

D5 Oberseminar

- Students will present their **ongoing M.Sc. theses** done @ D5
- When: **November 24 from 14:00 to 16:00** (next Monday)
- Where: **E1.4 / R024** (this room)
- You:
 - should have time since there is **no tutorial next week**
 - get to see **what M.Sc. thesis topics look like @ D5**
 - are **cordially invited to attend**

3. Semantic Search

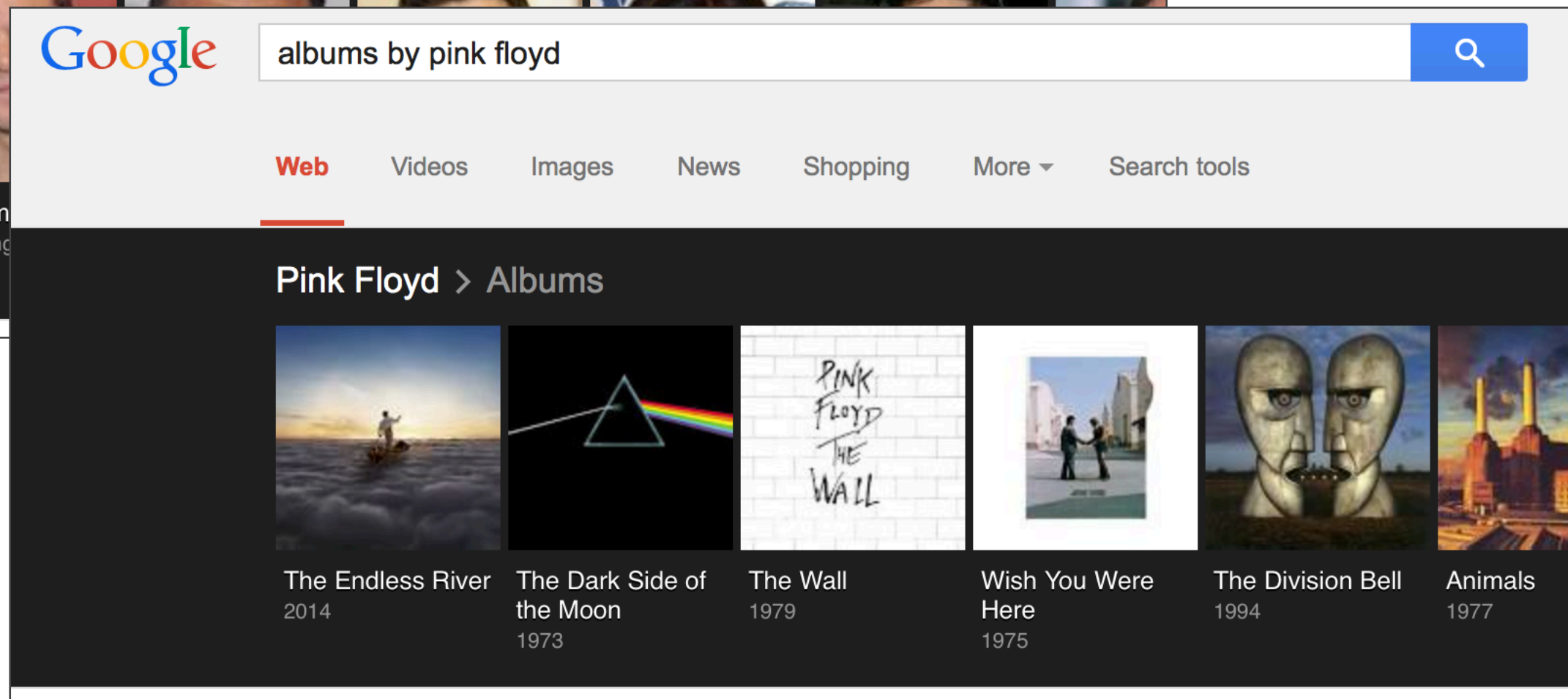
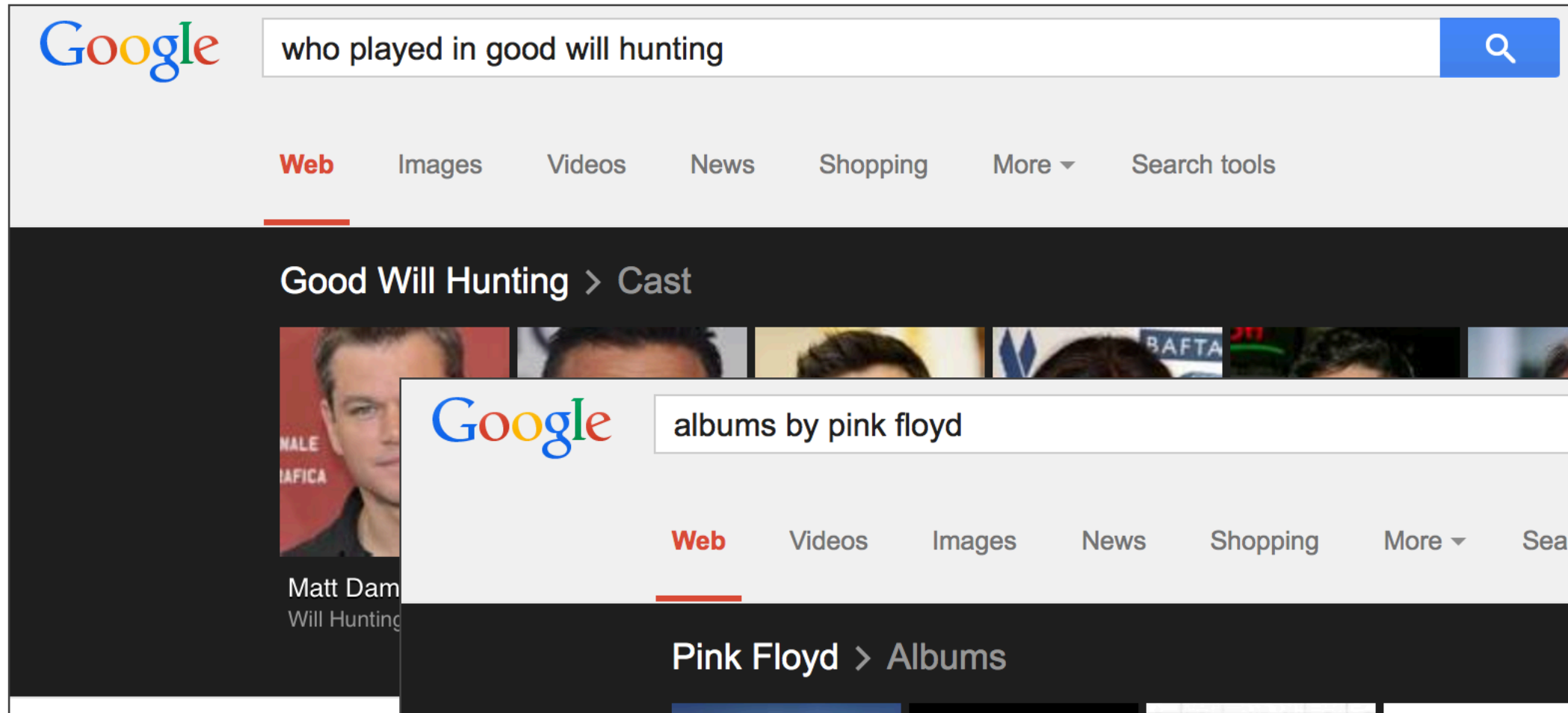
Semantic Search

- **Semantic search** is about
 - going **beyond** documents and queries as **bags of words**
 - having a **deeper understanding** of document contents by leveraging **world knowledge available as structured data**
 - going **beyond 10 blue links** and providing users with **direct answers** to their (natural language) questions

Semantic Search

Semantic Search

List Questions



Semantic Search



how tall is dirk nowitzki



Examples Random

Input interpretation:

Dirk Nowitzki height

Result:

Show non-metric

2.13 meters

Physical characteristics:

height	2.13 meters
weight	111 kg (kilogr

Unit conversions:

6.99 feet
6' 11.9"
83.9 inches

Factoid Questions



how did janis joplin die



Web

Images

Videos

News

Shopping

More ▾

Search tools

About 376,000 results (0.27 seconds)

Heroin overdose

Janis Joplin, Cause of death

Feedback

Janis

Singer

Janis Lyn Jo
1960s whos
stardom in l

Semantic Search

Still Beyond Hope



Web

Images

Videos

Shopping

News

More ▾

Search tools

About 30

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Web

News

Videos

Images

Shopping

More ▾

Search tools

About 6,050,000 results (0.45 seconds)

Assassination of **Martin Luther King, Jr.** **Martin Luther King, Jr.** was an American clergyman, activist, and prominent leader of the African-American civil rights movement and Nobel Peace Prize laureate who became known for his advancement of civil rights by using civil disobedience.

[Assassination of Martin Luther King, Jr. - Wikipedia, the free ...](https://en.wikipedia.org/wiki/Assassination_of_Martin_Luther_King,_Jr.)
en.wikipedia.org/wiki/Assassination_of_Martin_Luther_King,_Jr.

[Feedback](#)

[Assassination of Martin Luther King, Jr. - Wikipedia, the free ...](#)

Outline

3.1. Semantic Web

3.2. Knowledge Bases

3.2. (More) Semantic Keyword Search

3.3. Entity Search

3.4. Knowledge Search

1. Semantic Web

- ◉ **Semantic Web** is an extension of the **World Wide Web**, envisioned by Berners-Lee et al. [2], which aims at
 - ◉ giving **well-defined meaning** to information (in web pages)
 - ◉ making the Web **interpretable for machines**
 - ◉ facilitating **exchange and reuse of data**

Semantic Web Standards

- ◉ **World Wide Web Consortium (W3C) Semantic Web standards**
 - ◉ **Unified Resource Identifier (URI)**
to uniquely identify an abstract or physical resource
 - ◉ **Resource Description Framework (RDF)**
to describe properties of abstract or physical resources
 - ◉ **Resource Description Framework Schema (RDF/S)**
to describe schemata of properties of abstract or physical resources
 - ◉ **Web Ontology Language (OWL)**
to describe ontologies
 - ◉ **SPARQL Protocol and Query Language (SPARQL)**
to formulate queries over properties of abstract or physical resources

URI

- **Unified Resource Identifier** (URI) is a string of characters that uniquely identifies an abstract or physical resource



http://en.wikipedia.org/wiki/Foo_Fighters

<http://www.bbc.co.uk/music/artists/67f66c07-6e61-4026-ade5-7e782fad3a5d>

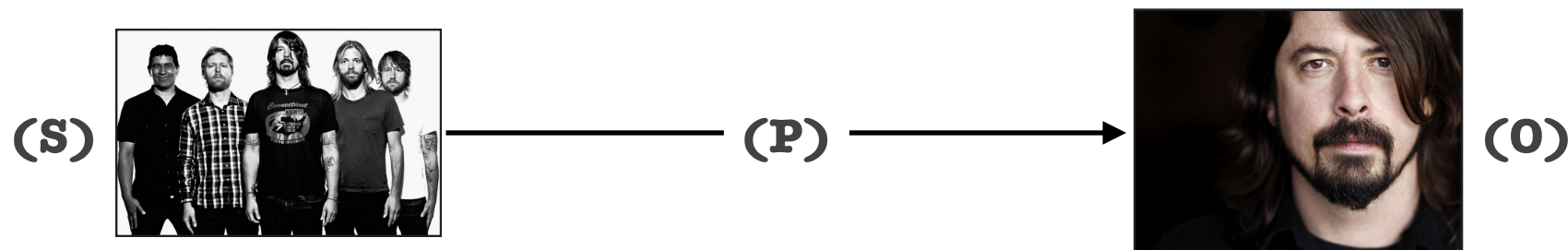
<http://www.musicbrainz.org/artist/67f66c07-6e61-4026-ade5-7e782fad3a5d>

- <http://www.host.org/pub/bands?query=FF#albums>
 - **scheme** (e.g., http, ftp, urn) determines interpretation of URI
 - **authority** indicates who is responsible for the resource (e.g., a host)
 - **path** provides hierarchical information for identifying the resource
 - **query** provides non-hierarchical information for identifying the resource
 - **fragment** refers to a specific part of the resource

RDF

- **Resource description framework** (RDF) provides a data model to describe properties of resources (identified by their URI)
- **RDF statements** are (S,P,O) **triples** consisting of a **subject** (URI), **predicate** (URI), and an **object** (URI or literal)
- Example: Foo Fighters have member Dave Grohl

<http://dbtune.org/musicbrainz/page/artist/67f66c07-6e61-4026-ade5-7e782fad3a5d> **(S)**
<http://xmlns.com/foaf/spec/20100809.html#member> **(P)**
<http://dbtune.org/musicbrainz/page/artist/4d5f891d-9bce-45ae-ad86-912dd27252fa> **(O)**



RDF

- RDF triples form a **RDF graph** (a labeled directed multigraph)
- **Namespaces** represent common URI prefixes and allow for a more compact representation of RDF data
- **RDF/N3** as one common **text representation** of RDF data

```
@ prefix      a: http://allaboutmusic.org  
a:Foo_Fighters a:member a:Dave_Grohl  
a:Foo_Fighters a:member a:Pat_Smear
```

RDF

- RDF triples form a **RDF graph** (a labeled directed multigraph)

