

True Knowledge

Using AI to get Answers from the Internet

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ECIR Industry Day

Milton Keynes

1st April 2010

Using AI to get Answers from the Internet

- True Knowledge
 - Who are we
 - What we do
- How it works
 - System architecture
 - Data mining architecture
- Progress
 - Objects, facts, relations and NLP
- Get Involved

Who are we?

- Cambridge based start-up
- 24 people
- 3 1/2 years in business

Simon Overell

- Masters in AI and PhD in IR from Imperial College London
- Data Miner at True Knowledge
- Background in Search, NLP and Data Mining

What is True Knowledge?

An open-domain question answering platform

Semantic Technology

- Patented technology allowing True Knowledge to understand what a query means

Inference Engine

- Combined with strong semantics it is capable of answering trillions of queries including tail queries it has never seen before

Structured Knowledge

- (*continuously growing*) knowledge base of ~235million structured facts

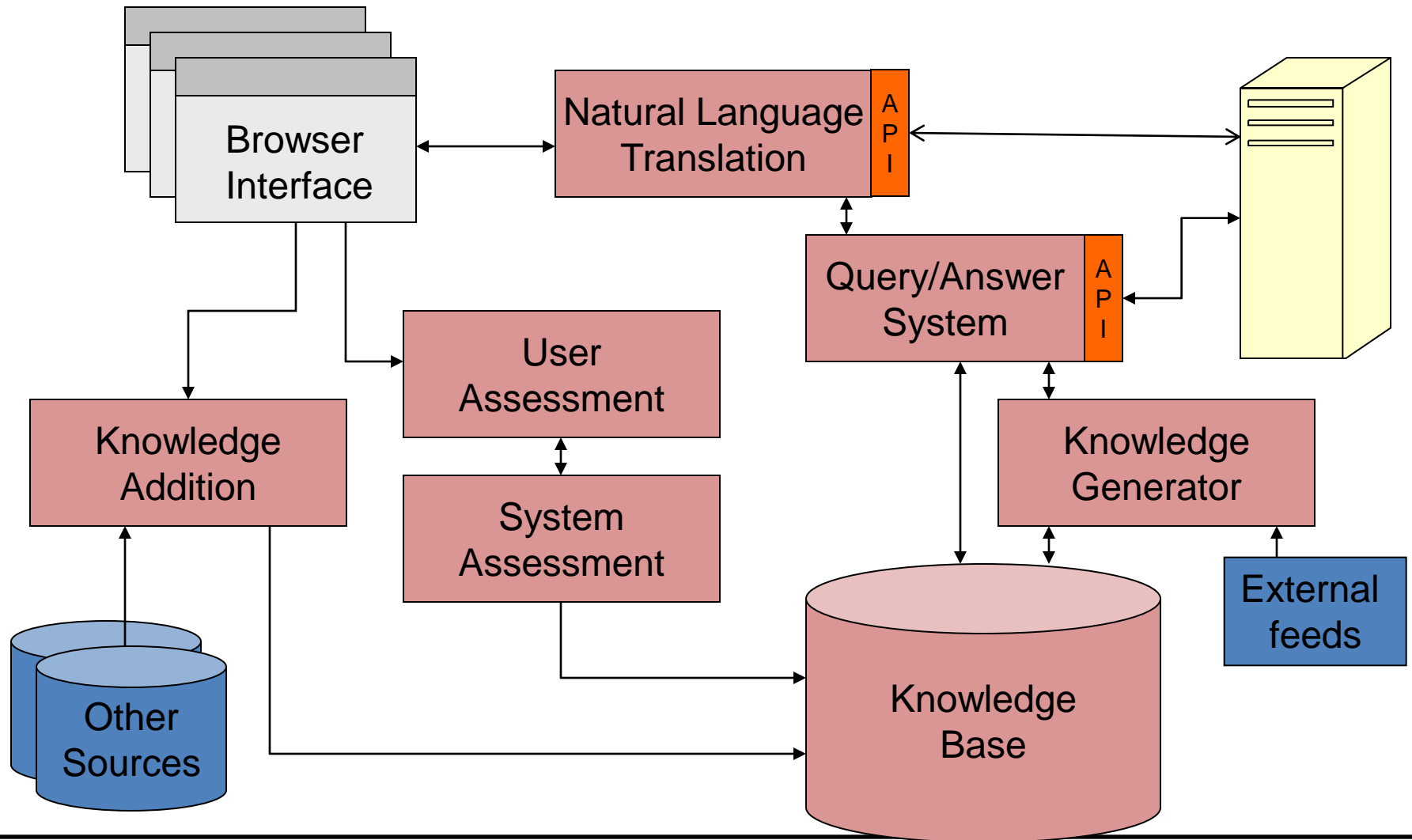
Integration with search

- Reliably answers when it knows, stays quiet when it doesn't

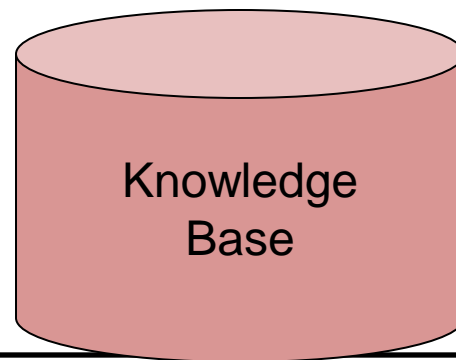


How it works

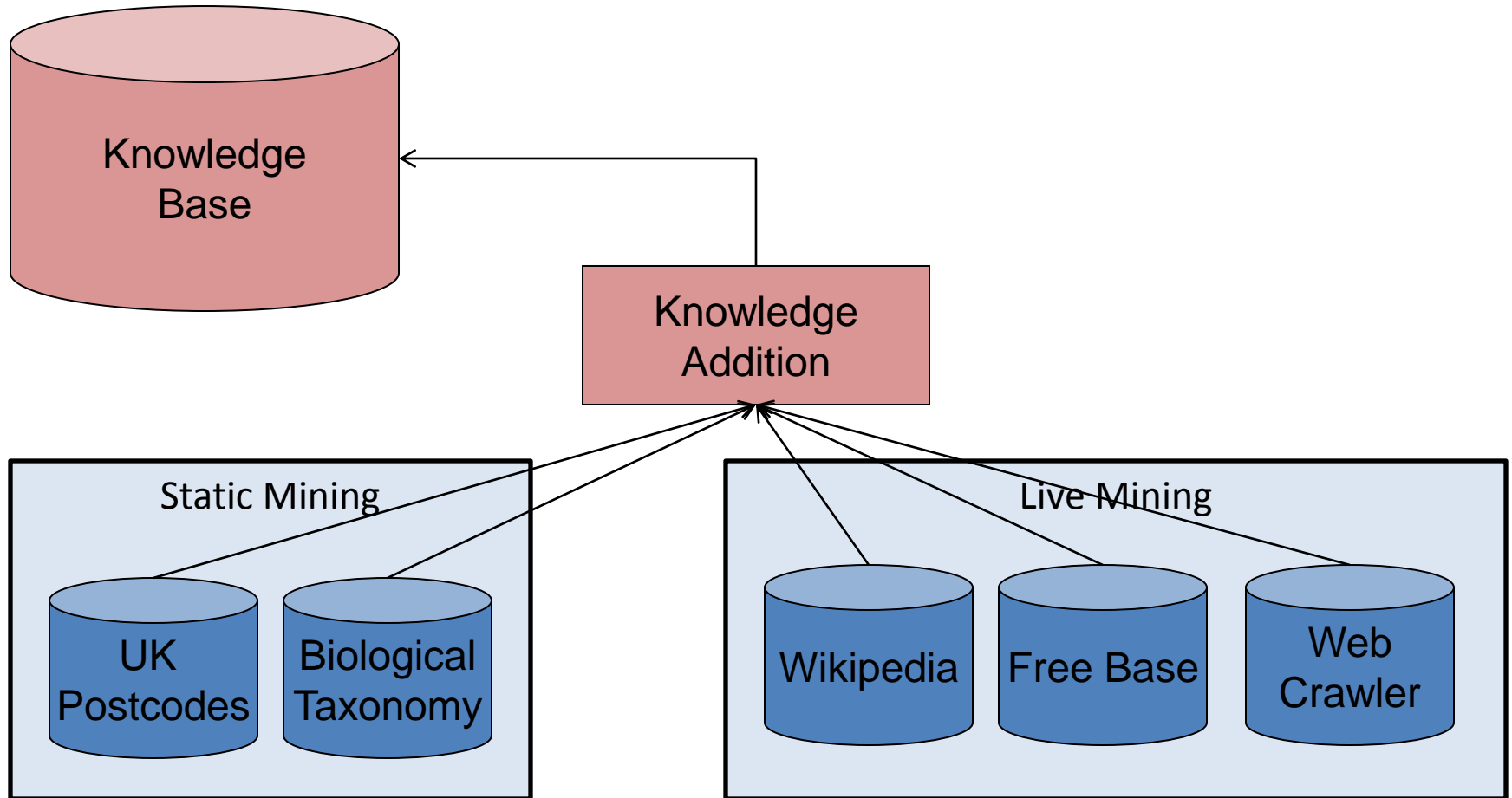
Architecture



Architecture



Architecture – Data Mining



Static Mining Example

The screenshot shows the True Knowledge BETA website interface. At the top left is the logo "True Knowledge BETA". To the right are links for "register" and "sign in". Below the logo is a navigation bar with social media links: "@trueknowledge on Twitter", "True Knowledge on Facebook", "True Knowledge Blog", and "Help/Contact Us".

