadership ▾

Tim Cook is the CEO of Apple and serves on its Board of Directors. Before being named CEO in August 2011, Tim was Apple's Chief Operating Officer and was responsible ...

[News about Apple Tim Cook](#)
bing.com/news

[Apple's Tim Cook 'deeply offended' by fresh allegations of factory worker mistreatment](#)
Engadget · 3 days ago

Apple CEO Tim Cook has said he's "deeply offended" by fresh allegations of poor working conditions in its suppliers' Chinese factories. Contractors hired by Apple to assemble its latest products have been exposed...

[Tim Cook 'deeply offended' by BBC Apple allegations](#)
U Switch · 1 day ago

[Apple CEO Tim Cook donates 'substantial' amount to gay rights campaign](#)
Times of India · 3 days ago

[Tim Cook - Wikipedia, the free encyclopedia](#)
en.wikipedia.org/wiki/Tim_Cook ▾

Timothy Donald "Tim" Cook (born November 1, 1960) is an American business executive, and is the CEO of Apple Inc. Cook joined Apple in March 1998 as Senior Vice ...

Early life and education · Career · Leadership style · Personal life

Tim Cook

Timothy Donald "Tim" Cook is an American business executive, and is the CEO of Apple Inc. Cook joined Apple in March 1998 as Senior Vice President of Worldwide Operations—he also served as Executive Vice President of World... + en.wikipedia.org

Born: Nov 01, 1960 (age 54) · Mobile, Alabama

Height: 6' 3" (1.90 m)

Education: Auburn University · Duke University · Robertsdale High School · Fuqua School of Business

Timeline

1998: Cook was asked by Jobs to join Apple in 1998.

2005: Predicting its importance, his group invested in long-term deals such as advance investment in flash memory from 2005 onwards, guaranteeing stable supply of what would become a key iPod nano, then iPhone and iPad component.

2011: After Jobs resigned as CEO and became chairman of the board, Cook was named CEO of Apple Inc. on August 24, 2011.

'Tim Cook is the CEO of Apple and serves on its Board of Directors. Before being named CEO in August 2011, Tim was Apple's Chief Operating Officer and was responsible ...'

Agenda

1. Motivation and Applications
2. Time in Text / Time Representation
3. Temporal Information from Wikipedia
4. Temporal Slot Filling
5. Evaluation
6. Demo / Experiments

- **Temporal Quality**
 - Let $\langle t_1, t_2, t_3, t_4 \rangle$ be system output, $\langle g_1, g_2, g_3, g_4 \rangle$ be gold standard

$$Q(S) = \frac{1}{4} \sum_i \frac{c}{c + |t_i - g_i|}$$

- An error of c time units produces a 0.5 score
- Each element in tuple is scored independently
- A correct slot fill with temporal information t gets credit $Q(S)$ (instead of 1)

- **Overall Metrics (Precision / Recall)**

$$P = \frac{\sum_{S^i \in C(S)} Q(S^i)}{M} \quad R = \frac{\sum_{S^i \in C(S)} Q(S^i)}{N}$$

- **M:** the number of system output tuples
- **N:** the number of gold standard tuples
- **C(S):** the number of instances that have correct slot fills

Evaluation Parameter

- A parameter should determine if a certain amount of vagueness is worse/better than a certain amount of over-constraining

$$c_i = \begin{cases} c_{vag}, & \text{if } (i \in \{1, 3\} \wedge t_i \leq g_i) \vee (i \in \{2, 4\} \wedge t_i \geq g_i) \\ c_{cons}, & \text{otherwise} \end{cases}$$

- If $S \subset S_g$:
$$Q(S) = \frac{1}{4} \sum_i \frac{c_{cons}}{c_{cons} + |t_i - g_i|}$$