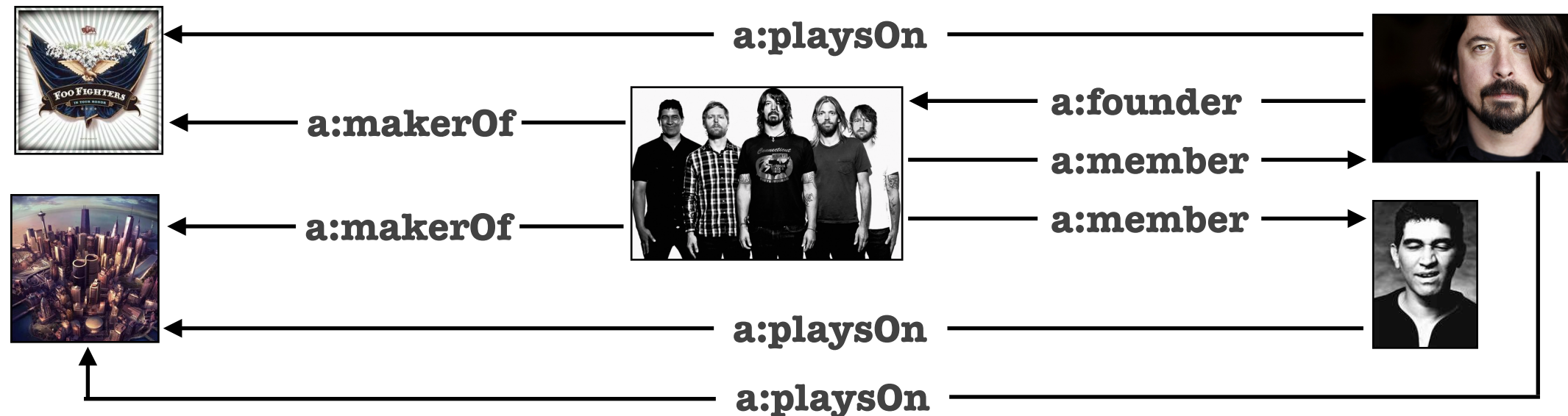


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RDF

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```
@ prefix      a:  http://allaboutmusic.org

a:Foo_Fighters a:member a:Dave_Grohl
a:Foo_Fighters a:member a:Pat_Smear
```

SPARQL

- **SPARQL Protocol and Query Language** (SPARQL) is a **query language** for the Semantic Web standardized by W3C
- SPARQL has a **SQL-inspired syntax** to define **graph patterns** and retrieves **all matching subgraphs** as query answers

Query

```
PREFIX a: <http://allmusic.org/>

SELECT DISTINCT ?b, ?r, ?p WHERE {
    ?b a:hasMember ?p .
    ?p ?r a:Seattle .
}
ORDER BY ?p
```

SPARQL

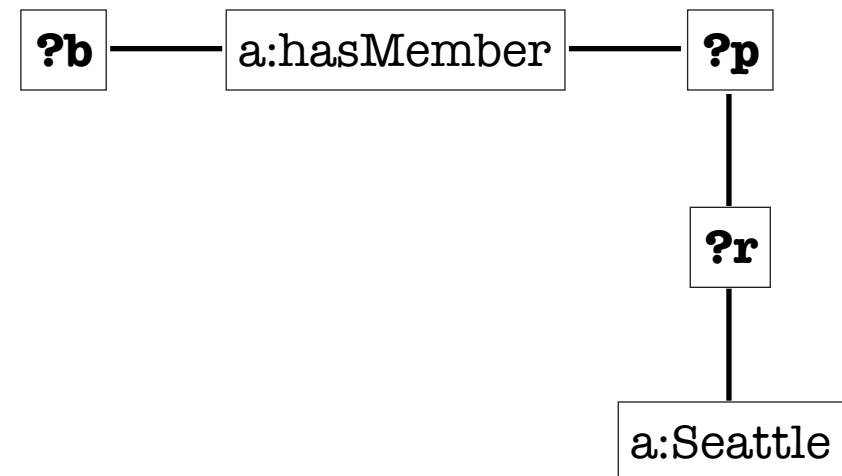
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Graph Pattern



SPARQL

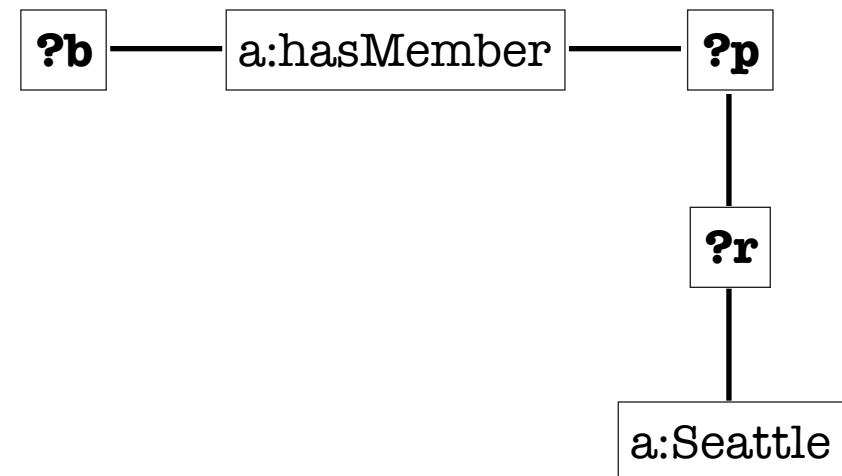
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Query