The main content area features a question: "What would you like to know?" followed by a search box containing "What is the flight time from barcelona to luton?" and a blue "answer" button. Below this, a search result is displayed in a white box with a light blue border. The result includes a small image of Barcelona, the text "1 hour and 30 minutes", and a "Rate this answer" section with "vote up", "vote down", and "report abuse" options. At the bottom of the result box are two advertisements: "Best UK Exchange Rate" and "Trade Stocks & FX Online".

Live Mining Example

The screenshot shows the True Knowledge BETA website interface. At the top, the logo 'True Knowledge BETA' is on the left, and 'register sign in' is on the right. Below the logo is a navigation bar with links for '@trueknowledge on Twitter', 'True Knowledge on Facebook', 'True Knowledge Blog', and 'Help/Contact Us'. The main content area features a search prompt 'What would you like to know?' followed by a search box containing 'List actors who died in 2010' and an 'answer' button. The search results are displayed in a list format, each with a small image, the actor's name, a brief biography, and a 'wikipedia' link. The results include James Mitchell, Ian Carmichael, Howard Zinn, and Grethe Sønck. An advertisement for GFC Markets is also visible, offering a \$50 bonus with no commission and 200:1 leverage. At the bottom of the results list, there is a link to 'show all (55 more)'.

True Knowledge[®] BETA


register sign in


@trueknowledge on Twitter True Knowledge on Facebook True Knowledge Blog Help/Contact Us

What would you like to know?