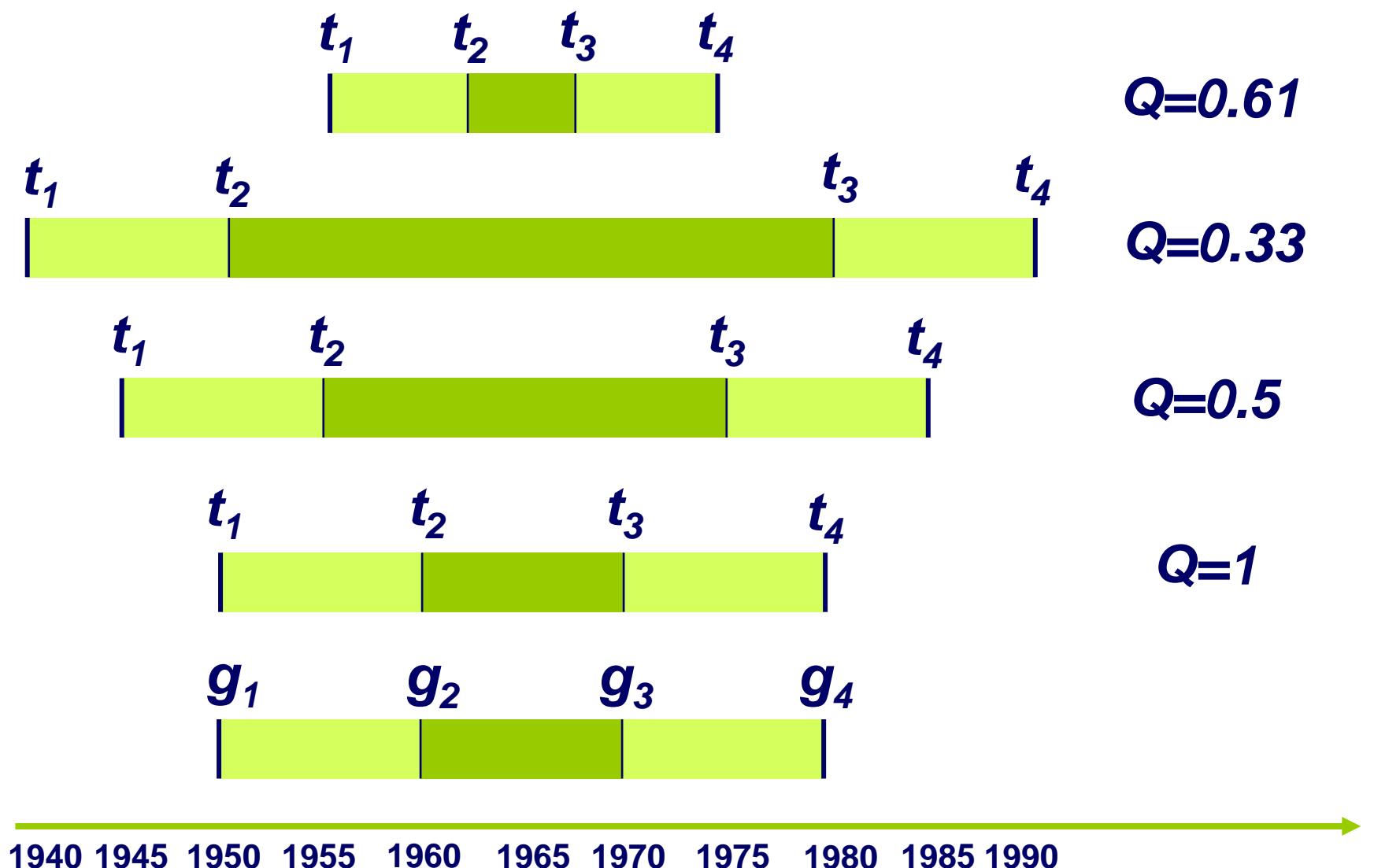


- If $S_g \subset S'$:
$$Q(S') = \frac{1}{4} \sum_i \frac{c_{vag}}{c_{vag} + |t_i - g_i|}$$



Evaluation Example

- $C_{\text{cons}} = C_{\text{vag}} = 5$
- $+\text{Infinite} = 10,000$
- $-\text{Infinite} = 0$

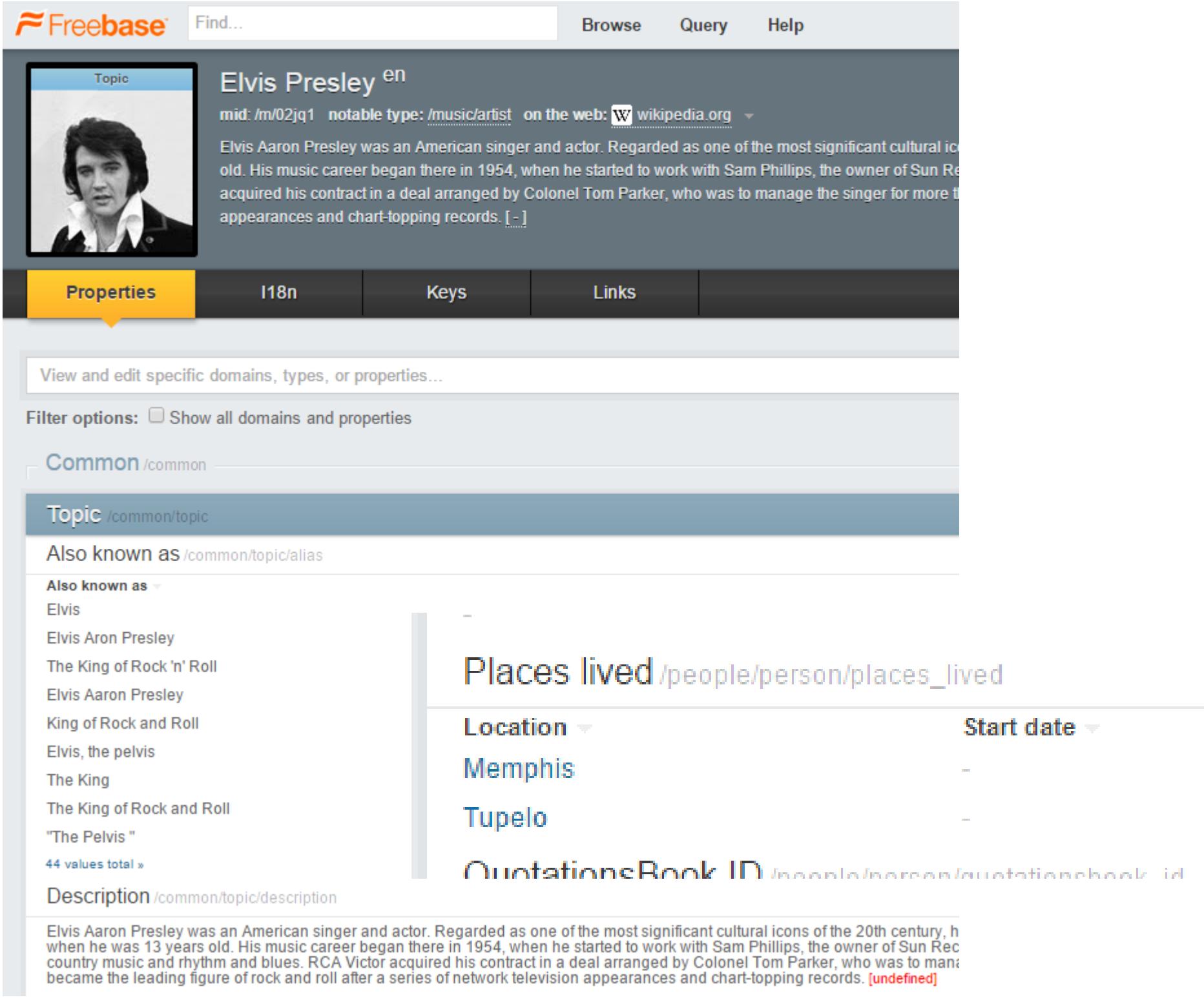


Agenda

1. Motivation and Applications
2. Time in Text / Time Representation
3. Temporal Information from Wikipedia
4. Temporal Slot Filling
5. Evaluation
6. Demo / Experiments