```
PREFIX a: <http://allmusic.org/>

SELECT DISTINCT ?b, ?r, ?p WHERE {
  ?b a:hasMember ?p .
  ?p ?r a:Seattle .
}
ORDER BY ?p
```

Graph Pattern



Answer



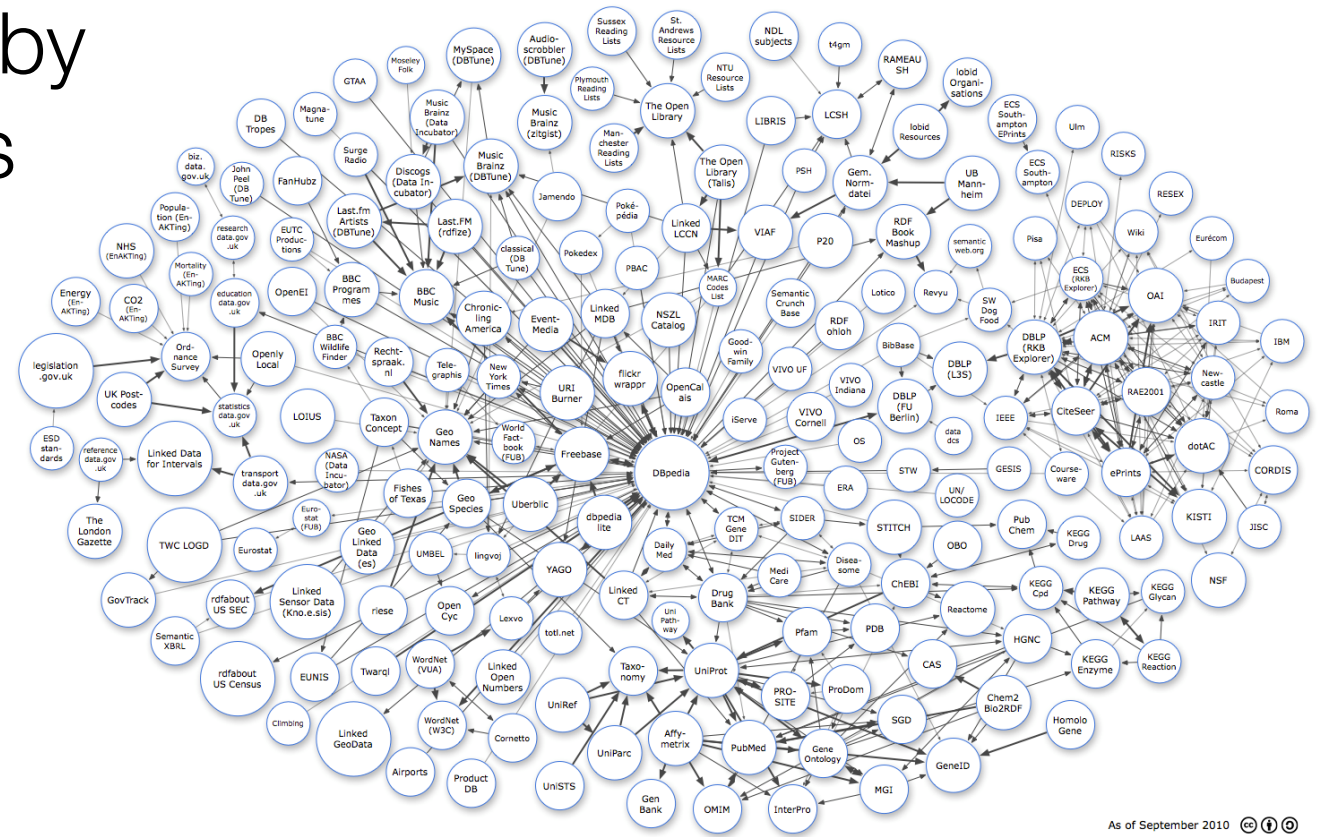
Linked Open Data Project

- Problem: **Resources** can be referred to by **different URIs in different RDF datasets**

- **Linked Open Data Project** creates a **Web of Linked Open Data** by establishing owl:sameAs links between RDF data sources

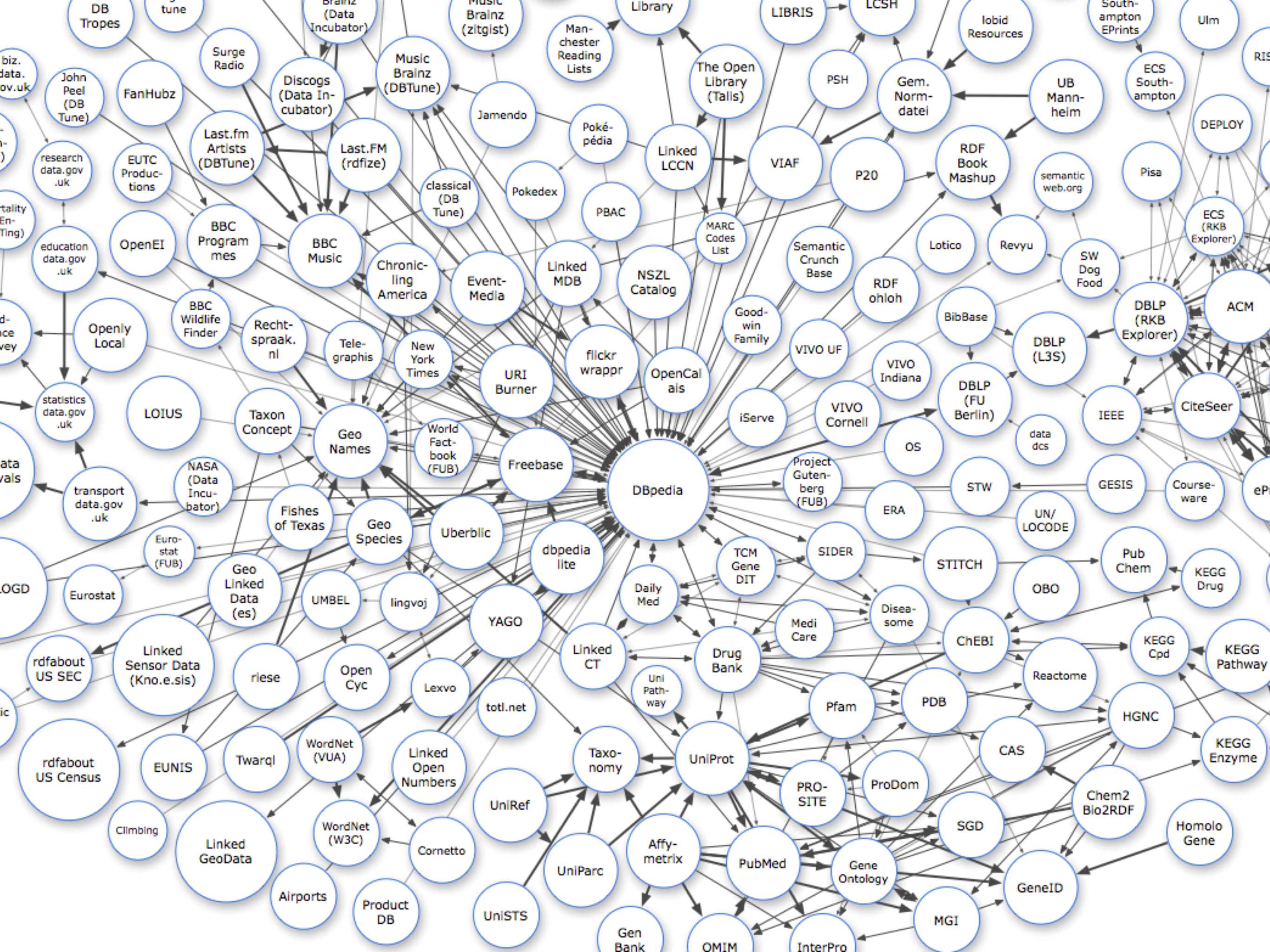
- As of 2011:

- 295 RDF data sources
- 32 billion RDF triples
- 504 million links



As of September 2010

<http://www.linkeddata.org>



2. Knowledge Bases


- ◉ **Knowledge bases** (e.g., DBpedia, Freebase, YAGO)
 - ◉ provide data about real-world **named entities**, their **properties**, and **relations** between them
 - ◉ have typically been **extracted from Wikipedia** and different other data sources (e.g., WordNet, GeoNames, MusicBrainz, etc.)
 - ◉ form the **core of the linked open data cloud**

Wikipedia

- **Collaboratively edited encyclopedia** that forms the common basis of other knowledge bases
 - **4.6 M** articles / **34.2 M** pages / **743.2 M** edits (for English)
 - available in **287 languages** (with vastly different coverage)
 - **templates**, **infoboxes**, and **categories** (quasi-structured)
 - **article contents** (unstructured) with **rich interlinkage**
 - **revision history** (who edited which page at what time)
 - **usage data** (e.g., access statistics)
 - started in **2001**



Joe Bonamassa



Bonamassa (2014)

Background information

Born May 8, 1977 (age 37)^[1]
New Hartford, New York, United States

Genres Blues rock, rock and roll

Occupation(s) Musician, singer-songwriter

Instruments Vocals, guitar, theremin, mandolin, dobro, banjo

Years active 1989–present

Labels J&R Adventures, Provogue

Associated acts Bloodline, Black Country Communion, Beth Hart, Rock Candy Funk Party, Jason Bonham, Joe Lynn Turner

Website www.jbonamassa.com

Notable instruments

Gibson Les Paul
Music Man Custom Steve Morse single and double necks
Gibson ES335
Fender Stratocaster
Fender Telecaster
Gibson Flying V

Categories: [1977 births](#) | [Living people](#) | [People from Utica, New York](#) | [Lead guitarists](#) | [Slide guitarists](#) | [American blues guitarists](#) | [American rock guitarists](#) | [American blues singers](#) | [American rock singers](#) | [Blues rock musicians](#) | [Electric blues musicians](#) | [American people of Italian descent](#) | [Black Country Communion members](#) | [Epic Records artists](#) | [Musicians from New York](#) | [Resonator guitarists](#) | [Blue-eyed soul singers](#) | [People from New Hartford, New York](#)

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Eric Clapton

From Wikipedia, the free encyclopedia

Eric Patrick Clapton, **CBE**, (born 30 March 1945) is an [English](#) musician, [singer-songwriter](#) and guitarist. He is the only [three-time inductee](#) to the [Rock and Roll Hall of Fame](#): once as a solo artist and separately as a member of [the Yardbirds](#) and [Cream](#). Clapton has been referred to as one of the most important and influential guitarists of all time.^[1] Clapton ranked [second](#) in *Rolling Stone* magazine's list of the "[100 Greatest Guitarists of All Time](#)"^[2] and fourth in [Gibson's](#) "[Top 50 Guitarists of All Time](#)".^[3] He was also named number five in *Time* magazine's list of "[The 10 Best Electric Guitar Players](#)" in 2009 ^[4]

In the mid-1960s, Clapton left the Yardbirds to play [blues](#) with [John Mayall & the Bluesbreakers](#). Immediately after leaving Mayall, Clapton joined [Cream](#), a [power trio](#) with drummer [Ginger Baker](#) and bassist [Jack Bruce](#) in which Clapton played sustained blues improvisations and "arty, blues-based psychedelic pop".^[5] For most of the 1970s, Clapton's output bore the influence of the mellow style of [JJ Cale](#) and the [reggae](#) of [Bob Marley](#). His version of Marley's "[I Shot the Sheriff](#)" helped reggae reach a mass market.^[6] Two of his most popular recordings were "[Layla](#)", recorded while he was a member of band [Derek and the Dominos](#); and [Robert Johnson's](#) "[Crossroads](#)", recorded by band Cream. Following the death of his son Conor in 1991, Clapton's grief was expressed in the song "[Tears in Heaven](#)", which featured in his *Unplugged* album.

Clapton has been the recipient of 18 [Grammy Awards](#), and the [Brit Award](#) for Outstanding Contribution to Music. In 2004, he was awarded a [CBE](#) at Buckingham Palace for services to music.^{[7][8][9]} In 1998, Clapton, a recovering alcoholic and [drug addict](#), founded the [Crossroads Centre](#) on [Antigua](#), a medical facility for recovering substance abusers.^[10]

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 - [2.1.1 The Yardbirds and the Bluesbreakers](#)

Eric Clapton CBE




Clapton performing at Hyde Park, London in June 2008

Background information

Birth name	Eric Patrick Clapton
Also known as	Slowhand
Born	30 March 1945 (age 69) <div>Ripley, Surrey, England</div>
Genres	Blues rock, rock, psychedelic rock, hard rock, blues
Occupation(s)	Musician, guitarist, singer-songwriter, record producer, artist
Instruments	Guitar, vocals
Years active	1962–present

Wikipedia

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Languages 

Afrikaans
العربية
Aragonés
Azərbaycanca
বাংলা
Беларуская
Беларуская (тарашкевіца)
Български
Bosanski
Català
Čeština
Cymraeg
Dansk
Deutsch
Eesti
Ελληνικά
★ Español
Esperanto
Euskara
فارسی
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Frysk
Gaeilge
Galego
한국어
Հայերեն
हिन्दी
Hrvatski
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עברית
മലയാളം

- 2.1 Early career, breakthrough, and international success
 - 2.1.1 The Yardbirds and the Bluesbreakers
 - 2.1.2 Cream
 - 2.1.3 Blind Faith, Delaney, and Bonnie and Friends
- 2.2 "Layla" and solo career
 - 2.2.1 Derek and the Dominos
 - 2.2.2 Personal challenges and early solo success
- 2.3 Continued success
- 2.4 Resurgence and stardom
- 2.5 Collaboration albums
- 2.6 *Clapton*, *Old Sock* and recent events
- 3 Influences
- 4 Legacy
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 - 8.2 Political views
 - 8.3 Controversy over remarks on immigration
 - 8.4 Wealth and assets
 - 8.5 Charitable work
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Early life [edit]

Instruments Guitar, vocals

Years active 1962–present

Labels Surfdog, Warner Bros., Reprise, Polydor, RSO, Atco, Apple

Associated acts The Yardbirds, John Mayall & the Bluesbreakers, Powerhouse, Cream, the Beatles, the Dirty Mac, Blind Faith, Free Creek, George Harrison, Plastic Ono Band, Delaney & Bonnie and Friends, Derek and the Dominos, the Rolling Stones, the Band, JJ Cale, Phil Collins, Robert Cray, Kate Bush, Luciano Pavarotti, Freddie King, B.B. King, Santana, Brian Wilson, John Mayer, Roger Waters, Dire Straits, Elton John, Steve Winwood, Stevie Ray Vaughan and Double Trouble, Sheryl Crow, Paul Wassif

Website www.ericclapton.com 

Notable instruments

See: Guitars section

Fender Stratocaster "Blackie"

Fender Stratocaster "Brownie"

Gibson SG "The Fool"

Gibson ES-335

Fender Telecaster

1939 Martin 000-42 acoustic

Wikipedia

Discography [edit]

Main article: Eric Clapton discography

Solo studio albums [edit]

- *Eric Clapton* (1970)
- *461 Ocean Boulevard* (1974)
- *There's One in Every Crowd* (1975)
- *No Reason to Cry* (1976)
- *Slowhand* (1977)
- *Backless* (1978)
- *Another Ticket* (1981)
- *Money and Cigarettes* (1983)
- *Behind the Sun* (1985)
- *August* (1986)
- *Journeyman* (1989)
- *Rush* (soundtrack) (1992)
- *From the Cradle* (1994)
- *Pilgrim* (1998)
- *Riding with the King* (with B.B. King) (2000)
- *Reptile* (2001)
- *Me and Mr. Johnson* (2004)
- *Sessions for Robert J* (2004)
- *Back Home* (2005)
- *The Road to Escondido* (with JJ Cale) (2006)
- *Clapton* (2010)
- *Old Sock* (2013)^[163]
- *The Breeze: An Appreciation of JJ Cale* (2014)

References [edit]

- ↑ *a b* "55 – Eric Clapton" . *Rolling Stone*. Retrieved 11 November 2014.
- ↑ *a b* "100 Greatest Guitarists of All Time – 2. Eric Clapton" . *Rolling Stone*. Retrieved 30 November 2011.
- ↑ *a b* "Top 50 Guitarists of All Time – 10 to 1" . Gibson Guitar Company. Retrieved 22 July 2011.
- ↑ Tyrangiel, Josh (2009-08-14). "The 10 Greatest Electric Guitar Players" . *Time* (Time, Inc.). Retrieved 2011-04-26.
- ↑ *a b* "Eric Clapton Biography - The Rock and Roll Hall of Fame and Museum" . Rockhall.com. Retrieved 22 September 2014.
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- ↑ "Ex-rebel Clapton receives his CBE" . *Telegraph.co.uk*. 4 November 2004. Retrieved 22 September 2014.
- ↑ "Eric Clapton, All Music: Grammy Awards" . *AllMusic*. Retrieved 22 September 2014.
- ↑ *a b* "Brit Awards 1987" . Brits.co.uk. Retrieved 22 September 2014.
- ↑ "Eric Clapton Biography" . *Rolling Stone*. Retrieved 23 October 2011.
- ↑ Harry Shapiro (1992) *Eric Clapton: Lost in the Blues* pg. 29. Guinness, 1999
- ↑ Concert" . *TIME.com*. Retrieved 22 September 2014.
- ↑ "Eric Clapton's T-Shirt Hit A Crossroad(s)" . TicoDo. 17 June 2013. Retrieved 27 June 2013.