List actors who died in 2010 ? answer


List actors who died in 2010

 **James Mitchell**
James Mitchell (born February 29, 1920 in Sacramento, California), the American actor and dancer, probably best known for his role as Palmer Cortlandt on the long-running soap opera All My Children
wikipedia

 **Ian Carmichael**
Ian Carmichael OBE (born 16 June 1920), the English film, stage, television and radio actor
wikipedia

START TRADING WITH JUST \$50 • No Commission • 200:1 Leverage [Start Now!](#)
www.GFCmarkets.com **GFC MARKETS** Ads by Google

 **Howard Zinn**
Howard Zinn (born 1922), the historian
wikipedia

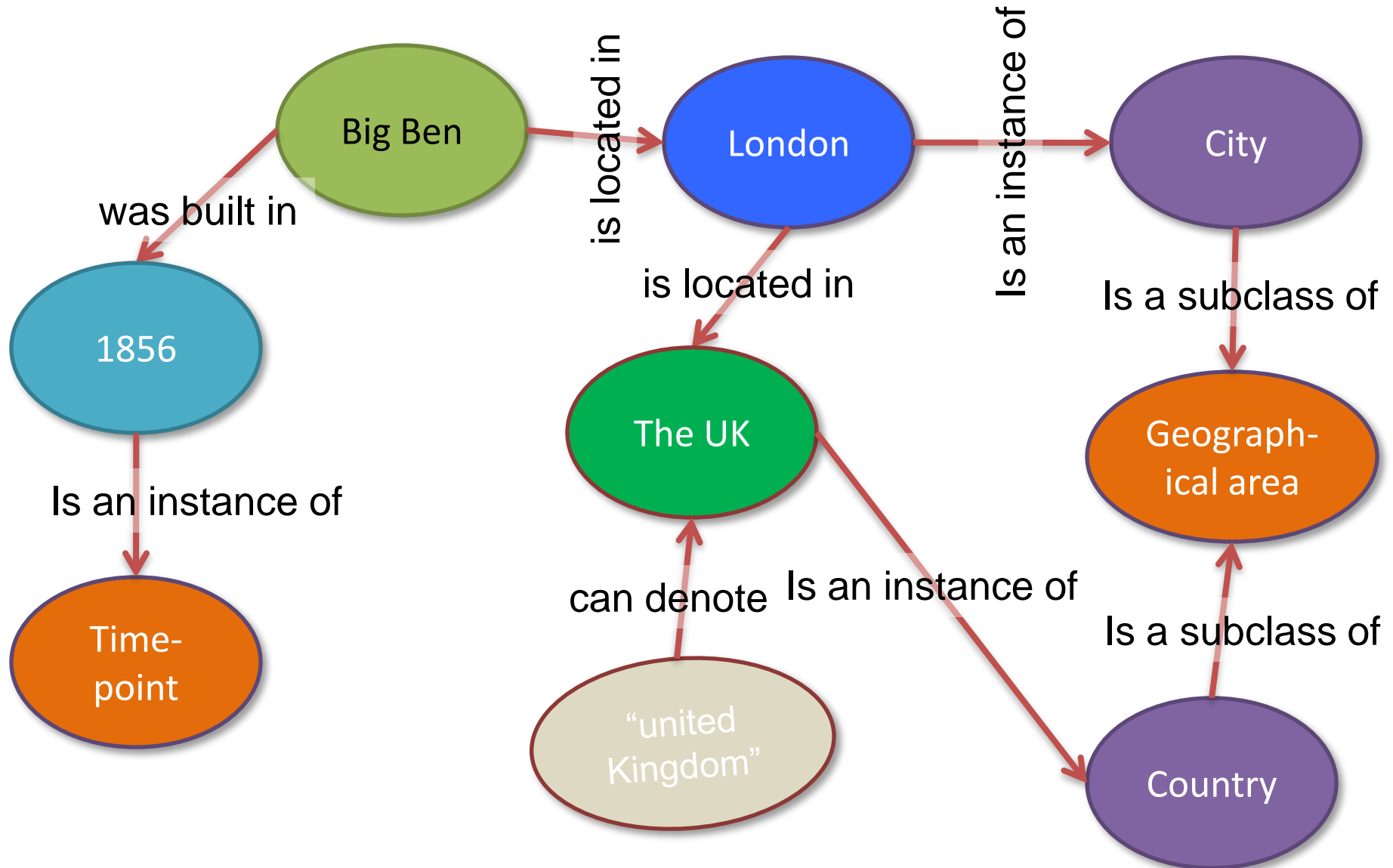
 **Grethe Sønck**
Grethe Sønck (16 July 1929 - February 12 2010), the Danish actress and singer
wikipedia

show all (55 more) ...