Demo / Experiments

- TSF for 'Places lived' of *Elvis Presley*
 - <http://www.firebaseio.com/m/02jq1>



The screenshot shows the Freebase interface for the topic 'Elvis Presley'. The top navigation bar includes 'Find...', 'Browse', 'Query', and 'Help'. Below the navigation is a summary card for 'Elvis Presley en' with a thumbnail image, a 'mid' link, and a brief bio. A horizontal menu bar at the bottom of the card has tabs: 'Properties' (highlighted in yellow), 'I18n', 'Keys', and 'Links'. The main content area starts with a search bar and a 'View and edit specific domains, types, or properties...' button. A 'Filter options' checkbox is present. The 'Common /common' section is expanded, showing the 'Topic /common/topic' tab. Under 'Also known as /common/topic/alias', there is a list including 'Elvis', 'Elvis Aron Presley', 'The King of Rock 'n' Roll', 'Elvis Aaron Presley', 'King of Rock and Roll', 'Elvis, the pelvis', 'The King', 'The King of Rock and Roll', and '"The Pelvis"'. A note indicates '44 values total ». The 'Places lived /people/person/places_lived' section is shown on the right, listing 'Memphis' and 'Tupelo' under 'Location'. The 'QuotationsBook ID' section is also visible. The bottom part of the screen contains the full bio of Elvis Presley.

Elvis Presley en

mid: /m/02jq1 notable type: /music/artist on the web: [wikipedia.org](#)

Elvis Aaron Presley was an American singer and actor. Regarded as one of the most significant cultural icons of the 20th century, he was 13 years old. His music career began there in 1954, when he started to work with Sam Phillips, the owner of Sun Records. RCA Victor acquired his contract in a deal arranged by Colonel Tom Parker, who was to manage the singer for more than 20 years. He became the leading figure of rock and roll after a series of network television appearances and chart-topping records. [-]

Properties I18n Keys Links

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

- Elvis
- Elvis Aron Presley
- The King of Rock 'n' Roll
- Elvis Aaron Presley
- King of Rock and Roll
- Elvis, the pelvis
- The King
- The King of Rock and Roll
- "The Pelvis"

44 values total »

Description /common/topic/description

Elvis Aaron Presley was an American singer and actor. Regarded as one of the most significant cultural icons of the 20th century, he was 13 years old. His music career began there in 1954, when he started to work with Sam Phillips, the owner of Sun Records. He became the leading figure of rock and roll after a series of network television appearances and chart-topping records. [undefined]

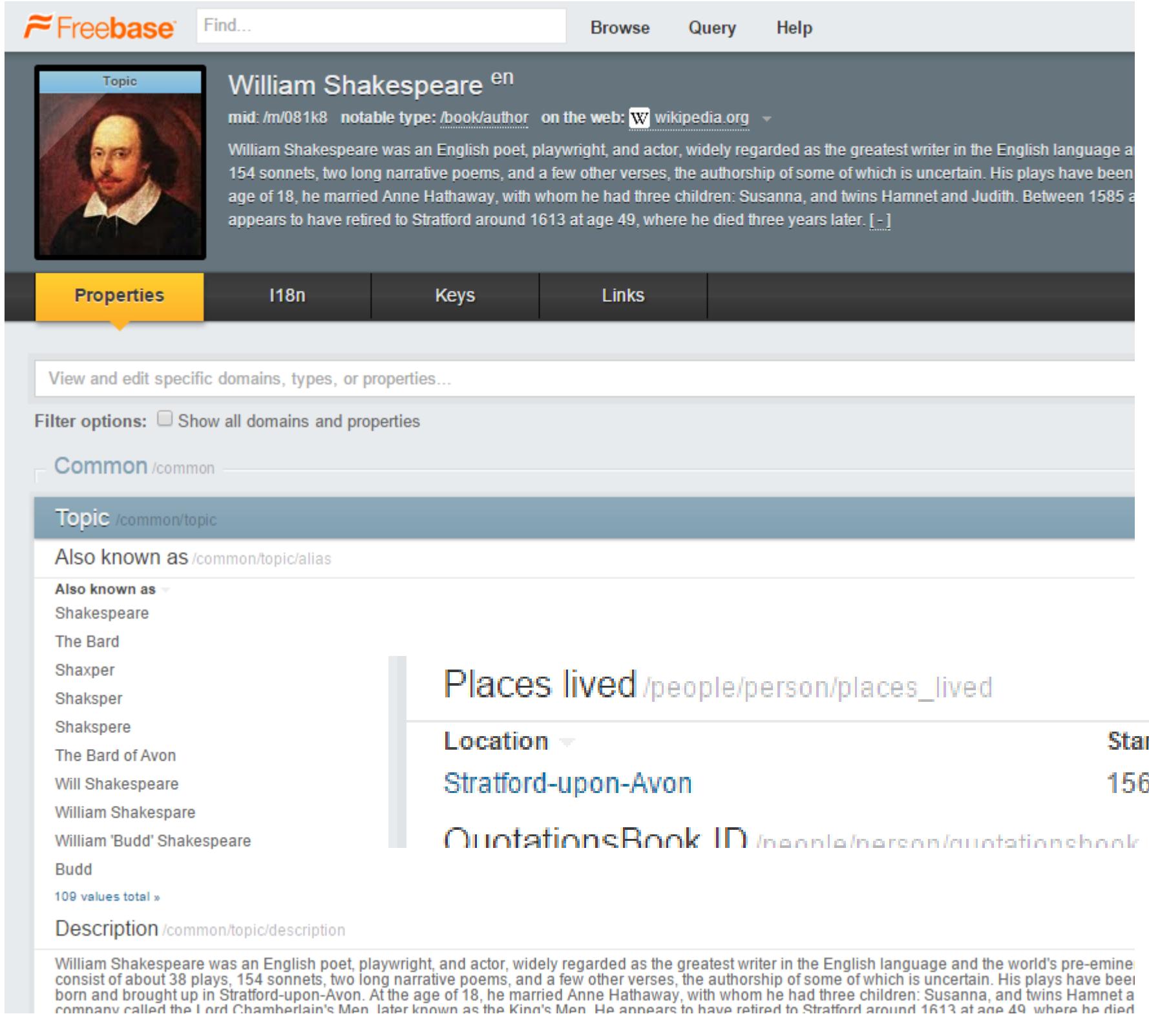
Places lived /people/person/places_lived