- ↑ "Eric Clapton Kicks Off 50th Anniversary Tour With Killer Setlist" . Coolalbumreview.com. 15 March 2013. Retrieved 9 June 2013.
- ↑ "Eric Clapton: 'When I'm 70, I'll Stop Touring'" . RollingStone Magazine. Retrieved 11 June 2014.
- ↑ "More Signs Point Towards Eric Clapton Touring Retirement" . JamBase. Retrieved 11 June 2014.
- ↑ "Eric Clapton Says Touring Has Become 'Unbearable,' Confirms Retirement Plans" . Ultimate Classic Rock. Retrieved 27 June 2014.
- ↑ "Eric Clapton to headline Baloise Session in November" . *Where's Eric*. Retrieved 8 April 2014.
- ↑ "Eric Clapton Live from Basel on SRF3" . *Where's Eric*. Retrieved 8 April 2014.
- ↑ "ERIC CLAPTON & FRIENDS: THE BREEZE OUT JULY 29" . Where's Eric. Retrieved 11 June 2014.
- ↑ "Eric Clapton and Friends Honor JJ Cale With New Tribute LP" .

Wikipedia

V T E	Eric Clapton	[show]
	Associated bands	[show]
V T E	Rock and Roll Hall of Fame Class of 2000	[show]
Authority control	WorldCat [↗] • VIAF: 46945873 [↗] • LCCN: n84222859 [↗] • ISNI: 0000 0001 0896 4267 [↗] • GND: 119073102 [↗] • SUDOC: 033662827 [↗] • BNF: cb13892530m [↗] (data) [↗] • MusicBrainz: 618b6900-0618-4f1e-b835-bccb17f84294 [↗] • NDL: 00620495 [↗]	

Categories: [Eric Clapton](#) | [1945 births](#) | [Alumni of Kingston College \(England\)](#) | [Alumni of Kingston University](#) | [Atco Records artists](#) | [Blind Faith members](#) | [Blues rock musicians](#) | [Blues singer-songwriters](#) | [Brit Award winners](#) | [British rhythm and blues boom musicians](#) | [Commanders of the Order of the British Empire](#) | [Cream \(band\) members](#) | [Delaney & Bonnie & Friends members](#) | [Derek and the Dominos members](#) | [English autobiographers](#) | [English blues guitarists](#) | [English blues musicians](#) | [English blues singers](#) | [English buskers](#) | [English Christians](#) | [English male singers](#) | [English people of Canadian descent](#) | [English rock guitarists](#) | [English rock singers](#) | [English singer-songwriters](#) | [Electric blues musicians](#) | [Grammy Award-winning artists](#) | [Guitar performance techniques](#) | [Ivor Novello Award winners](#) | [Jazz-blues guitarists](#) | [John Mayall & the Bluesbreakers members](#) | [Lead guitarists](#) | [Living people](#) | [People from Guildford \(district\)](#) | [Plastic Ono Band members](#) | [Polydor Records artists](#) | [Reprise Records artists](#) | [Resonator guitarists](#) | [Rock and Roll Hall of Fame inductees](#) | [RSO Records artists](#) | [Silver Clef Awards winners](#) | [Slide guitarists](#) | [Songwriters Hall of Fame inductees](#) | [The Yardbirds members](#) | [The Dirty Mac members](#) | [Warner Bros. Records artists](#)

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Wikidata

- ◉ **Collaboratively edited knowledge base** intended to provide **common source of structured data** for other related projects (e.g., Wikipedia)
 - ◉ **12 M** data items
 - ◉ started in **2012**



<http://www.wikidata.org>

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Eric Clapton (Q48187)

[\[edit\]](#)

English musician, singer, songwriter, and guitarist

[\[edit\]](#)

Also known as:

[\[edit\]](#)

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In other languages

[\[edit\]](#)

	Eric Clapton
Deutsch	englischer Blues- und Rock-Gitarrist und -Sänger
	Also known as: Eric Patrick Clapton Clapton Slowhand
	No label defined yet
Plattdüütsch	No description defined yet
	Also known as:
	No label defined yet

Wikidata

Statements

sex or gender	<div><div><div></div><div></div><div></div></div><div>male</div><div>[edit]</div></div> <div><div>► 4 references</div><div>[add]</div></div>
discography	<div><div><div></div><div></div><div></div></div><div>Eric Clapton discography</div><div>[edit]</div></div> <div><div>► 1 reference</div><div>[add]</div></div>
Commons category	<div><div><div></div><div></div><div></div></div><div>Eric Clapton ↗</div><div>[edit]</div></div> <div><div>▼ 0 references</div><div>[add reference]</div></div> <div><div>[add]</div></div>
LCNAF identifier	<div><div><div></div><div></div><div></div></div><div>n84222859 ↗</div><div>[edit]</div></div> <div><div>► 2 references</div><div>[add]</div></div>
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member of	<div><div><div></div><div></div><div></div></div><div>Cream</div><div>[edit]</div></div>
	<div>▼ 0 references</div> <div>[add reference]</div>
	<div><div><div></div><div></div><div></div></div><div>The Yardbirds</div><div>[edit]</div></div>
	<div>▼ 0 references</div> <div>[add reference]</div>
	<div>[add]</div>
NDL identifier	<div><div><div></div><div></div><div></div></div><div>00620495 ↗</div><div>[edit]</div></div>
	<div>▼ 0 references</div> <div>[add reference]</div>
	<div>[add]</div>
date of birth	<div><div><div></div><div></div><div></div></div><div>30 March 1945</div><div>[edit]</div></div>
	<div>► 2 references</div>
	<div>[add]</div>
topic's main category	<div><div><div></div><div></div><div></div></div><div>Category:Eric Clapton</div><div>[edit]</div></div>
	<div>▼ 0 references</div> <div>[add reference]</div>

Wikidata

place of birth	<div><div><div></div><div></div><div></div></div><div>Ripley, Surrey</div><div>[edit]</div></div> <div><div>▼ 0 references</div><div>[add reference]</div></div> <div>[add]</div>
instance of	<div><div><div></div><div></div><div></div></div><div>human</div><div>[edit]</div></div> <div><div>► 1 reference</div><div>[add]</div></div>
official website	<div><div><div></div><div></div><div></div></div><div>http://www.ericclapton.com/ ↗</div><div>[edit]</div></div> <div><div>► 1 reference</div><div>[add]</div></div>
image	<div><div><div></div><div></div><div></div></div><div>Eclapton cardiff.jpg ↗</div><div>[edit]</div></div> <div><div>► 1 reference</div><div>[add]</div></div>
Commons gallery	<div><div><div></div><div></div><div></div></div><div>Eric Clapton ↗</div><div>[edit]</div></div> <div><div>► 1 reference</div><div>[add]</div></div>

DBpedia

- ◉ Knowledge base **extracted from Wikipedia**
 - ◉ **4.6 M things** (for English)
 - ◉ **80 M** links to **Wikipedia categories**
 - ◉ **41 M** links to **YAGO categories**
 - ◉ **50 M** owl:sameAs links to **other data sources**
 - ◉ started in **2007**



<http://www.dbpedia.org>

DBpedia

About: [Eric Clapton](#)

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



Eric Patrick Clapton, CBE, (born 30 March 1945) is an English musician, singer and songwriter. He is the only three-time inductee to the Rock and Roll Hall of Fame: once as a solo artist and separately as a member of the Yardbirds and Cream. Clapton has been referred to as one of the most important and influential guitarists of all time.

Property	Value
dbpedia-owl:abstract	<ul style="list-style-type: none">Eric Patrick Clapton, CBE, (born 30 March 1945) is an English musician, singer and songwriter. He is the only three-time inductee to the Rock and Roll Hall of Fame: once as a solo artist and separately as a member of the Yardbirds and Cream. Clapton has been referred to as one of the most important and influential guitarists of all time. Clapton ranked second in Rolling Stone magazine's list of the "100 Greatest Guitarists of All Time" and fourth in Gibson's "Top 50 Guitarists of All Time".In the mid-1960s, Clapton left the Yardbirds to play blues with John Mayall & the Bluesbreakers. Immediately after leaving Mayall, Clapton joined Cream, a power trio with drummer Ginger Baker and bassist Jack Bruce in which Clapton played sustained blues improvisations and "arty, blues-based psychedelic pop." For most of the 1970s, Clapton's output bore the influence of the mellow style of JJ Cale and the reggae of Bob Marley. His version of Marley's "I Shot the Sheriff" helped reggae reach a mass market. Two of his most popular recordings were "Layla", recorded by Derek and the Dominos, another band he formed, and Robert Johnson's "Crossroads", recorded by Cream. Following the death of his son Conor in 1991, Clapton's grief was expressed in the song "Tears in Heaven", which featured in his Unplugged album.Clapton has been the recipient of 17 Grammy Awards, and the Brit Award for Outstanding Contribution to Music. In 2004, he was awarded a CBE at Buckingham Palace for services to music. In 1998, Clapton, a recovering alcoholic and drug addict, founded the Crossroads Centre on Antigua, a medical facility for recovering substance abusers.
dbpedia-owl:activeYearsStartYear	<ul style="list-style-type: none">1962-01-01 (xsd:date)
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dbpedia-owl:associatedBand	<ul style="list-style-type: none">dbpedia:Cream_(band)dbpedia:Eric_Clapton_and_the_Powerhousedbpedia:Delaney_&_Bonniedbpedia:George_Harrisondbpedia:Kate_Bushdbpedia:Sheryl_Crowdbpedia:The_Banddbpedia:The_Beatlesdbpedia:The_Rolling_Stonesdbpedia:Brian_Wilsondbpedia:Elton_Johndbpedia:B.B._Kingdbpedia:Dire_Straitsdbpedia:John_Mayall_&_the_Bluesbreakersdbpedia:Phil_Collinsdbpedia:Roger_Watersdbpedia:Stevie_Ray_Vaughandbpedia:Derek_and_the_Dominosdbpedia:Blind_Faithdbpedia:John_Mayerdbpedia:Mark_Knopfler

DBpedia

dbpedia-owl:background	▪ solo_singer
dbpedia-owl:birthDate	▪ 1945-03-30 (xsd:date)