Ingredients

- Complete tree of (20k+) classes
 - Every entity is a member of multiple classes
 - Distinctness knowledge known
- Unique Recognition String (URS) for **every** entity
- Disambiguation techniques
- Simple knowledge representation
- Inference

How we represent knowledge (visual)



Reality

- Basic KR is very simple

- Three* field database table:

```
[london] [is an instance of] [city]
```

- Temporal knowledge represented by “facts about facts”

```
[fact: ["123"]] [applies for timeperiod] [<1970 onwards>]
```

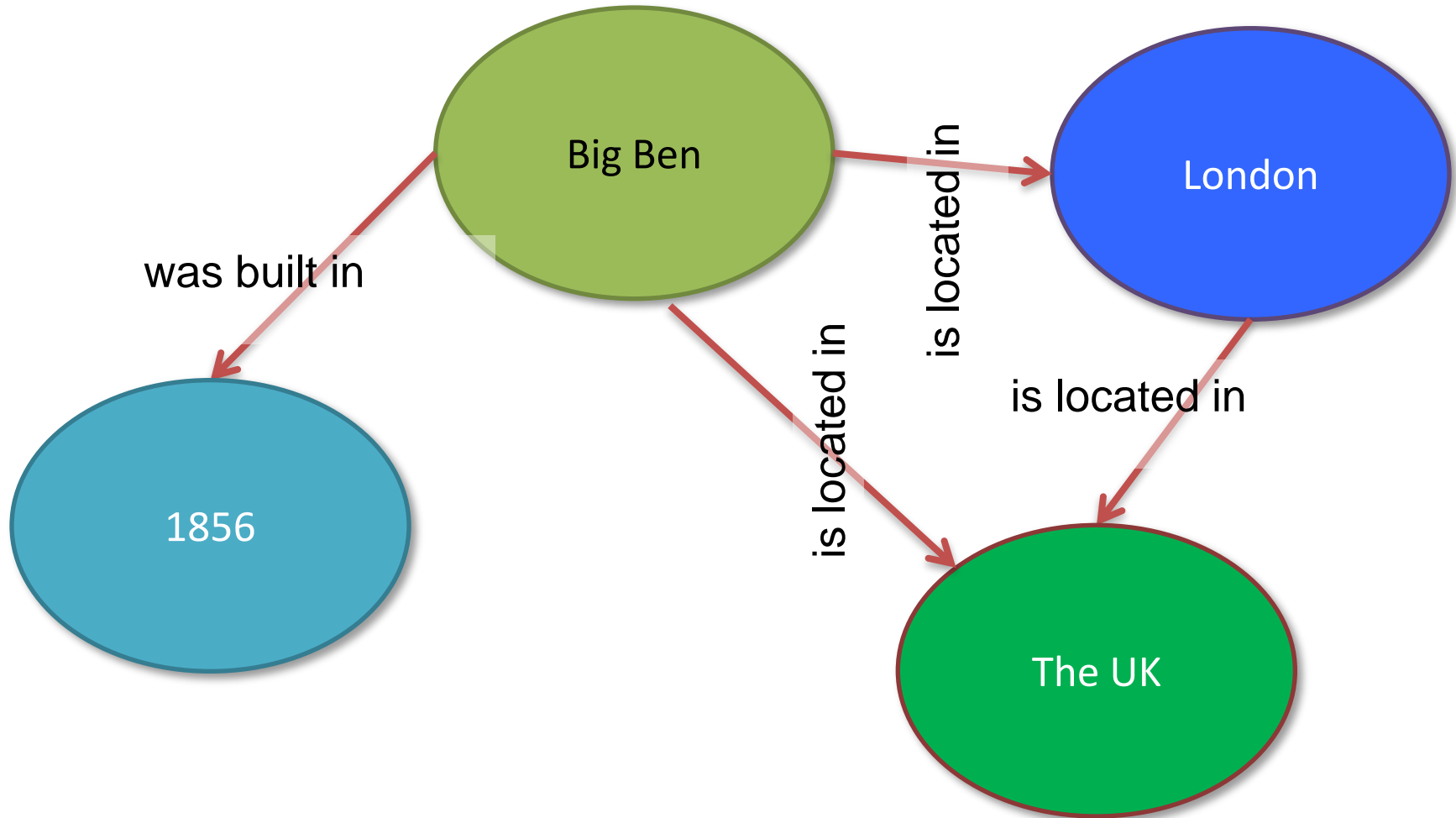
- Richness within entity representation

- “parametered” objects


- [integer: ["8128"]]
- [group: [london]; [san francisco]]

* Actually 4 with negative relation


We use inference to extend knowledge




Inference example



who was us president when joe biden was a teenager Good answer? [Yes](#) [No](#)

John F. Kennedy 
Wikipedia page

Dwight D. Eisenhower 
Wikipedia page

Your question

At the time when ' Joe Biden (born 1942), the American politician was a teenager (a human being between the ages of 13 and 19 inclusive)'who was a US president, the president of the United States of America?

I used the following facts to provide this answer:

Joe Biden is a human being - [agree](#) / [disagree](#)

November 20th 1942 is the birthdate of Joe Biden - [agree](#) / [disagree](#)

John F. Kennedy has been a US president between January 20th 1961 and November 22nd 1963 - [agree](#) / [disagree](#)