Location	Start date	End date
Memphis	-	-
Tupelo	-	-

QuotationsBook ID

Demo / Experiments

- Distant Supervision using *William Shakespeare*
 - <http://www.freebase.com/m/081k8>



The screenshot shows the Freebase interface for the topic 'William Shakespeare' (en). The top navigation bar includes 'Freebase' (with a logo), 'Find...', 'Browse', 'Query', and 'Help'. Below the title 'William Shakespeare en' is a portrait of Shakespeare and a brief summary: 'mid: /m/081k8 notable type: /book/author on the web: wikipedia.org'. A 'Properties' tab is selected, showing tabs for 'Properties', 'I18n', 'Keys', and 'Links'. A sidebar on the left lists 'Common /common' and 'Topic /common/topic'. Under 'Topic', there's a section for 'Also known as /common/topic/alias' with entries like 'Shakespeare', 'The Bard', 'Shaxper', 'Shaksper', 'Shakspere', 'The Bard of Avon', 'Will Shakespeare', 'William Shakespeare', 'William 'Budd' Shakespeare', and 'Budd'. A link to '109 values total' is shown. The main content area displays 'Places lived /people/person/places_lived' with a table:

Location	Start date	End date
Stratford-upon-Avon	1564	1616

Below this is a section for 'Quotations Book ID /inanna/naren/quotationbook_id'.

Description /common/topic/description

William Shakespeare was an English poet, playwright, and actor, widely regarded as the greatest writer in the English language and the world's pre-eminent dramatist. He is often called England's national poet and the 'Bard of Avon'. His works consist of about 38 plays, 154 sonnets, two long narrative poems, and a few other verses, the authorship of some of which is uncertain. His plays have been translated into every major language and are performed more often than those of any other playwright.

Demo / Experiments

▪ Distant Supervision using *William Shakespeare*

Google William Shakespeare Stratford-upon-Avon

Web Images News Shopping Maps More Search tools

About 504,000 results (0.38 seconds)

[William Shakespeare - Stratford-upon-Avon for ...](#)
www.stratford-upon-avon.co.uk › William Shakespeare
William Shakespeare (1564 - 1616) was born at Stratford-upon-Avon in a house in Henley Street. This is preserved intact. His mother, Mary Arden, was one of ...

[The Shakespeare Birthplace Trust](#)
www.shakespeare.org.uk
4.2 ★★★★☆ 33 Google reviews · Google+ page

[Anne Hathaway's Cottage](#)
www.shakespeare.org.uk
4.5 ★★★★☆ 7 Google reviews · Google+ page

[Visit Stratford-upon-Avon](#)
www.visitstratforduponavon.co.uk
Google+ page

[Map results for William Shakespeare Stratford-upon-Avon](#)

[Shakespeare Birthplace Trust: Life and work of ...](#)
www.shakespeare.org.uk/ ▾ Shakespeare Birthplace Trust ▾
Home of Shakespeare's Birthplace, Stratford-upon-Avon. The world's leading charity ...
A perfect introduction to William Shakespeare's Works, Life and Times.
Visit the Houses - Work With Us - Shakespeare's Birthplace - Plan your visit

[Shakespeare's Birthplace - Wikipedia, the free encyclopedia](#)
en.wikipedia.org/wiki/Shakespeare's_Birthplace ▾ Wikipedia
Shakespeare's Birthplace, Stratford-upon-Avon - Sept 2012.jpg ... where it is believed that William Shakespeare was born in 1564 and spent his childhood years ...

Henley Street Stratford-upon-Avon, United Kingdom +44 1789 204016

Cottage Lane Stratford-upon-Avon, United Kingdom +44 1789 292100

1 Wood Street Stratford-upon-Avon, United Kingdom +44 1789 262329

 WIKIPEDIA The Free Encyclopedia

Main page Contents Featured content Current events Random article Donate to Wikipedia Wikimedia Shop

Interaction Help About Wikipedia Community portal Recent changes Contact page

Tools What links here Related changes Upload file

Article Talk Read Edit View history Search

Create account Log in

Shakespeare's Birthplace

From Wikipedia, the free encyclopedia

Coordinates: 52.1939°N 1.7080°W

Shakespeare's Birthplace

Shakespeare's Birthplace in 2012

General information

Type House

Location Henley Street, Stratford-upon-Avon, Warwickshire, England

Coordinates 52.1939°N 1.7080°W

Completed 16th-century

- “... *Stratford-upon-Avon, Warwickshire, England, where it is believed that William Shakespeare was born in 1564 ...*” → START

Demo / Experiments



- <http://www.express.co.uk/news/history/548791/Why-2015-year-remember-anniversaries-famous-events-memorable-dates>