dbpedia-owl:birthPlace	▪ dbpedia:Surrey ▪ dbpedia:Ripley,_Surrey
dbpedia-owl:birthYear	▪ 1945-01-01 (xsd:date)
dbpedia-owl:genre	▪ dbpedia:Blues ▪ dbpedia:Psychedelic_rock ▪ dbpedia:Rock_music ▪ dbpedia:Blues_rock ▪ dbpedia:Hard_rock
dbpedia-owl:individualisedGnd	▪ 119073102
dbpedia-owl:instrument	▪ dbpedia:Blackie_(guitar)
dbpedia-owl:lccnId	▪ n/84/222859
dbpedia-owl:recordLabel	▪ dbpedia:Warner_Bros._Records ▪ dbpedia:Apple_Records ▪ dbpedia:Polydor_Records ▪ dbpedia:Reprise_Records ▪ dbpedia:Atco_Records ▪ dbpedia:Surfdog_Records ▪ dbpedia:RSO_Records
dbpedia-owl:thumbnail	▪ http://commons.wikimedia.org/wiki/Special:FilePath/Eric_Clapton_2.jpg?width=300
dbpedia-owl:viafId	▪ 46945873
dbpedia-owl:wikiPageExternalLink	▪ http://crossroadsantigua.org/ ▪ http://guitarinternational.com/wpmu/2010/02/26/a-talk-with-lee-dickson-guitar-tech-to-eric-clapton/ ▪ http://muzica.acasa.ro/stiri-muzica/Clapton-si-Winwood-la-Bucuresti-sau-cum-am-ajuns-sa-am-din-nou-credinta-oarba-in-blues ▪ http://whereseric.com/home ▪ http://www.ericclapton.com/ ▪ http://www.free-covers.org/cd-covers/eric-clapton-backless-1978-cd-cover-1335.html ▪ http://www.gibson.com/en-us/Lifestyle/Features/how-to-get-claptons-classic/ ▪ http://www.spoonfed.co.uk/spooners/jhallam-2972/eric-clapton-at-floridita-461/
dbpedia-owl:wikiPageID	▪ 10049 (xsd:integer)
dbpedia-owl:wikiPageRevisionID	▪ 606135391 (xsd:integer)
dbpprop:alias	▪ Slowhand
dbpprop:alternativeNames	▪ Clapton, Eric Patrick; Slowhand
dbpprop:associatedActs	▪ dbpedia:Cream_(band) ▪ dbpedia:Eric_Clapton_and_the_Powerhouse ▪ dbpedia:Delaney_&_Bonnie ▪ dbpedia:George_Harrison ▪ dbpedia:Kate_Bush ▪ dbpedia:Sheryl_Crow ▪ dbpedia:The_Band ▪ dbpedia:The_Beatles ▪ dbpedia:The_Rolling_Stones

DBpedia

dcterms:subject

- category:1945_births
- category:Alumni_of_Kingston_College_(England)
- category:Alumni_of_Kingston_University
- category:Atco_Records_artists
- category:Blind_Faith_members
- category:Blues_rock_musicians
- category:Blues_singer-songwriters
- category:Brit_Award_winners
- category:British_rhythm_and_blues_boom_musicians
- category:Car_collectors
- category:Commanders_of_the_Order_of_the_British_Empire
- category:Cream_(band)_members
- category:Delaney_&_Bonnie_&_Friends_members
- category:Derek_and_the_Dominos_members
- category:Electric_blues_musicians
- category:English_Christians
- category:English_autobiographers
- category:English_blues_guitarists
- category:English_blues_musicians
- category:English_blues_singers
- category:English_buskers
- category:English_male_singers
- category:English_people_of_Canadian_descent
- category:English_rock_guitarists
- category:English_rock_singers
- category:English_singer-songwriters
- category:Eric_Clapton
- category:Grammy_Award-winning_artists
- category:Guitar_performance_techniques
- category:Ivor_Novello_Award_winners
- category:Jazz-blues_guitarists
- category:John_Mayall_&_the_Bluesbreakers_members
- category:Lead_guitarists
- category:Living_people
- category:People_from_Guildford_(district)
- category:Plastic_Ono_Band_members
- category:Polydor_Records_artists
- category:RSO_Records_artists
- category:Reprise_Records_artists
- category:Resonator_guitarists
- category:Rock_and_Roll_Hall_of_Fame_inductees
- category:Silver_Clef_Awards_winners
- category:Slide_guitarists
- category:Songwriters_Hall_of_Fame_inductees
- category:The_Dirty_Mac_members
- category:The_Yardbirds_members
- category:Warner_Bros._Records_artists

DBpedia

rdf:type

- foaf:Person
- <http://schema.org/Person>
- yago:WarnerBros.RecordsArtists
- <http://wikidata.dbpedia.org/resource/Q215627>
- owl:Thing
- <http://schema.org/MusicGroup>
- <http://wikidata.dbpedia.org/resource/Q5>
- dul:Agent
- dul:NaturalPerson
- dbpedia-owl:Agent
- dbpedia-owl:Artist
- dbpedia-owl:MusicalArtist
- dbpedia-owl:Person
- <http://umbel.org/umbel/rc/Artist>
- <http://umbel.org/umbel/rc/MusicalPerformer>
- yago:AlumniOfKingstonUniversity
- yago:Alumnus109786338
- yago:Artist109812338
- yago:Autobiographer109825296
- yago:Biographer109855433
- yago:BluesRockMusicians
- yago:BritishBluesGuitarists
- yago:Busker109883174
- yago:CarCollectors
- yago:CausalAgent100007347
- yago:Collector109936620
- yago:CommandingOfficer109941964
- yago:Communicator109610660
- yago:Creator109614315
- yago:Entertainer109616922
- yago:Guitarist110151760
- yago:Intellectual109621545
- yago:LivingThing100004258
- yago:MilitaryOfficer110317007
- yago:Musician110339966
- yago:Musician110340312
- yago:Object100002684
- yago:Organism100004475
- yago:Performer110415638
- yago:Person100007846
- yago:Scholar110557854
- yago:Serviceman110582746
- yago:Singer110599806
- yago:SkilledWorker110605985
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- yago:Yagol:AgentGoo

DBpedia

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DBpedia

is dbpedia-owl:composer of	<ul style="list-style-type: none"> dbpedia:Edge_of_Darkness
is dbpedia-owl:formerBandMember of	<ul style="list-style-type: none"> dbpedia:Cream_(band) dbpedia:Eric_Clapton_and_the_Powerhouse dbpedia:Delaney_&_Bonnie dbpedia:Derek_and_the_Dominos dbpedia:Blind_Faith dbpedia:Plastic_Ono_Band dbpedia:The_Dirty_Mac
is dbpedia-owl:musicComposer of	<ul style="list-style-type: none"> dbpedia:The_Story_of_Us_(film) dbpedia:Water_(1985_film) dbpedia:Lethal_Weapon_(film_series) dbpedia:Communion_(1989_film) dbpedia:Rush_(1991_film) dbpedia:Nil_by_Mouth_(film) dbpedia:Wonderwall_(film) dbpedia:The_Van_(1996_film) dbpedia:Live_in_Hyde_Park_(Eric_Clapton_album) dbpedia:Lethal_Weapon dbpedia:Homeboy_(film) dbpedia:The_Hit_(1984_film) dbpedia:Concert_for_George_(film) dbpedia:Lethal_Weapon_2 dbpedia:Lethal_Weapon_3 dbpedia:Lethal_Weapon_4
is dbpedia-owl:musicalArtist of	<ul style="list-style-type: none"> dbpedia:After_Midnight_(song) dbpedia:Lay_Down_Sally dbpedia:I've_Got_a_Rock_'n'_Roll_Heart dbpedia:Willie_and_the_Hand_Jive dbpedia:Tears_in_Heaven dbpedia:Wonderful_Tonight dbpedia:Forever_Man dbpedia:Bad_Love_(Eric_Clapton_song) dbpedia:My_Father's_Eyes_(song) dbpedia:I_Shot_the_Sheriff dbpedia:Dirty_City dbpedia:Cocaine_(song)___Cocaine__1 dbpedia:Layla dbpedia:Change_the_World dbpedia:I_Can't_Stand_It dbpedia:Tearing_Us_Apart dbpedia:It's_Probably_Me dbpedia:Behind_the_Mask_(Yellow_Magic_Orchestra_song)___Behind_the_Mask__3
is dbpedia-owl:musicalBand of	<ul style="list-style-type: none"> dbpedia:After_Midnight_(song) dbpedia:Lay_Down_Sally dbpedia:I've_Got_a_Rock_'n'_Roll_Heart dbpedia:Willie_and_the_Hand_Jive dbpedia:Tears_in_Heaven


Freebase



- **Collaboratively edited knowledge base** which includes information extracted from other data sources (e.g., Wikipedia, MusicBrainz)
- **44 M topics** (organized into domains)
- **2.4 B facts**
- focused on entertainment
- many topics without textual data
- started in **2007**, acquired by Google in **2010**
- forms the core of the **Google Knowledge Graph**

<http://www.freebase.com>

Freebase



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[Sign In or Sign Up](#) [English](#)

Topic



Eric Clapton^{en}

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

Eric Patrick Clapton, CBE, is an English musician, singer-songwriter and guitarist. He is the only three-time inductee to the Rock and Roll Hall of Fame: once as a solo artist and separately as a member of the Yardbirds and Cream. Clapton has been referred to as one of the most important and influential guitarists of all time. Clapton ranked second in Rolling Stone magazine's list of the "100 Greatest Guitarists of All Time" and fourth in Gibson's "Top 50 Guitarists of All Time". He was also named number five in Time magazine's list of "The 10 Best Electric Guitar Players" in 2009. In the mid-1960s, Clapton left the Yardbirds to play blues with John Mayall & the Bluesbreakers. Immediately after leaving Mayall, Clapton joined Cream, a power trio with drummer Ginger Baker and bassist Jack Bruce in which Clapton played sustained blues improvisations and "arty, blues-based psychedelic pop". For most of the 1970s, Clapton's output bore the influence of the mellow style of JJ Cale and the reggae of Bob Marley. His version of Marley's "I Shot the Sheriff" helped reggae reach a mass market. [-]

Properties

118n

Keys

Links



Filter options: ☐ Show all domains and properties

Common /common

Freebase Commons

Topic /common/topic

X

Also known as

/common/topic/alias

Also known as

Clapton, Eric

Eric Clapton

Eric Patrick Clapton

eric_clapton

Slow Hand

God

Derek and the Dominoes

Blind Faith

The Yardbirds

Types:

Common

Topic

Film

Film music contributor

Film actor

Person or entity appearing in film

Music

Musical Artist

Musician

Record Producer


Composer

Guitarist

Songwriter

Lyricist

Freebase