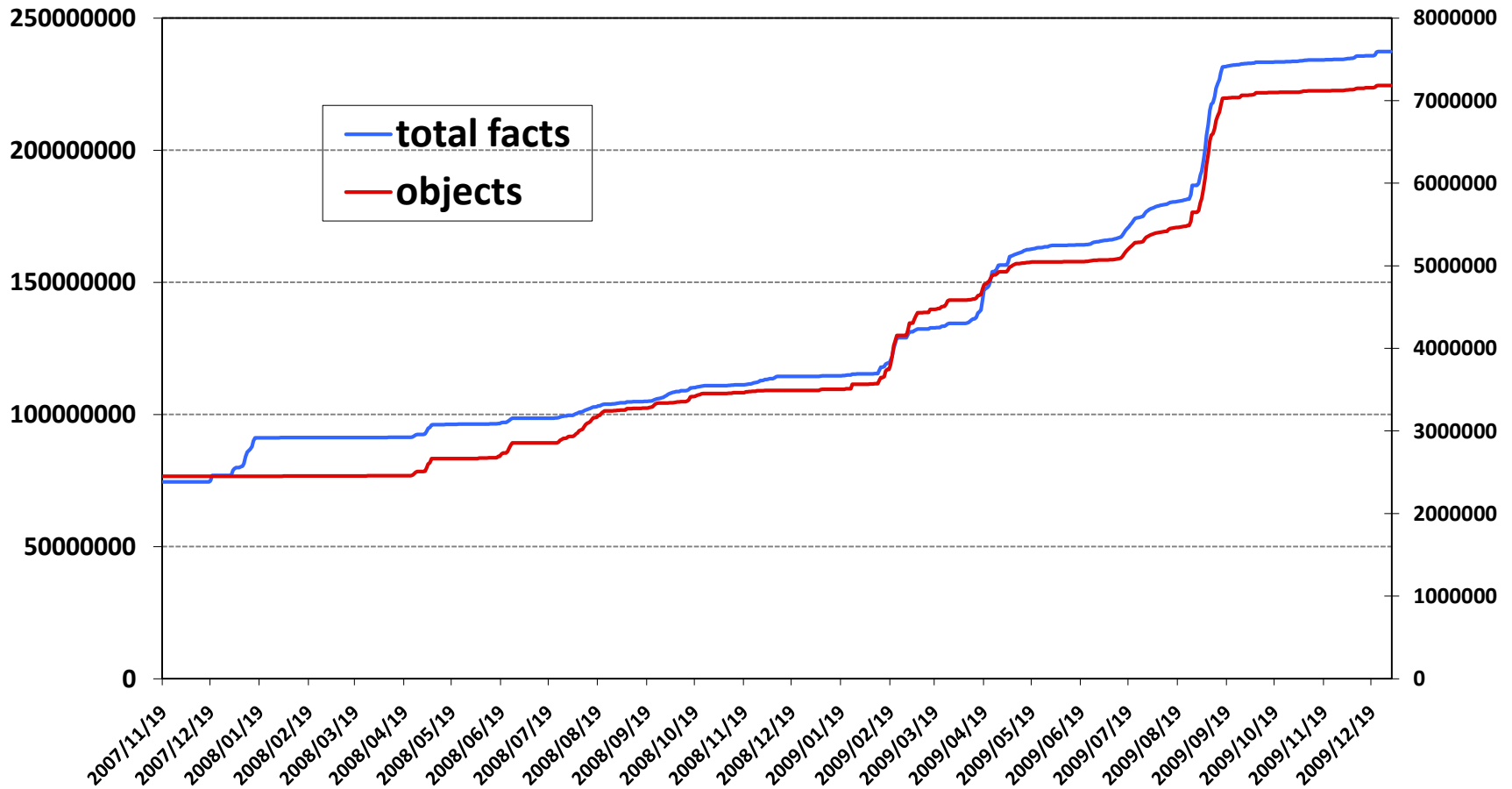
Dwight D. Eisenhower has been a US president between January 20th 1953 and January 20th 1961 - [agree](#) / [disagree](#)

[Show a detailed explanation](#)