The screenshot shows the homepage of the Daily Express website. At the top, there's a navigation bar with links for HOME, NEWS, SPORT, COMMENT, FINANCE, TRAVEL, ENTERTAINMENT, UK, WORLD, SHOWBIZ, ROYAL, NATURE, POLITICS, WEIRD, HISTORY (which is highlighted in red), WWI, and OBITUARY. Below the navigation is a breadcrumb trail: Home > News > History > Why 2015 is a year to remember: A guide to significant anniversaries. The main headline is "Why 2015 is a year to remember: A guide to significant anniversaries". Below the headline, there's a paragraph about significant anniversaries from the birth of Elvis Presley to the death of Sir Winston Churchill. The author is listed as JANE WARREN, and the date is Saturday, December 27, 2014. There are several thumbnail images with captions: "BBC postpones documentary claiming Prince Charles used", "Zara Phillips goes casual in shorts and T-Shirt as she picks up...", and "'It's a dream come true' Sir Richard Branson's daughter Holly...". On the right side, there's a sidebar with links for Login, Register, Weather, and London.

January

January 1: It is 30 years since the first mobile phone call in the UK was made by comedian Ernie Wise.

He called Vodafone's head office in Berkshire from St Katherine Docks in London.

January 8: 80 years ago Elvis Presley, the "King" of rock and roll, was born in Tupelo, Mississippi.

His identical twin brother Jesse was delivered stillborn 35 minutes before him.

January 10: The Sinclair C5, a battery-powered electric vehicle, was launched 30 years ago to immediate ridicule – but it did help earn its inventor Sir Clive Sinclair his knighthood.

January 24: The 50th anniversary of the death of Sir Winston Churchill who died at the age of 90 at his London home after suffering a stroke.

January 27: 70 years since the Soviet Red Army liberated Auschwitz concentration camp in southern Poland where at least 1.1 million prisoners had died.

February

- Reference date?
 - Document creation date: 2014-12-27
 - Actual reference: 2015-01-08

Demo / Experiments



- <http://heideltme.ifi.uni-heidelberg.de/heideltme/>



HeidelTime Demo

UNIVERSITÄT
HEIDELBERG
Zukunft. Seit 1386.



Configuration

HeidelTime is a **multilingual** and **cross-domain** temporal tagger.
Please click the question marks for additional instructions.

Document type: News
Language: English
Document creation time: 2015-01-05

Input

Choose between manually entering text and inserting a text file (up to 2 MB, ensure it's encoded in UTF-8).

Text File

Jan. 8, 1935: Elvis Aaron Presley is born in a two-room house in Tupelo, Mississippi. His twin brother, Jesse Garon, was stillborn.

Output

Extracted temporal expressions are marked in blue. To see their normalization value, click them.

You may also receive a TimeML-annotated file (ensure your browser isn't blocking popups).

Yes, I want to receive a TimeML-annotated file.

Compute

Result: Type: DATE Value: 1935

90 years ago Elvis Presley, the "King" of rock and roll, was born in Tupelo, Mississippi.

Demo / Experiments

- <http://nlp.stanford.edu:8080/corenlp/process>

Stanford CoreNLP

Output format: Visualise ▾

Please enter your text here:

```
80 years ago Elvis Presley, the "King" of rock and  
roll, was born in Tupelo, Mississippi.
```

Part-of-Speech:

```
1 CD NNS IN NNP NNP DT IN NN CC NN VBD VBN IN NNP NNP  
1 80 years ago Elvis Presley, the `King'ofrock and roll, was born in Tupelo, Mississippi.
```

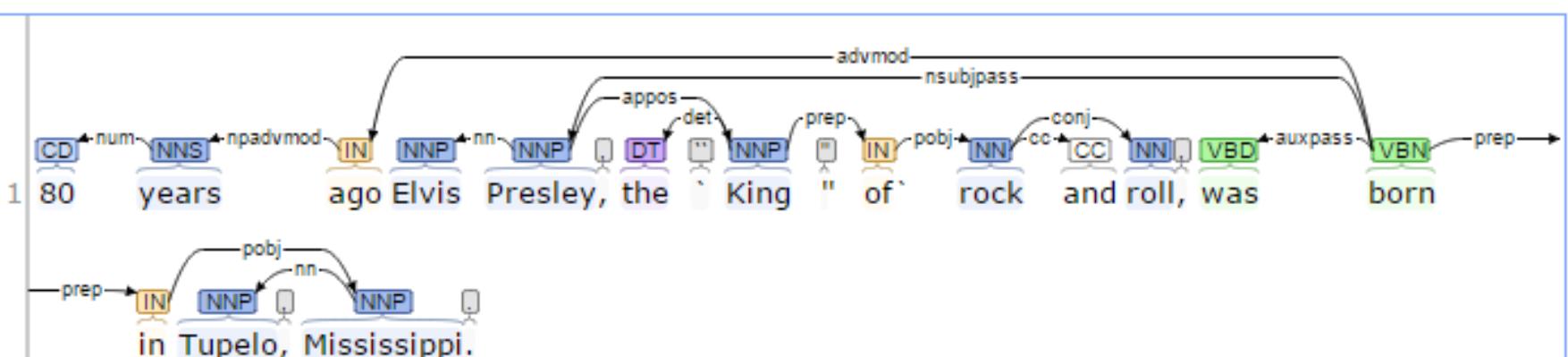
Named Entity Recognition:

```
1 Date Person Loc Location  
1 80 years ago Elvis Presley, the `King'bfrock and roll, was born in Tupelo, Mississippi.
```

Coreference:

```
1 80 years ago Elvis Presley, the `King'bfrock and roll, was born in Tupelo, Mississippi.
```

Basic dependencies:



Demo / Experiments



- Alternative: use rules (compare YAGO2)
 - http://dbpedia.org/page/Elvis_Presley

About: Elvis Presley

An Entity of Type : [military person](#), from Named Graph : [http://dbpedia.org](#), within Data Space : [dbpedia.org](#)

DBpedia

Elvis Aaron Presley (January 8, 1935 – August 16, 1977) was an American singer, musician, and actor. Regarded as one of the most significant cultural icons of the 20th century, he is often referred to as "the King of Rock and Roll", or simply, "the King". Born in Tupelo, Mississippi, Presley and his family moved to Memphis, Tennessee, when he was 13 years old. His music career began there in 1954, when he started to work with Sam Phillips, the owner of Sun Records.