<div>Image /common/topic/image</div> <div></div> <div>Official website /common/topic/official_website</div> <div>http://www.ericclapton.com/</div> <div>Topic equivalent webpage /common/topic/topic_equivalent_webpage</div> <div>Topic equivalent webpage ▾</div> <div>http://www.nytimes.com/top/reference/timestopics/people/c/eric_clapton</div> <div>http://www.nndb.com/people/670/000024598/</div> <div>http://www.imdb.com/name/nm0002008/</div> <div>http://www.myspace.com/ericclapton</div> <div>http://www.tvrage.com/person/id-64649</div> <div>http://www.netflix.com/RoleDisplay/17288</div> <div>http://it.wikipedia.org/wiki/index.html?curid=102202</div> <div>http://es.wikipedia.org/wiki/index.html?curid=49785</div> <div>http://de.wikipedia.org/wiki/index.html?curid=92491</div> <div>http://pt.wikipedia.org/wiki/index.html?curid=73685</div> <div>114 values total »</div> <div>Social media presence /common/topic/social_media_presence</div> <div>Social media presence ▾</div> <div>http://www.facebook.com/ericclapton</div> <div>http://www.twitter.com/EricClaptonNews</div> <div>Topical webpage /common/topic/topical_webpage</div> <div>Topical webpage ▾</div> <div>http://www.whereseric.com/</div> <div>http://www.discogs.com/artist/Eric+Clapton</div> <div>http://musicmoz.org/Bands_and_Artists/C/Clapton,_Eric/</div> <div>http://whereseric.com/</div> <div>http://lyrics.wikia.com/Eric_Clapton</div> <div>http://decoda.com/eric-clapton-lyrics</div> <div>http://www.lyrics.com/100-150/9528/eric-clapton-lyrics.html</div>	<div>TV Personality</div> <div>Broadcast</div> <div>Broadcast Artist</div> <div>People</div> <div>Person</div> <div>Measured person</div> <div>Internet</div> <div>Social network user</div> <div>Organization</div> <div>Organization founder</div> <div>Media</div> <div>Author</div> <div>Awards</div> <div>Award Nominee</div> <div>Award Winner</div> <div>Hall of fame inductee</div> <div>Ranked item</div> <div>Influence</div> <div>Influence Node</div> <div>Celebrities</div> <div>Celebrity</div>
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Freebase

Film /film

Freebase Commons

Film music contributor /film/music_contributor

X

Film music credits /film/music_contributor/film

Film music credits

Nil by Mouth

Rush

Water

Lethal Weapon 2

Wonderwall

Lethal Weapon 4

Lethal Weapon

Lethal Weapon 3

Homeboy

The Van

14 values total »

Film actor /film/actor

X

Film performances /film/actor/film

Film	Character	Special Performance Type	Character note
Sweet Toronto	-	-	-
The Cream of Eric Clapton	-	-	-
The Very Best of Cher: The Video Hits Collection	-	-	-
Tommy	The Preacher	-	-
Hail! Hail! Rock 'n' Roll	-	-	-
Water	-	-	-
The Rolling Stones Rock and Roll Circus	-	-	-
Concert for George	-	-	-
Blues Brothers 2000	The Louisiana Gator Boys member #4	-	-
Cucumber Castle	-	-	-
52 values total »			

Freebase

Music /music

Freebase Commons

Musical Artist /music/artist

X

Musical Genres /music/artist/genre

Musical Genres

Blues

Rock music

Blues rock

Pop rock

Hard rock

Psychedelic rock

Reggae

Soft rock

Place Musical Career Began /music/artist/origin

London

Albums /music/artist/album

Albums

The Early Clapton Collection

Eric Clapton

Eric Clapton's Rainbow Concert

461 Ocean Boulevard

There's One in Every Crowd

E.C. Was Here

No Reason to Cry

Slowhand

Backless

Just One Night

224 values total »

Record Labels /music/artist/label

Record Labels

Warner Bros. Records

Apple Records

Freebase

Musician /music/group_member X			
Member of /music/group_member/membership			
Group ▾	Roles ▾	Period (start) ▾	Period (end) ▾
Derek and the Dominos	Vocals	1970	1971
	Lead guitar		
John Mayall & the Bluesbreakers	Guitar	1965 April	1966 July
Blind Faith	Guitar	1968	1969 October
	Vocals		
The Yardbirds	Guitar	1963 October	1965
Cream	Guitar	1966	1968
	Vocals		
The Plastic Ono Band	Lead guitar	1969	1969
Delaney & Bonnie and Friends	-	-	-
Sting with Eric Clapton	-	-	-
The Dirty Mac	-	-	-
Eric Clapton & The Powerhouse	-	-	-
14 values total »			
Artists supported /music/group_member/artists_supported			
-			
Instruments Played /music/group_member/instruments_played			
Instruments Played ▾			
Guitar			
Slide guitar			
Piano			
Mandolin			
Vocal Range /music/group_member/vocal_range			
-			

Record Producer /music/producer X	
-----------------------------------	--

Freebase

People /people

Freebase Commons

Person /people/person

X

Date of birth /people/person/date_of_birth

✓ 2013-12-05

3/30/1945

Place of birth /people/person/place_of_birth

✓ 2013-12-12

Ripley

Country of nationality /people/person/nationality

✓ 2014-02-10

England

Gender /people/person/gender

✓ 2013-12-05

Male

Profession /people/person/profession

Profession ▾

Guitarist

Singer-songwriter

Musician

Composer

Artist

Actor

Record producer

Film Producer

Television producer

Film Score Composer

11 values total »

Religion /people/person/religion

-

Ethnicity /people/person/ethnicity

-

Parents /people/person/parents

YAGO

- ◉ **Knowledge base** extracted from Wikipedia, WordNet, and GeoNames
 - ◉ **10 M** named entities
 - ◉ **120 M** facts
 - ◉ **72 relation types** with manually assessed accuracy (95%)
 - ◉ started in **2007**



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

YAGO

Browse YAGO2

Search: eng ↕

<Eric_Clapton>

← <Pattie_Boyd>

<isMarriedTo>

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<Abbey_Road>
<Abe_Laboriel,_Jr.>
<A_Boxful_of_Treasures>
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<Alice_Ormsby-Gore>
<Alicia_Witt>
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<All_Things_Must_Pass>
<Almost_Famous>
<Amsterdam_International>

Entity Linking

- Entity linking (aka. “Wikification”) is the process of spotting **mentions of named entities** in a text document, resolving their **ambiguity**, and linking them to known identifiers

Page played his Gibson on Kashmir

- Examples:
 - Wikipedia Miner** (<http://wikipedia-miner.cms.waikato.ac.nz>)
 - AIDA** (<https://gate.d5.mpi-inf.mpg.de/webaida/>)

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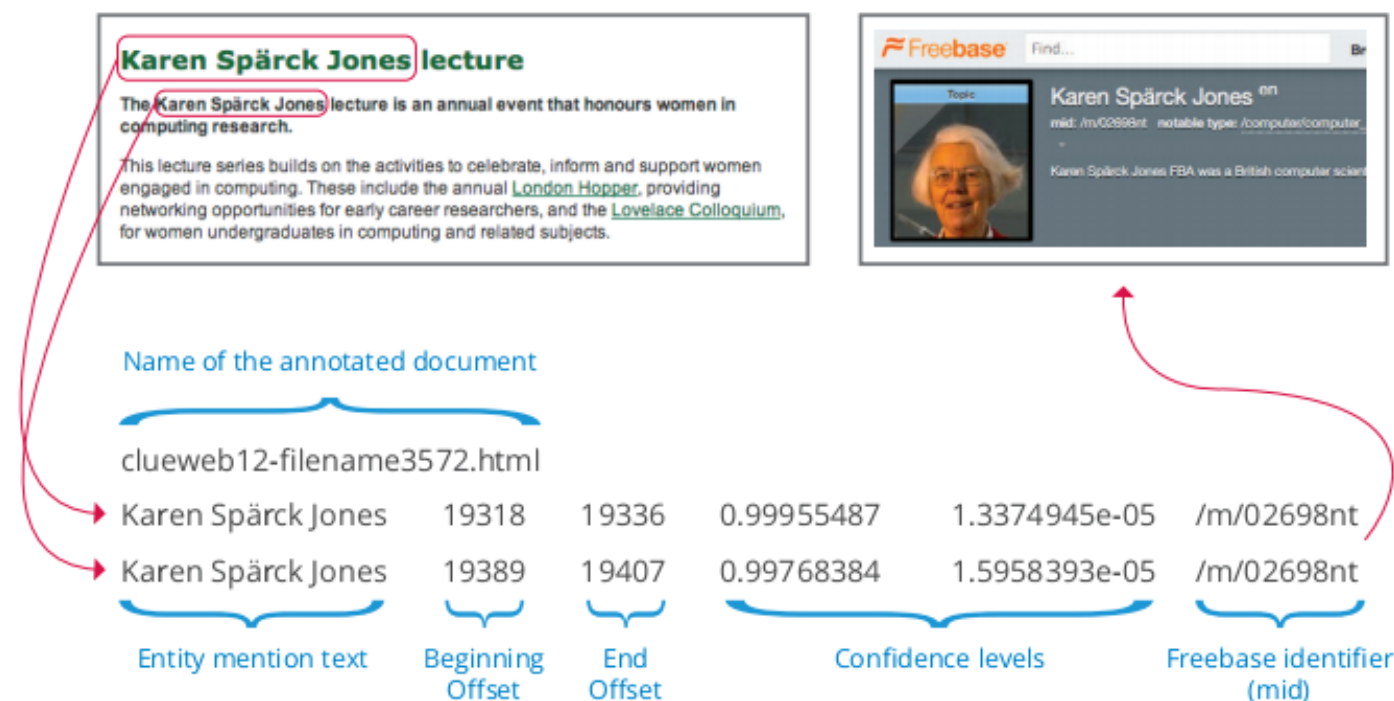
Page played his Gibson on Kashmir



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Google Freebase Annotations

- **ClueWeb09/12** are large-scale collections of web documents (**1 B web pages**) often used in Information Retrieval research



- Google has annotated these collections with Freebase topics (<http://googleresearch.blogspot.de/2013/03/learning-....html>)

Semantic Search

- **Semantic search** includes a **wide variety of approaches** (see Trinh and Mika [8] for a comprehensive overview)

Query

Keywords

Keywords
+ Types

Structured
+ Keywords

Structured

Data

Text

Structured

Structured
+ Text

Text
+ Structured

Result

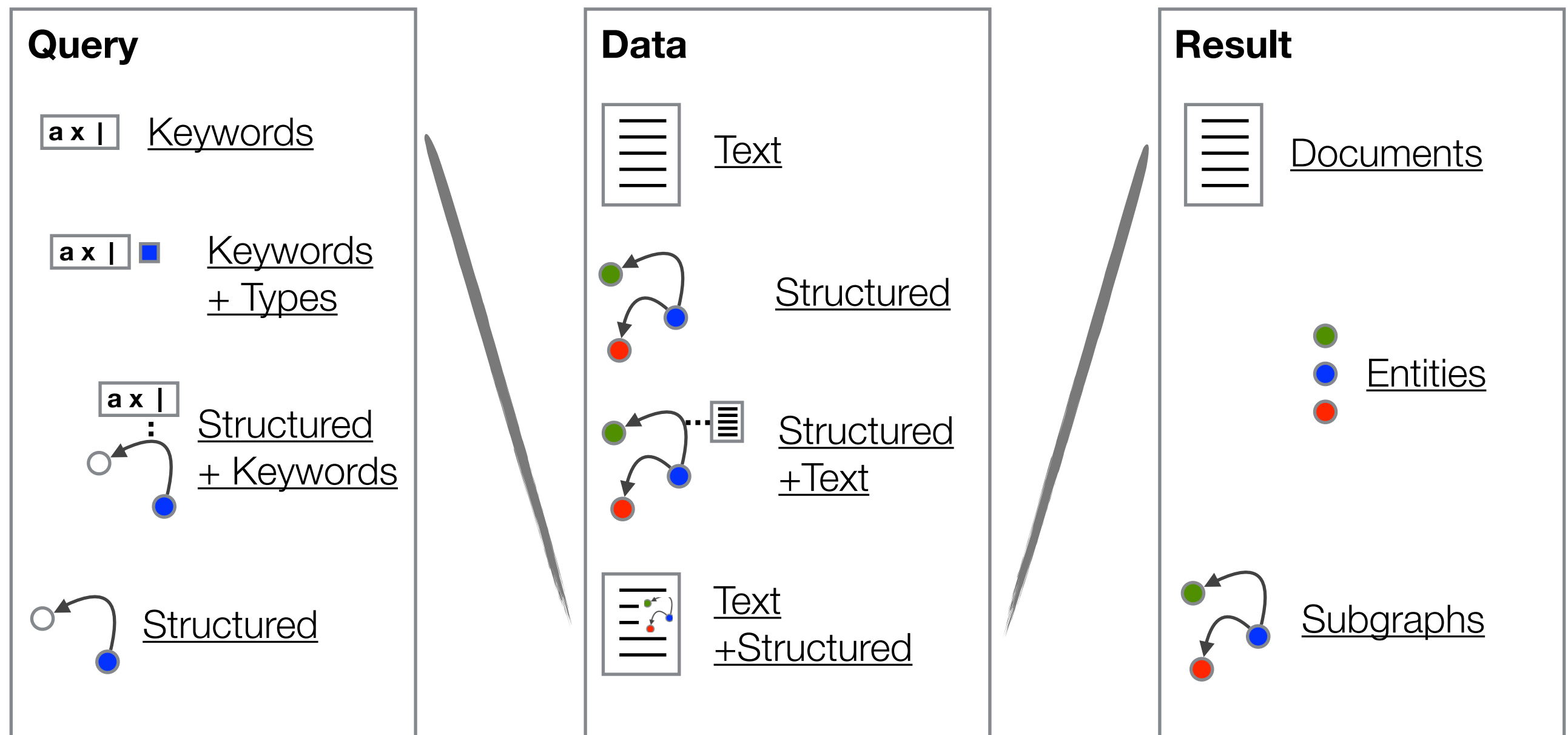
Documents

Entities

Subgraphs

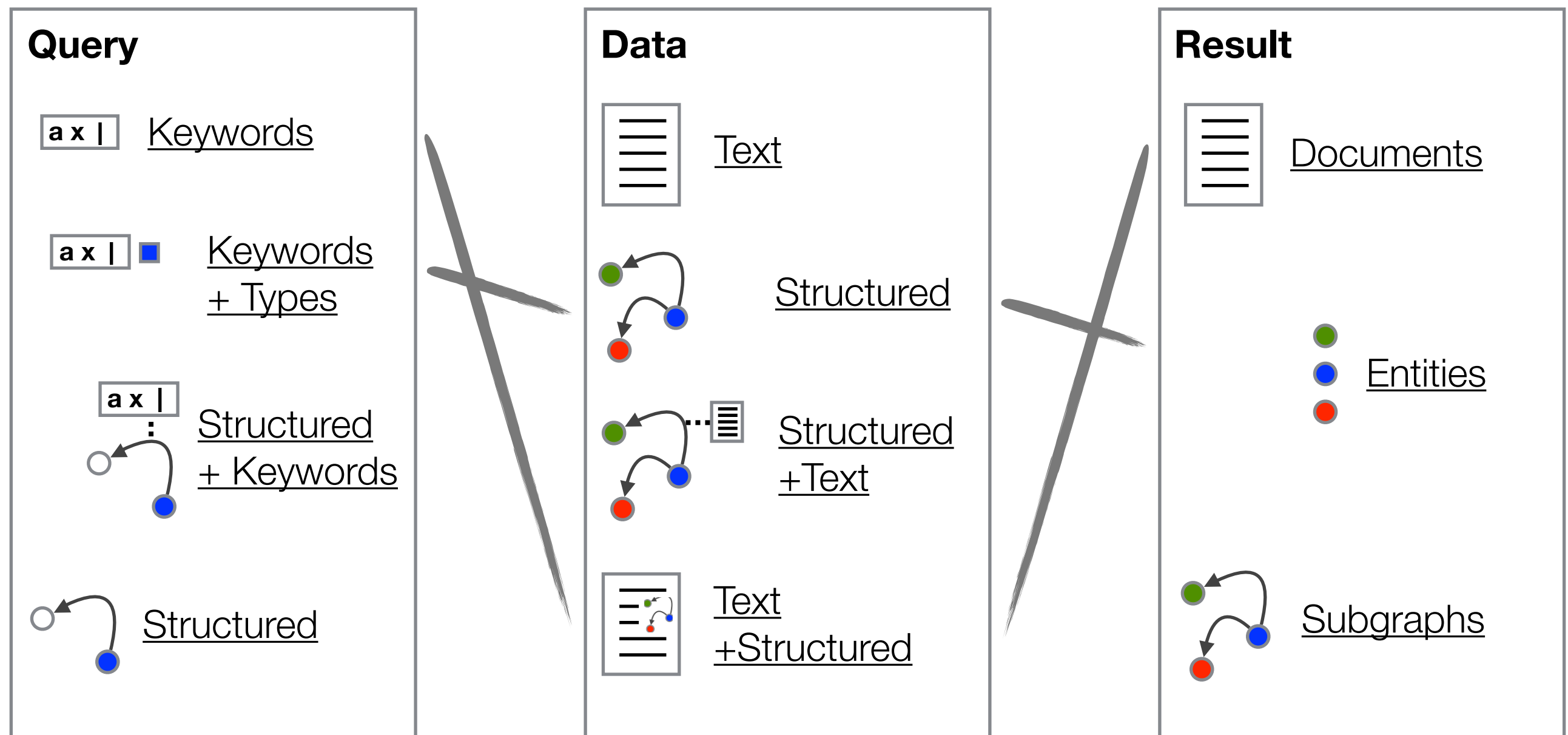
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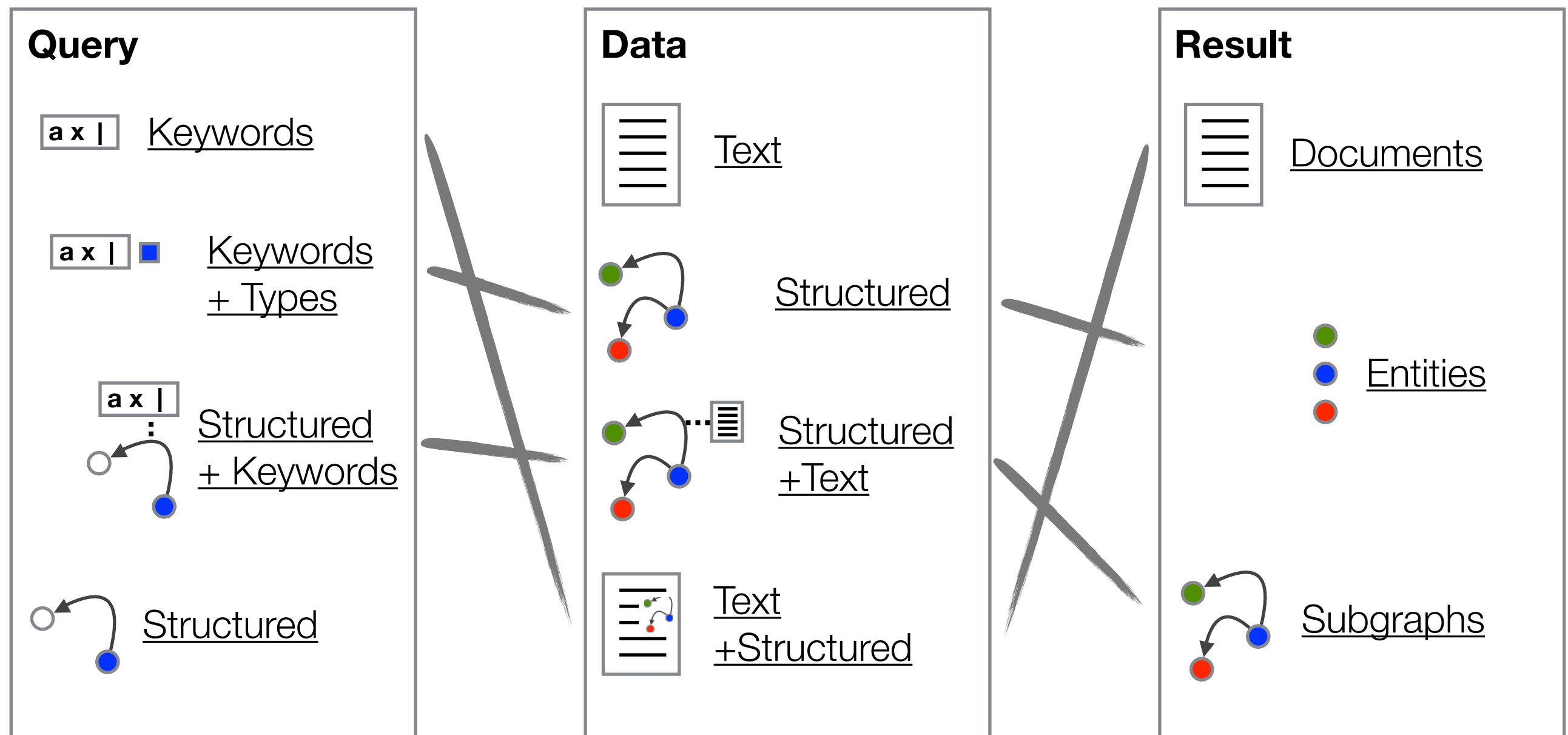
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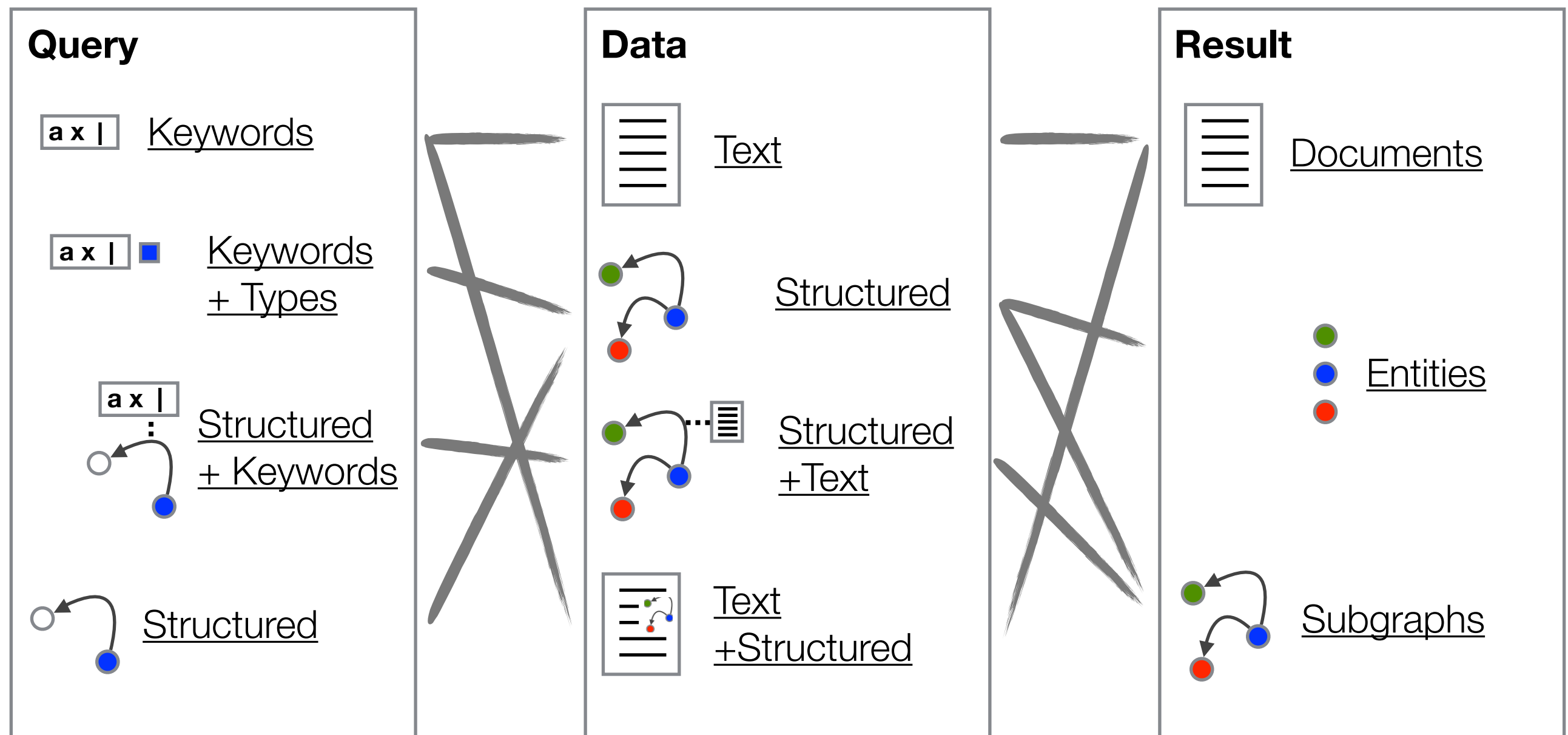
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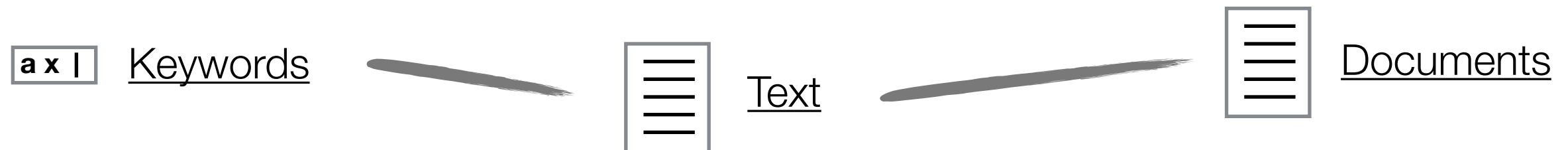


Semantic Search

- ◉ **(More) Semantic Keyword Search** improves **ad-hoc information retrieval** by leveraging knowledge bases (input: keywords, output: list of documents)
- ◉ **Entity Search** retrieves **entities** based on **keyword queries** which may include explicit/implicit **cues about the target type** (input: keywords + types, output: list of entities)
- ◉ **Knowledge Search** retrieves **subgraphs** as answers to **structured queries** which may be **augmented with keywords** (input: structured + keywords, output: list of subgraphs)

3. (More) Semantic Keyword Search

- **(More) Semantic Keyword Search** improves **ad-hoc information retrieval** by leveraging knowledge bases
(input: keywords, output: list of documents)



Explicit Semantic Analysis

- ◉ **Synonymy** (e.g., car/automobile) and **polysemy** (e.g., jaguar as cat, car, guitar) have **negative effects** on retrieval effectiveness
- ◉ Concept-based Information Retrieval **represents queries and documents in terms of (semantic) concepts** instead of terms
 - ◉ **WordNet synsets** after performing **word sense disambiguation**
 - ◉ **Latent concepts** identified based on **word co-occurrences** (e.g., latent semantic analysis applies SVD to term-document matrix)
- ◉ Egozi et al. [4] represent queries and documents in terms of **knowledge base concepts** (in their case from Wikipedia)

Words in Terms of Concepts

- **Explicit Semantic Analysis** (ESA) represents words (e.g., jaguar) in terms of the Wikipedia concepts that they describe (e.g., JAGUAR, JAGUAR_CARS, JAGUAR_XK, FENDER_JAGUAR)
- Step 1: Construct **tf.idf vectors for Wikipedia concepts** based on the text of their corresponding article

FENDER_JAGUAR

guitar:0.8

fender:0.6

strings:0.3

amp:0.5

cobain:0.1

JAGUAR_XK

car:0.2

engine:0.3

v8:0.7

fuel:0.4

british:0.2

racing:0.1

Words in Terms of Concepts

- Step 2: **Invert** the **concept vectors** to obtain **word vectors**

car JAGUAR_XK:0.2 PORSCHE_911:0.3 NISSAN_MICRA:0.1 MINI_COOPER:0.4

fuel SHELL:0.2 JAGUAR_XK:0.4 BP:0.4 PORSCHE_911:0.4

fender FENDER_JAGUAR:0.6 ERIC_CLAPTON:0.2 FENDER_STRATOCASTER:0.8

- Similarity of word vectors** (e.g., in terms of their cosine similarity) can be used to find out about **semantic relatedness of words**

Texts in Terms of Concepts

- **Texts** (e.g., documents, passages, queries) can now be represented in the space of concepts by **combining the vectors of contained words**