Progress

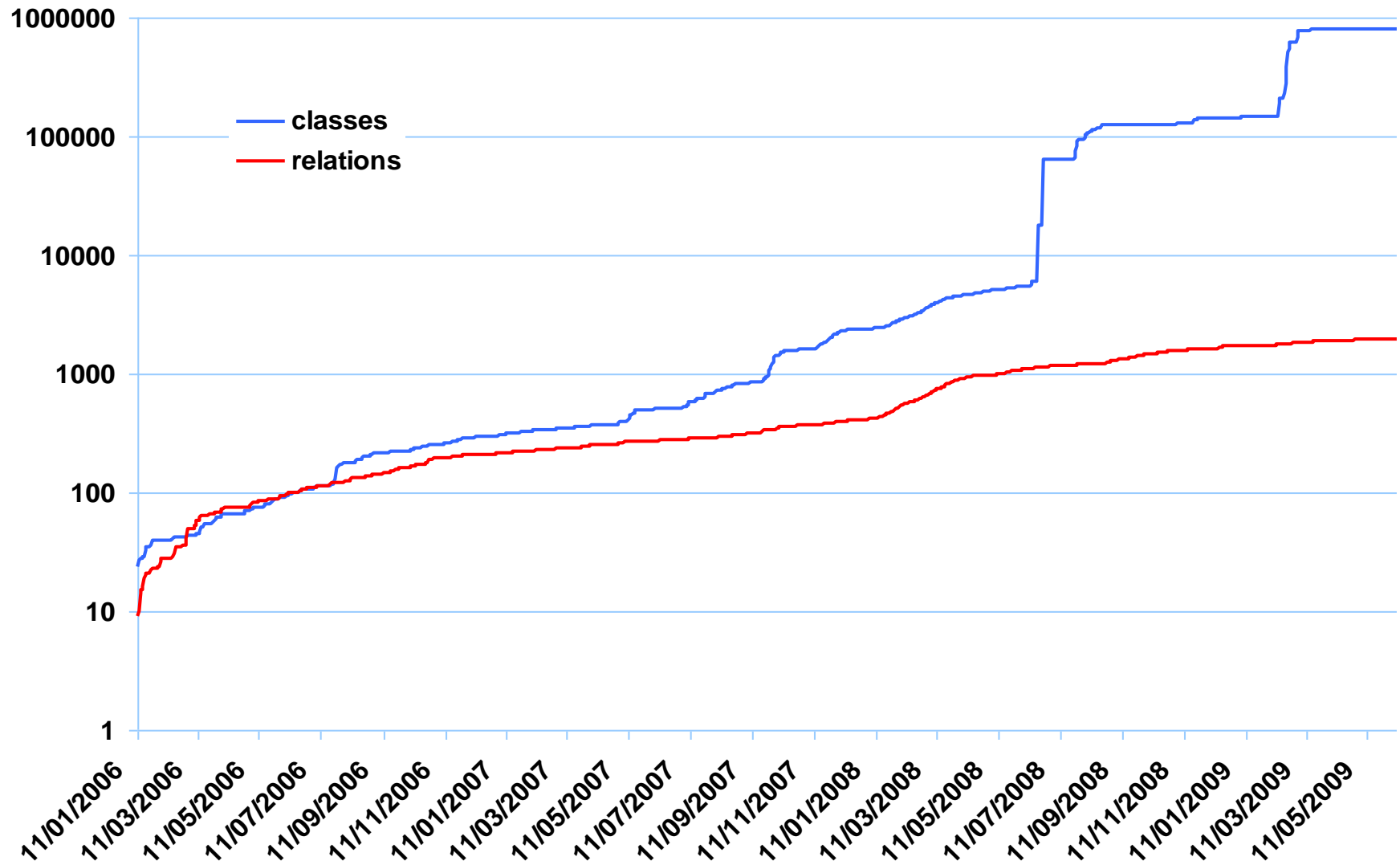


Successfully built Knowledge Base

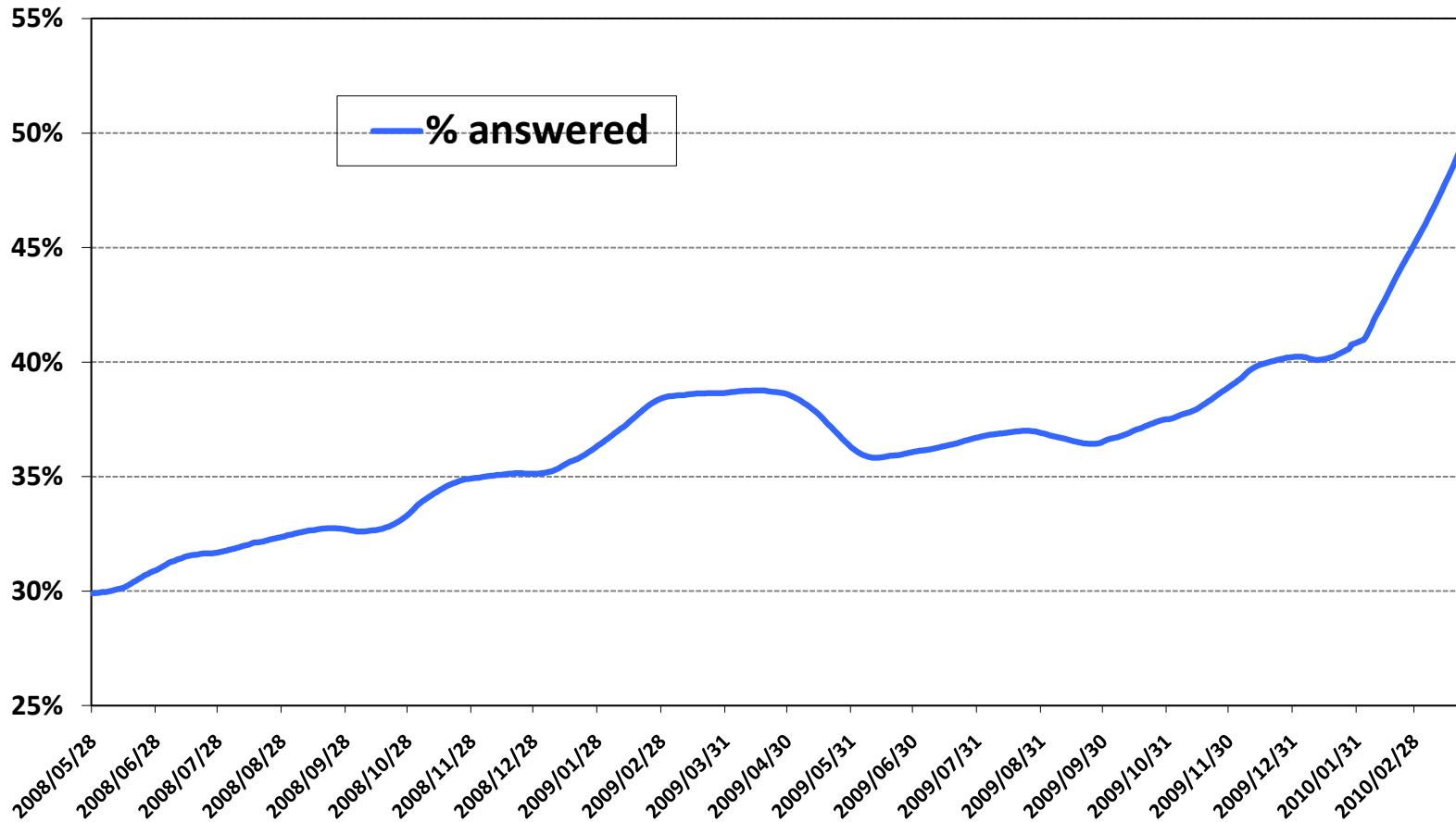


Representation of the growth of both facts and objects in the True Knowledge Knowledge Base