Property	Value
dbpedia-owl:abstract	<ul style="list-style-type: none">Elvis Aaron Presley (January 8, 1935 – August 16, 1977) was an American singer, musician, and actor. Regarded as one of the most significant cultural icons of the 20th century, he is often referred to as "the King of Rock and Roll", or simply, "the King". Born in Tupelo, Mississippi, Presley and his family moved to Memphis, Tennessee, when he was 13 years old. His music career began there in 1954, when he started to work with Sam Phillips, the owner of Sun Records. Accompanied by guitarist Scotty Moore and bassist Bill Black, Presley was an early popularizer of rockabilly: an up-tempo, backbeat-driven fusion of country music and rhythm and blues. RCA Victor acquired his contract in a deal arranged by Colonel Tom Parker, who was to manage the singer for more than two decades. Presley's first RCA single, "Heartbreak Hotel", released in January 1956, was a number-one hit in the US. He became the leading figure of rock and roll after a series of network television appearances and chart-topping records. His energized interpretations of songs and sexually provocative performance style, combined with a singularly potent mix of influences across color lines that coincided with the dawn of the Civil Rights Movement, made him enormously popular—and controversial. In November 1956, he made his film debut in Love Me Tender. In 1958, he was drafted into military service. He resumed his recording career two years later, producing some of his most commercially successful work before devoting much of the 1960s to making Hollywood movies and their accompanying soundtrack albums, most of which were critically derided. In 1968, following a seven-year break from live performances, he returned to the stage in the acclaimed televised comeback special, Elvis, which led to an extended Las Vegas concert residency and a string of highly profitable tours. In 1973, Presley was featured in the first globally broadcast concert via satellite, Aloha from Hawaii. Several years of prescription drug abuse severely deteriorated his health, and he died in 1977 at the age of 42. Presley is one of the most celebrated musicians of the 20th century. Commercially successful in many genres, including pop, blues and gospel, he is the best-selling solo artist in the history of recorded music, with estimated album sales of around 600 million units worldwide. He was nominated for 14 Grammys and won three, receiving the Grammy Lifetime Achievement Award at age 36, and has been inducted into multiple music halls of fame.Elvis Aaron Presley (* 8. Januar 1935 in Tupelo, Mississippi; † 16. August 1977 in Memphis, Tennessee), häufig einfach nur „Elvis“ genannt, war ein US-amerikanischer Sänger, Musiker und Schauspieler, der als einer der wichtigsten Vertreter der Rock- und Popkultur des 20. Jahrhunderts gilt. Wegen seiner Erfolge und seiner Ausstrahlung wird er auch als „King of Rock 'n' Roll“ oder einfach als „King“ bezeichnet. Presley gilt mit wahrscheinlich über einer Milliarde verkauften Tonträgern als der erfolgreichste Solo-Künstler weltweit. Elvis Presley begann seine Karriere 1954 als einer der ersten Musiker der Rockabilly-Bewegung, einer Fusion von „weißer“ Country-Musik und „schwarzer“ Rhythm & Blues. Seinen Durchbruch hatte er 1956, als er zu kontrovers diskutierten Identifikationsfigur der Rock-'n'-Roll-Bewegung wurde. Für Furore sorgte er mit seinen ausgesprochen körperbetonten Bühnenauftritten in einer Zeit, in der dies noch nicht zum Standardrepertoire von Live-Entertainern gehörte. Presleys Markenzeichen waren seine markante, annähernd drei Oktaven umfassende Stimme und sein innovativer, emotionsgeladener Gesangsstil, mit dem er in unterschiedlichen Genres wie dem Rock, Pop, Country, Gospel und Blues erfolgreich war. Presley wurde bis 1978 14 Mal für den Grammy nominiert, den er dreimal für seine Gospelinterpretationen gewann. Im Alter von 36 Jahren wurde er als bis dahin jüngster Künstler mit dem Lifetime Achievement Award (Bing Crosby Award) ausgezeichnet. Presley ist als einziger Künstler in fünf Halls of Fame vertreten: Rock 'n' Roll, Rockabilly, Country, Blues und Gospel. Ferner wurden sechs seiner Songinterpretationen als historisch besonders bedeutsam in die Grammy Hall of Fame aufgenommen. Laut RIAA (Recording Industry Association of America) hat er zudem mit 167 Einheiten die meisten Gold- und Platin-Auszeichnungen sowie einen Diamond-Award (Stand: Dezember 2011). Die RIAA zeichnete ihn wiederholt als „Best Selling Solo Artist in U.S. History“ aus. In den amerikanischen Billboard-Charts erreichte Presley bis 1977 mit 15 Alben und 16 Extended Plays den ersten Platz. Er ist der einzige Musiker in der amerikanischen Chartgeschichte mit Nummer-eins-Hits sowohl in Billboards Pop- (18) als auch Country- (11), Rhythm-&-Blues- (6) sowie Adult-Contemporary-Charts (7) und führt bis heute Billboards „Liste der 500 erfolgreichsten Künstler ab 1955“ an. Zwischen 1956 und 1969 wirkte Presley zudem in 31 Spielfilmen mit. 1970 und 1972 erschienen zwei Dokumentarfilme über ihn; „Elvis on Tour“ wurde mit einem Golden Globe Award als beste Dokumentation ausgezeichnet.
dbpedia-owl:activeYearsEndYear	1977-01-01 (xsd:date)
dbpedia-owl:activeYearsStartYear	1953-01-01 (xsd:date)
dbpedia-owl:alias	Presley, Elvis Aaron
dbpedia-owl:birthDate	1935-01-08 (xsd:date)
dbpedia-owl:birthName	Elvis Aaron Presley
dbpedia-owl:birthPlace	dbpedia:Tupelo,_Mississippi dbpedia:Mississippi
dbpedia-owl:birthYear	1935-01-01 (xsd:date)
dbpedia-owl:child	dbpedia:Lisa_Marie_Presley
dbpedia-owl:deathDate	1977-08-16 (xsd:date)
dbpedia-owl:deathPlace	dbpedia:Memphis,_Tennessee dbpedia:Tennessee
dbpedia-owl:deathYear	1977-01-01 (xsd:date)
dbpedia-owl:icnld	n78/79487
dbpedia-owl:militaryBranch	dbpedia:United_States_Army
dbpedia-owl:militaryUnit	dbpedia:3rd_Armored_Division_(United_States)
dbpedia-owl:occupation	dbpedia:Elvis_Presley_1
dbpedia-owl:relative	dbpedia:Riley_Keough
dbpedia-owl:serviceEndYear	1960-01-01 (xsd:date)