- For a sequence of words $d = \langle v_1, v_2, \dots, v_n \rangle$ with $w(v_i, d)$ as the **tf.idf weight** of word v_i in d and $w(c, v_i)$ as the **tf.idf weight** of concept c for word v_i construct a vector for d in terms of concepts as

$$w(c, d) = \sum_{v_i \in d} w(c, v_i) \cdot w(v_i, d)$$

ESA-Based Retrieval

- Egozi et al. [4] represent and index **documents as a whole** and their **contained passages** in terms of concepts; the obtained **vectors are truncated**, setting all but the **s** largest components (concepts) to zero
- **Queries** are also represented in terms of concepts; the obtained **query vectors are truncated**, setting all but the **s** largest components (concepts) to zero
- For a document **d** containing passages $\langle p_1, p_2, \dots, p_3 \rangle$ the retrieval score for query **q** is determined as

$$\text{score}(q, d) = \text{sim}(q, d) + \max_i \text{sim}(q, p_i)$$

ESA-Based Retrieval

- Unfortunately, the approach is prone to **topic drift** and **performs worse** (MAP 0.1760) than a word-based retrieval method (MAP 0.2481) on TREC-8 benchmark
- Example: Concepts with high weight for query **estonia economy**
ESTONIA, ECONOMY OF ESTONIA, ESTONIA AT THE 2000 SUMMER OLYMPICS, ESTONIA AT THE 2004 SUMMER OLYMPICS, ESTONIA NATIONAL FOOTBALL TEAM, etc.

Selective ESA-Based Retrieval

- **Pseudo-relevant** and **pseudo-irrelevant** documents identified using a word-based retrieval method yield a better query vector
- Let D_R and D_{NR} be the sets of top-k and bottom-k documents returned; assume D_R as relevant, D_{NR} as irrelevant
- Use **Rocchio's relevance-feedback method** to estimate a better query vector considering pseudo-(ir)relevant documents

$$w(c, q) = \left(\sum_{v \in q} w(c, v) \cdot w(v, q) \right) + \frac{1}{|D_R|} \left(\sum_{d \in D_R} w(c, v) \cdot w(v, d) \right) - \frac{1}{|D_{NR}|} \left(\sum_{d \in D_{NR}} w(c, v) \cdot w(v, d) \right)$$

Fused ESA-Based Retrieval

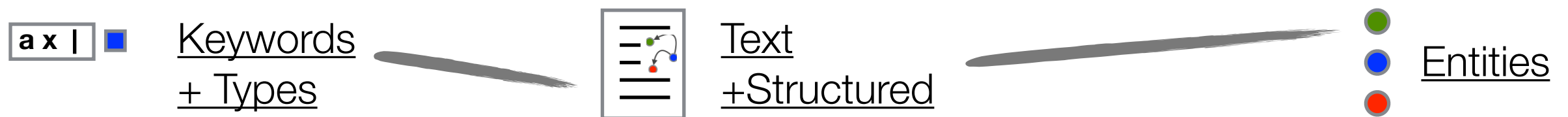
- **Pseudo-relevance feedback helps** (MAP 0.2200) but the approach still performs worse than the baseline (MAP 0.2481)
- **Fusion** of ESA-based results and word-based results beneficial
 - Let R_{ESA} be the results returned by the ESA-based retrieval method
 - Let R_W be the results returned by the word-based retrieval method
 - **Combine their retrieval scores** as

$$\text{score}(d) = \alpha \cdot \frac{\text{score}_{ESA}(d) - \min_{ESA}}{\max_{ESA} - \min_{ESA}} + (1 - \alpha) \cdot \frac{\text{score}_W(d) - \min_W}{\max_W - \min_W}$$

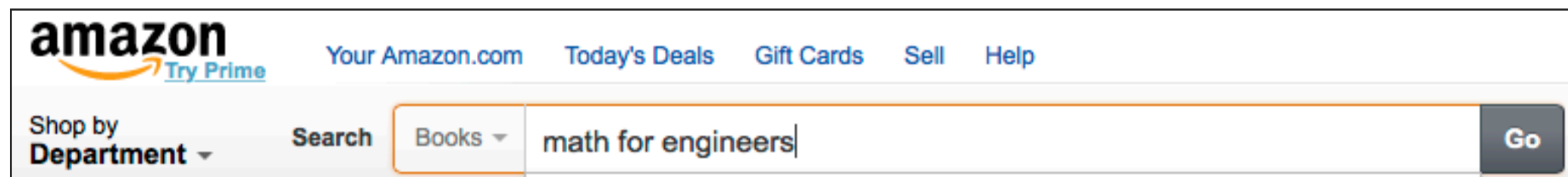
- **Fused approach** (MAP 0.2888) **improves** (+16.4%) over baseline

4. Entity Search

- Entity Search retrieves **entities** based on **keyword queries** which may include explicit/implicit **cues about the target type** (input: keywords + types, output: list of entities)



- Queries for specific entities are **common in web search** (e.g., **museums with van goghs**, **bayern munich players**, etc.)
- Product search with type cues a **common in e-commerce**

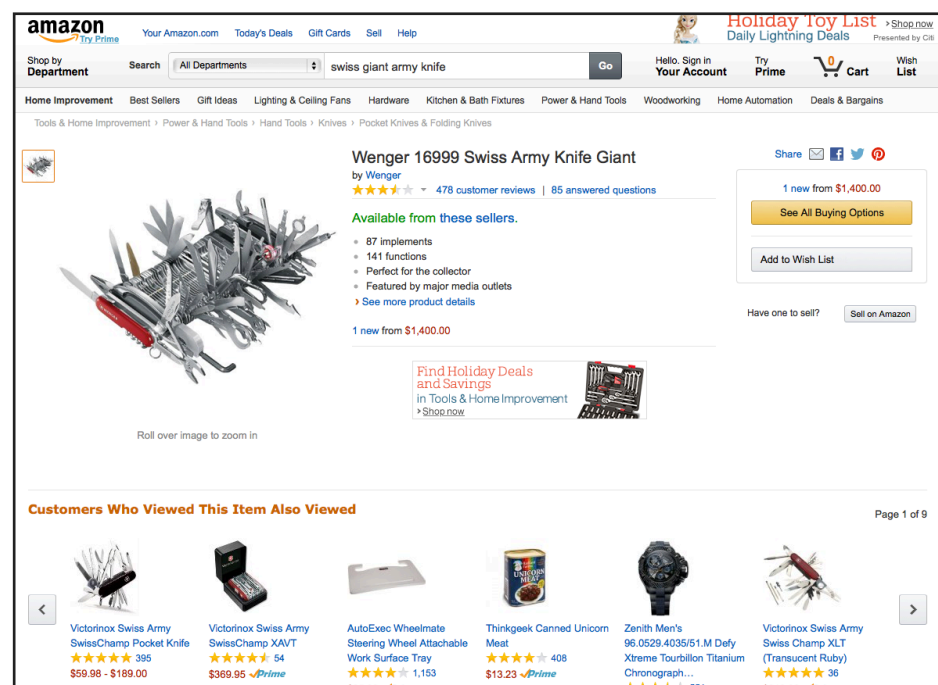


Language Models for Entity Search

- ◉ Balog et al. [1] develop a **language modeling approach**, assuming that entities come with ready-to-use representation:
 - ◉ **a textual description** (e.g., Wikipedia article, IMDB profile, etc.)
 - ◉ **a set of categories** with meaningful names (e.g., `AMERICAN_FILM`)



AMERICAN_FILM, 2002 FILMS,
FILMS ABOUT DRUGS, ...



TOOLS, POCKET KNIVES,
POWER & HAND TOOLS, ...

Language Models for Entity Search

- **Query** $q = (T, C)$ consists of **textual terms** T and **categories** C
- Estimate **language models** θ_q^T and θ_q^C for **query components**
- Estimate **language models** θ_e^T and θ_e^C for **entity components**
- Rank entities for query q according to **query likelihood**

$$P[q | e] = \lambda \cdot P[\theta_q^T | \theta_e^T] + (1 - \lambda) \cdot P[\theta_q^C | \theta_e^C]$$

with probabilities estimated from **Kullback-Leibler divergences**

Language Models for Query Components

- **Heuristic estimation** of probabilities $P[\theta_q|\theta_e]$ from **Kullback-Leibler divergences** to make them comparable and combinable

$$P[\theta_q | \theta_e] = \frac{\max_{e^*} KL(\theta_q || \theta_{e^*}) - KL(\theta_q || \theta_e)}{\sum_{e'} \max_{e^*} KL(\theta_q || \theta_{e^*}) - KL(\theta_q || \theta_{e'})}$$

- Language modeling framework with **various instantiations**, e.g.:
 - estimate θ_q^T from **T** and **C** but ignore θ_q^C (M2)
 - estimate both θ_q^T and θ_q^C from **T** (M3)
 - estimate θ_q^T only from **T** and θ_q^C only from **C** (M4)
 - estimate θ_q^T only from **T** and **C** and θ_q^C only from **C** (M5)

Language Models for Query Components

- Estimate both θ_q^T and θ_q^C from T (M3)

$$P[v | \theta_q^T] = \frac{tf(v, T)}{\sum_{v'} tf(v', T)}$$

$$P[c | \theta_q^C] = \begin{cases} \frac{P[T | c]}{\sum_{c' \in tc(k, T)} P[T | c']} & : c \in tc(k, T) \\ 0 & : \text{otherwise} \end{cases}$$

with $P[T|c]$ as query likelihood of generating T from terms in c
and $tc(k, T)$ as the set of k categories with highest query likelihood

- Estimate θ_q^T only from T and θ_q^C only from C (M4)

$$P[v | \theta_q^T] = \frac{tf(v, T)}{\sum_{v'} tf(v', T)} \quad P[c | \theta_q^C] = \frac{tf(c, C)}{\sum_{c'} tf(c', C)}$$

Language Models for Entity Components

- Language models θ_e^T and θ_e^C for entity components based on maximum-likelihood estimation with **Dirichlet smoothing**

$$P[v \mid \theta_e^T] = \frac{tf(v, e) + \mu^T \cdot \frac{tf(v, E)}{\sum_{v'} tf(v', E)}}{\sum_{v'} tf(v', e) + \mu^T}$$

$$P[c \mid \theta_e^C] = \frac{tf(c, e) + \mu^C \cdot \frac{tf(c, E)}{\sum_{c'} tf(c', E)}}{\sum_{c'} tf(c', e) + \mu^C}$$

with μ^T and μ^C as component-specific smoothing parameters

Language Models for Entity Search

- Example: Query $T = \{\text{Paul Auster novels}\}$ $C = \{\text{NOVELS}\}$

rank	M3 qT-Q	M4 qT-QC
1	The New York Trilogy	In the Country of Last Things
2	Moon Palace	The Winthrop Woman (novel)
3	Brooklyn Follies	Extremely Loud and Incredibly Close
4	In the Country of Last Things	Novel sequence
5	The Book of Illusions	The City and the Pillar
6	Oracle Night	Going After Cacciato
7	The Music of Chance	Raj Quartet
8	Paul Auster	Paul Clifford
9	Fanshawe (novel)	The Age of Reason (Sartre)
10	French literature of the 19th century	The Notebooks of Malte Laurids Brigge

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The New York Trilogy

From Wikipedia, the free encyclopedia

The New York Trilogy is a series of novels by Paul Auster. Originally published sequentially as *City of Glass* (1985), *Ghosts* (1986) and *The Locked Room* (1986), it has since been collected into a single volume.

Contents [hide]

1 Plot introduction

1.1 City of Glass

1.2 Ghosts

1.3 The Locked Room

2 Adaptations

3 Bibliography

4 Notes

5 External links

Plot introduction [edit]

Ostensibly presented as **detective fiction**, the stories of *The New York Trilogy* have been described as "meta-detective-fiction", "anti-detective fiction", "mysteries about mysteries", a "strangely humorous working of the detective novel", "very soft-boiled", a "metamystery" and a "mixture between the detective story and the nouveau roman"^[*citation needed*]. This may classify Auster as a **postmodern** writer whose works are influenced by the "classical literary movement" of American **postmodernism** through the 1960s and 70s^[*citation needed*]. There

The New York Trilogy

Author	Paul Auster
Country	 United States
Language	English
Genre	Mystery novel

Categories: [1987 novels](#) | [Literary trilogies](#) | [Metafictional works](#) | [Mystery novels](#) | [Novel series](#) | [Novels by Paul Auster](#) | [Novels set in New York City](#) | [Faber and Faber books](#)

Language Models for Entity Search

- Example: Query $T = \{\text{Paul Auster novels}\}$ $C = \{\text{NOVELS}\}$

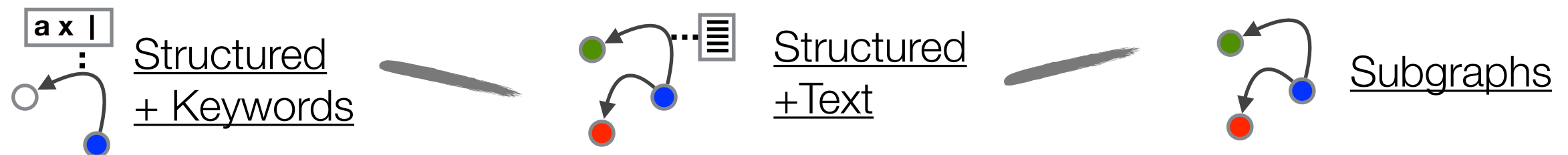
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Categories: [1958 novels](#) | [American historical novels](#) | [Novels by Anya Seton](#) | [Novels set in Massachusetts](#) | [Novels set in the American colonial era](#)

5. Knowledge Search

- Knowledge Search retrieves **subgraphs** as answers to **structured queries** which may be **augmented with keywords** (input: structured + keywords, output: list of subgraphs)



- SPARQL** as a query language for RDF has **some shortcomings**
 - it provides **no meaningful ranking** of query answer subgraphs
 - it assumes that **users know what the data looks like** (i.e., its schema)

Language Models for RDF Graphs

- ◉ Elbassuoni et al. [5] develop a **language modeling approach** for search in RDF graphs, which provides a **ranking of query answers**, and **augments SPARQL/RDF with keywords**

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Query

?p directed **?m** .
?p actedIn **?m** .

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Query

?p directed **?m** .
?p actedIn **?m** .

Answers

Ben_Affleck directed **Argo** .
Ben_Affleck actedIn **Argo** .

Til_Schweiger directed **Der_Eisbär** .
Til_Schweiger actedIn **Der_Eisbär** .

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```


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Query