Number of relations and classes

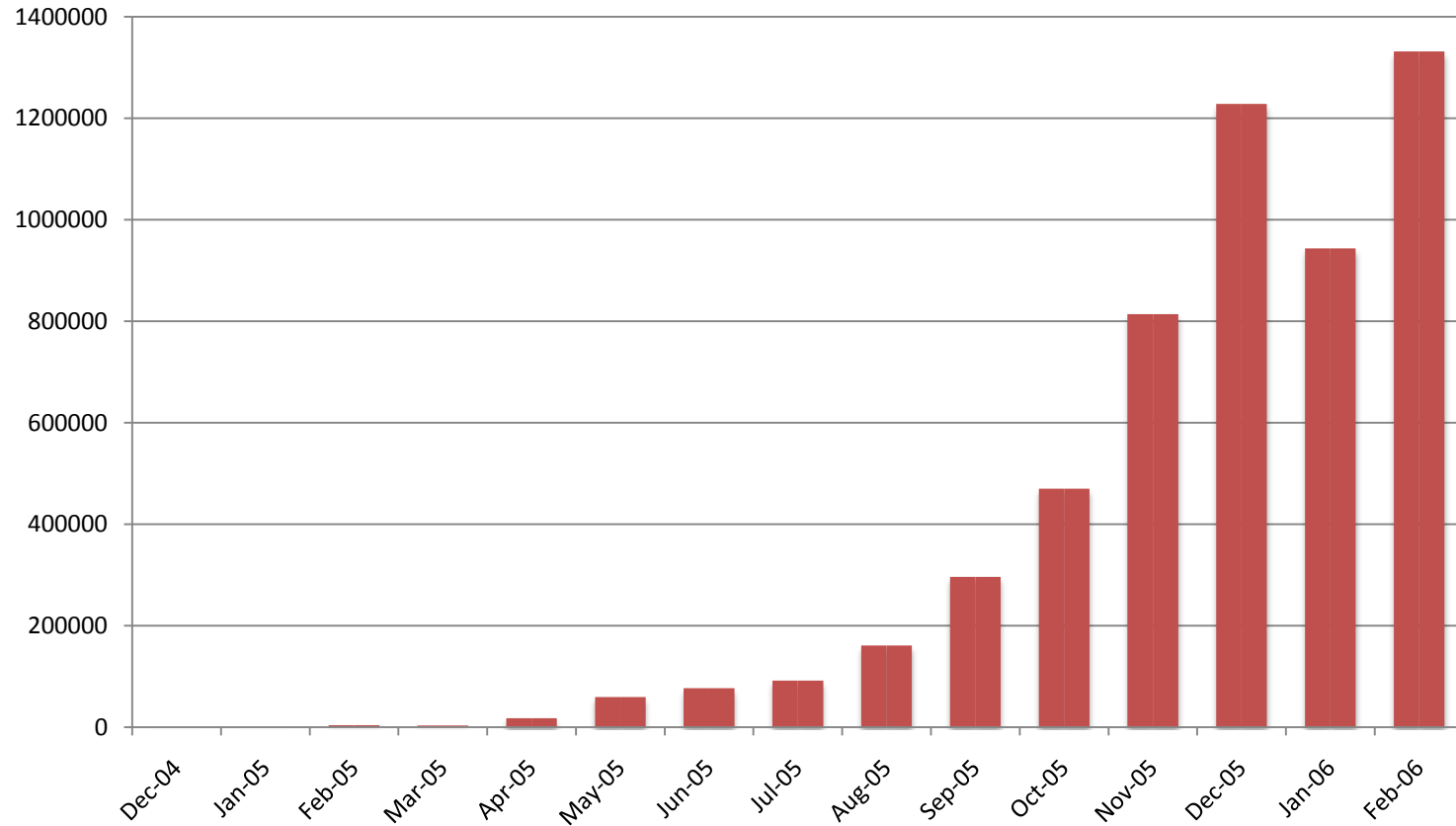


Ability to answer questions is improving



Traffic is continually growing

Monthly unique visitor growth
Jan. 2009 through Mar. 2010



Mining knowledge with NLP

- Scaling up populating our KB using uncurated facts extracted from unstructured text
- Standard NLP tools used (pos tagger, LR parsing etc.) plus the True Knowledge Platform
- TK provides disambiguation and common sense knowledge
 - Can throw away bad knowledge when contradicted by other things it knows
- **Achieving 98% accuracy** mining Wikipedia and News websites
- Facts also being mined from wider web

NLP mining of facts



Amur tigers, also known as Siberian tigers, live in the forests and mountains of Russia's far east. This litter are the offspring of two adults transported from Edinburgh Zoo last October.

Iain MacDonald went to meet them.

[fact: ["auto4_3209433@trueknowledge.com"]]
[siberian tiger] [is a class of things doing the action location pair]
[group: [reside]; [area of forest]]

This fact asserts that the relationship 'is a class with at least some members who regularly do the action/class of places pair' exists between Amur Tiger and live and forest at some point in time. The additional fact [fact: ["auto4_3209434@trueknowledge.com"]] asserts that this fact applies for June 27th 2009 onwards.

Assessments

This fact has had the following assessments:

Reporter	Source	Document	Time	Notes	Endorsement
[web_bot]	[the unstructured text of bbc]	[url: ["http://news.bbc.co.uk/2/hi/uk_news/8104260.stm"]]	2009-06-27 15:08:34	Fact extracted from BBC News using natural language processing of the following snippet "Amur tigers, also known as Siberian tigers, live in the forests and mountains of Russia's far east."	endorsed

Where do siberian tigers reside?