- TSF value equals birth place (creation relation)

dbprop:birthName	▪ ELVIS Aaron Presley
dbprop:birthPlace	▪ Tupelo, Mississippi, United States
dhprop:branch	▪ United States Army

Demo / Experiments

- **Elvis Presley existence**

dbpedia-owl:alias	▪ Presley, Elvis Aaron
dbpedia-owl:birthDate	▪ 1935-01-08 (xsd:date)
dbpedia-owl:birthName	▪ Elvis Aaron Presley
dbpedia-owl:birthPlace	▪ dbpedia:Tupelo,_Mississippi ▪ dbpedia:Mississippi
dbpedia-owl:birthYear	▪ 1935-01-01 (xsd:date)
dbpedia-owl:child	▪ dbpedia:Lisa_Marie_Presley
dbpedia-owl:deathDate	▪ 1977-08-16 (xsd:date)
dbpedia-owl:deathPlace	▪ dbpedia:Memphis,_Tennessee ▪ dbpedia:Tennessee
dbpedia-owl:deathYear	▪ 1977-01-01 (xsd:date)
dbpedia-owl:iconId	▪ n7879487

- **startsExistingOn 1935-01-08**
- **endsExistingOn 1977-08-16**
- **Creation relation rule**

```
$id: $s $p $o;  
$p type objectStartRelation;  
$o startsExistingOn $b  
  
$id occursSince $b;  
$id occursUntil $b
```

- **#1: ElvisPresley birthPlace Tupelo**
 - **#1 occursSince 1935-01-08**
 - **#1 occursUntil 1935-01-08**
- **#2: ElvisPresley placesLived Tupelo**
 - **#2 occursSince 1935-01-08**

Demo / Experiments

- **Evaluation (Resolution: month)**

- **c = 1, +INF = 100**

$$Q(S) = \frac{1}{4} \sum_i \frac{c}{c + |t_i - g_i|} \quad P = \frac{\sum_{S^i \in C(S)} Q(S^i)}{M} \quad R = \frac{\sum_{S^i \in C(S)} Q(S^i)}{N}$$

- **g = <1935-01-08, 1935-01-08, 1935-01-08, +INF>**
- **t = <1935-01-01, 1935-12-31, 1935-01-01, +INF>**

Re Type: DATE nent:
Value: 1935

80 years ago Elvis Presley, the "King" of rock and roll, was born in Tupelo, Mississippi.