```
Quentin_Tarantino ?p ?m { movie, vampires, criminals }.
```

Answers

1. Quentin_Tarantino **actedIn From_Dusk_till_Dawn** .

Tarantino
plays criminal
in vampire movie
From Dusk till Dawn

Ranking for RDF Graphs

- Consider **triple pattern query** Q and **matching answer** A

$$Q = \langle q_1, \dots, q_n \rangle \qquad A = \langle a_1, \dots, a_n \rangle$$

- Estimate **language models** over n -tuples of triples for Q and A

$$T = \langle t_1, \dots, t_n \rangle$$

- Assume that a **witness count** $c(t_i)$ is known for every triple t_i which reflects **how often the fact has been mentioned** (e.g., on the Web or in another document collection)

Ben_Affleck directed Argo	122,789
Til_Schweiger directed Der_Eisbär	2,014

Query Language Model

- Query language model θ_Q generates T with probability

$$P[T | \theta_Q] = \prod_{i=1}^n P[t_i | q_i]$$

assuming independence for generation of individual triples t_i

- Triple t_i is generated from triple pattern q_i with probability

$$P[t_i | q_i] = \begin{cases} \frac{c(t_i)}{\sum_{t \in m(q_i)} c(t)} & : t_i \in m(q_i) \\ 0 & : \text{otherwise} \end{cases}$$

with $m(q_i)$ as the **set of triples matching the triple pattern q_i**

Answer Language Model

- **Answer language model** θ_A generates T with probability

$$P[T | \theta_A] = \beta \cdot \left(\prod_{i=1}^n P[t_i | a_i] \right) + (1 - \beta) \cdot \left(\prod_{i=1}^n P[t_i | \theta_{KB}] \right)$$

assuming independence for generation of individual triples t_i
and **smoothing with a knowledge base language model** θ_{KB}

- Triple t_i is generated from **answer triple** a_i with probability

$$P[t_i | a_i] = \mathbb{1}(t_i = a_i)$$

- Triple t_i is generated from **knowledge base** with probability

$$P[t_i | \theta_{KB}] = \frac{c(t_i)}{\sum_{t \in KB} c(t)}$$

Ranking of Query Answers

- ◉ **Divergence-based ranking** of query answers according to

$$KL(\theta_Q || \theta_A) = \log P[T | \theta_Q] \cdot \frac{P[T | \theta_Q]}{P[T | \theta_A]}$$

Augmenting SPARQL/RDF with Keywords

- Users may **not know what the data looks like**, but they can **provide structure**, and are **familiar with keyword querying**

*“New movies by this person
who made that movie
with criminals and vampires”*

- Assume that a **witness count** $c(t_i, w)$ is known for every triple t_i which reflects **how often the corresponding fact** has been **mentioned together with the keyword v**
- Augment** query triple patterns with **sets of keywords w_i**

$$Q = \langle q_1 w_1, \dots, q_n w_n \rangle$$

Augmenting SPARQL/RDF with Keywords

- Users may **not know what the data looks like**, but they can **provide structure**, and are **familiar with keyword querying**

*“New movies by this person
who made that movie
with criminals and vampires”*

?qt ?m ?om { **vampires, criminals** }.
?qt ?m **?nm** { }.

- Assume that a **witness count** $c(t_i, w)$ is known for every triple t_i which reflects **how often the corresponding fact** has been **mentioned together with the keyword v**
- Augment** query triple patterns with **sets of keywords w_i**

$$Q = \langle q_1 w_1, \dots, q_n w_n \rangle$$

Augmented Query Language Model

- Keyword-augmented query model θ_Q generates T with

$$P[T | \theta_Q] = \prod_{i=1}^n P[t_i | q_i w_i]$$

- Triple t_i is generated from triple pattern q_i and keywords w_i with

$$P[t_i | q_i w_i] = \prod_{v \in w_i} (\alpha \cdot P[t_i | q_i v] + (1 - \alpha) \cdot P[t_i])$$

smoothing with uniform probability $P[t_i]$ and $P[t_i | q_i v]$ defined as

$$P[t_i | q_i v] = \begin{cases} \frac{c(t_i, v)}{\sum_{t \in m(q_i)} c(t, v)} & : t_i \in m(q_i) \\ 0 & : \text{otherwise} \end{cases}$$

Ranking of Query Answers

- **Answer language model** θ_A generates T with probability

$$P[T | \theta_A] = \beta \cdot \left(\prod_{i=1}^n P[t_i | a_i] \right) + (1 - \beta) \cdot \left(\prod_{i=1}^n P[t_i | \theta_{KB}] \right)$$

and thus **remains unchanged**

- **Divergence-based ranking** of query answers according to

$$KL(\theta_Q || \theta_A) = \log P[T | \theta_Q] \cdot \frac{P[T | \theta_Q]}{P[T | \theta_A]}$$

Language Models for RDF Graphs

- Example results obtained on Internet Movie Database (IMDb)
- Query 1: *A thriller movie and its director* (structure only)
 1. Batman_Begins, Christopher_Nolan
 2. Murder!, Alfred_Hitchcock
 3. Spider-Man_3, Sam_Raimi
 4. Eyes_Wide_Shut, Stanley_Kubrick
- Query 2: *An award winning director who directed a movie that is based on a {true story}* (structured + keywords)
 1. Martin_Scorsese, Good_fellas
 2. Steven_Spielberg, Schindler's_List
 3. Peter_Jackson, Heavenly_Creatures
 4. Bernando_Bertolucci, Little_Buddha

Summary

- ◉ **Semantic Web** aims at making the Web interpretable for machines; underlying standards include **RDF** and **SPARQL**
- ◉ **Knowledge Bases** provide world knowledge in structured form; have been harvested from Wikipedia and other data sources
- ◉ **Explicit Semantic Analysis** represents queries and documents in terms of concepts; can improve ad-hoc information retrieval
- ◉ **Entity Search** retrieves entities based on keyword queries which may include type cues; applications in web search and business
- ◉ **Knowledge Search** on RDF graphs adds ranking to SPARQL and provides user-friendly querying through keywords

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