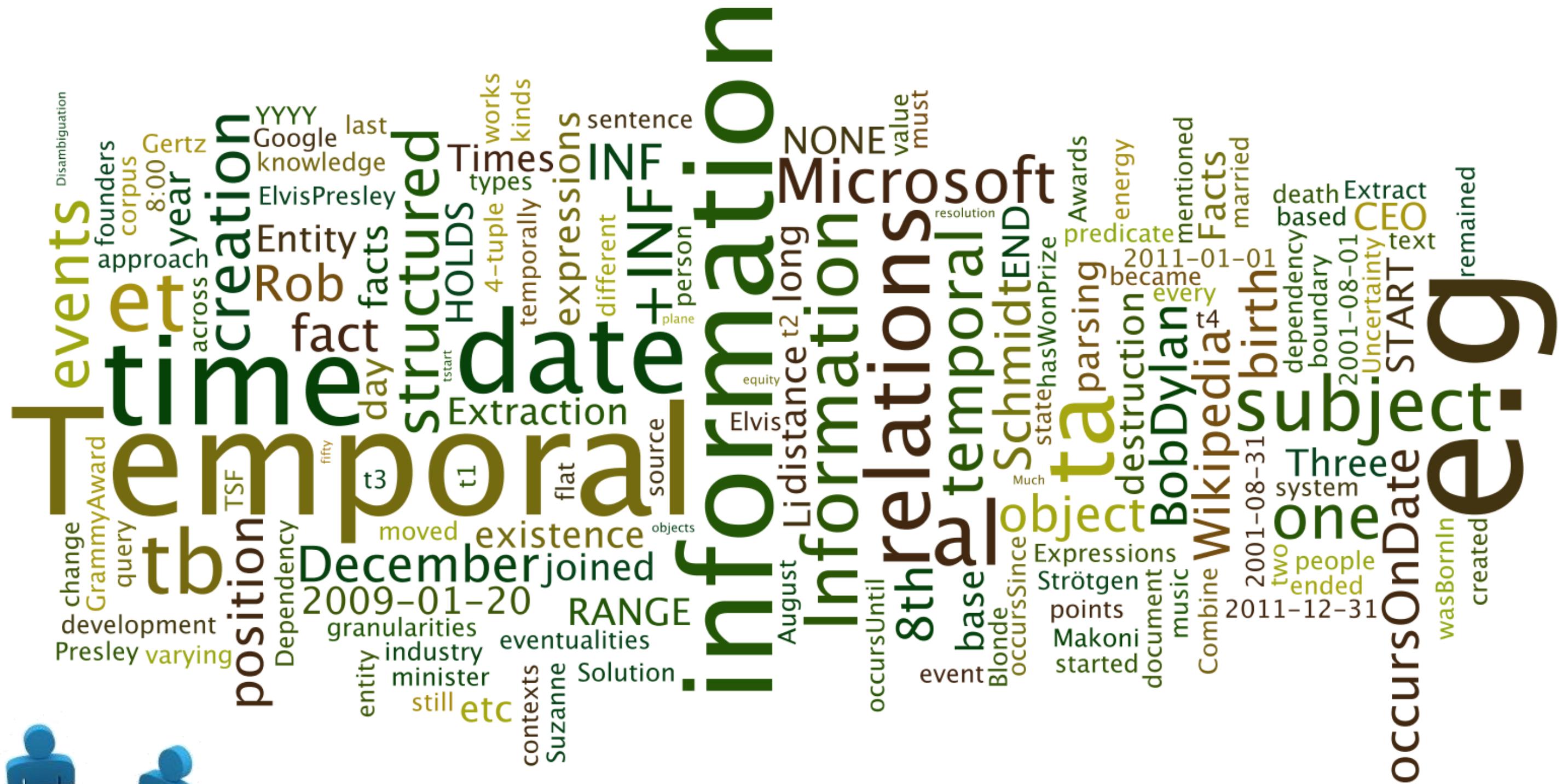
- $Q(S) = \frac{1}{4} \cdot \left(\frac{1}{1+|1-1|} + \frac{1}{1+|12-1|} + \frac{1}{1+|1-1|} + \frac{1}{1+|100-100|} \right) = \frac{1}{4} \cdot \left(1 + \frac{1}{12} + 1 + 1 \right) = \frac{37}{48} = 0.77$
- **P = R = Q(S) (because M = N = 1)**

- [Ahn et al., 2005]
 - D Ahn, S.F. Adafre, and M. de Rijke. 2005. Extracting temporal information from open domain text: A comparative exploration. In *Digital Information Management*.
- [Boguraev and Ando, 2005]
 - Branimir Boguraev and Rie Kubota Ando. 2005. TimeBank-Driven TimeML Analysis. Proc. *Annotating, Extracting and Reasoning about Time and Events*. IBFI, Schloss Dagstuhl, Germany.
- [Chang and Manning, 2012]
 - Angel X. Chang and Christopher D. Manning. 2012. SUTIME: A Library for Recognizing and Normalizing Time Expressions. 8th International Conference on Language Resources and Evaluation (LREC 2012).
- [Do et al., 2012]
 - Quang Do, Wei Lu and Dan Roth. 2012. Joint Inference for Event Timeline Construction. Proc. *Empirical Methods for Natural Language Processing (EMNLP2012)*.

- [Dölling, 2011]
 - DÖLLING, Johannes, et al. Aspectual coercion and eventuality structure. *Events, Arguments, and Aspects: Topics in the Semantics of Verbs*, 2014, 152. Jg., S. 189.
- [Hoffart et al., 2013]
 - HOFFART, Johannes, et al. YAGO2: a spatially and temporally enhanced knowledge base from Wikipedia. *Artificial Intelligence*, 2013, 194. Jg., S. 28-61.
- [Ji et al., 2011]
 - Heng Ji and Ralph Grishman. 2011. Knowledge Base Population: Successful Approaches and Challenges. Proc. The 49th Annual Meeting of the Association for Computational Linguistics: Human Language Technologies (ACL-HLT 2011).
- [Ji et al., 2013]
 - Ji, H., Cassidy, T., Li, Q., & Tamang, S. (2013). Tackling representation, annotation and classification challenges for temporal knowledge base population. *Knowledge and Information Systems*, 1-36.
- [Li et al., 2012]
 - Qi Li, Javier Artiles, Taylor Cassidy and Heng Ji. 2012. Combining Flat and Structured Approaches for Temporal Slot Filling or: How Much to Compress?. *Lecture Notes in Computer Science*, 2012, Volume 7182/2012, 194-205.

- [Mintz et al., 2009]
 - Mintz, M., Bills, S., Snow, R., & Jurafsky, D. (2009, August). Distant supervision for relation extraction without labeled data. In Proceedings of the Joint Conference of the 47th Annual Meeting of the ACL and the 4th International Joint Conference on Natural Language Processing of the AFNLP: Volume 2-Volume 2 (pp. 1003-1011). Association for Computational Linguistics.
- [Schilder and Habel, 2001]
 - Frank Schilder and Christopher Habel. 2001. From Temporal Expressions to Temporal Information: Semantic Tagging of News Messages. In Proceedings of the ACL-2001 Workshop on Temporal and Spatial Information Processing, pages 65–72. ACL.
- [Strötgen and Gertz, 2010]
 - Jannik Strötgen and Michael Gertz. 2010. HeidelTime: High Quality Rule-based Extraction and Normalization of Temporal Expressions. Proc. the 5th International Workshop on Semantic Evaluation.
- [UzZaman and Allen, 2010]
 - Naushad UzZaman and James F. Allen. 2010. TRIPS and TRIOS System for TempEval-2: Extracting Temporal Information from Text. Proc. the 5th International Workshop on Semantic Evaluation.

Questions?



**Thank you
for your attention!**