Web Images Videos Shopping News Maps More MSN Windows Live

bing

where do siberian tigers reside

ALL RESULTS 1-10 of 68,700 results · [Advanced](#)

SEARCH HISTORY
Turn on search history to start remembering your searches.
[Turn history on](#)

 [forest \(a piece of land that is covered with trees and shrubs\)](#)
[Wikipedia page](#)

Good answer? [Yes](#) [No](#) [source: True Knowledge](#)

[WikiAnswers - Why do tigers live in forest and jungle](#)
Tigers how do they act in the forest? Where do tigers reside in the forest? Are there tigers in the deciduous forest? Where is the tigers habitat in the jungle? Do siberian ...
[wiki.answers.com/Q/Why_do_tigers_live_in_forest_and_jungle](#) - [Cached page](#)

[WikiAnswers - How many types of tigers are there in the world and what ...](#)
Tigers question: How many types of tigers are there in the world and what are their names and where do they reside? ... SIBERIAN OR AMUR TIGER - the largest of the tiger subspecies ...
[wiki.answers.com/Q/How_many_types_of_tigers_are_there_in_the_world_and_what_are_their...](#) - [Cached page](#)

[Tiger - Wikipedia, the free encyclopedia](#)
The heaviest wild **Siberian tiger** on record weighed in ... Even apparently healthy white tigers generally do not live ... which allows tribal populations to reside inside designated tiger ...
[en.wikipedia.org/wiki/Tigers](#) - [Enhanced view](#)

NLP mining of facts



WIKINEWS

Navigation

- Main Page
- Newsroom
- Recent changes
- Random article
- Archives
- Free use media upload

Wikinews

- Help
- Write an article
- Water cooler
- Style guide
- Live chat
- World News Quiz

Article

Discussion

Opinions

Read

View source

View history

Go

Search

Ingmar Bergman dies at age 89

Monday, July 30, 2007

Swedish director Ingmar Bergman, a filmmaker widely regarded as one of the great masters of modern cinema, died today at his home on Fårö, Gotland, Sweden. He was 89. The exact cause of death is not known.

Biography

Born Ernst Ingmar Bergman in 1918 in Uppsala, Sweden to a Lutheran minister of Danish descent, Bergman grew up surrounded by religious imagery and discussion. He had a strict upbringing and went through two five-month stretches of mandatory military service. He attended Stockholm High School and Stockholm University, without completing his degree in literature and art. He instead became interested in theatre and later in film.

Current revision (unreviewed)



Ingmar Bergman (1918-2007), Swedish stage and film director, during the production of *Wild Strawberries* (Smultronstället)

NLP mining of facts

fact default Submit

[fact: ["457057736@trueknowledge.com"]]
[ingmar bergman] [is someone who studied at] [stockholm university]

This fact asserts that the relationship 'is someone who studied at' exists between Ingmar Bergman and Stockholm University for all time.

undo edit agree disagree

This fact was originally reported by [web_bot] at 2009-09-01 10:31:38.

Fact properties:

- True** (the system currently considers the fact to be correct)
- Uninfluenced** (this fact is not contradicted by other facts, nor is it rendered superfluous by other facts)

These properties were last updated at 2009-09-01 10:31:39

[reassess this fact's properties](#)

Assessments

This fact has had the following assessments:


Reporter	Source	Document	Time	Notes	Endorsement
[web_bot]	[unspecified member of: [missing object class: [fact pattern: [object unspecified]; [is responsible for content at]; [domain name: ["en.wikinews.org"]]]]	[url: ["http://en.wikinews.org/wiki/Ingmar_Bergman_dies_at_age_89"]]	2009-09-01 10:31:38	Extracted by natural language processing from http://en.wikinews.org/wiki/Ingmar_Bergman_dies_at_age_89 using snippet "He attended Stockholm High School and Stockholm University, without completing his degree in literature and art."	endorsed

Which university did Bergman go to

What would you like to know?





Which university did bergman go to? ? answer




Which university did bergman go to?

 **Stockholm University**
Stockholm University (Stockholms universitet), the state university in Stockholm, Sweden
[website](#) [wikipedia](#)

[easyJet Zurich Flights](#)
Flights from £27.99 inc. taxes & unlimited weight on hand baggage!
[easyJet.com](#)


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Which are the universities (institutions of higher education) that Ingmar Bergman (born 1918), the Swedish director is a person who has studied at the educational establishment?

▼ How do we know this?

✓ [facts...](#) [See reasoning...](#) 

I used the following facts to provide this answer:

Ingmar Bergman is someone who studied at Stockholm University	agree	disagree	edit
Stockholm University is or has been a university	agree	disagree	edit

Get Involved



YOUR COUNTRY NEEDS
VOTE

Visit our main site

- www.trueknowledge.com
- Ask Questions
- Add Knowledge



Find shops and products in your area

- Visit local.trueknowledge.com

The screenshot shows the True Knowledge Local BETA website interface. At the top, there is a search bar with the text "what pubs" and "where cambridge". Below the search bar, the page title is "pubs in Cambridge". On the left side, there is a list of pub details, including "Champion Of The Thames", "The Carpenters Arms", and "The Jubilee". Each entry includes a small image of the pub, its name, address, and phone number. On the right side, there is a map of Cambridge with numerous blue location pins indicating the locations of various pubs. The map includes labels for streets, landmarks like the University Botanic Garden, and the Cambridge Airport. The True Knowledge logo is visible in the top left corner of the page.

Enhance your Google* Results

- Visit www.trueknowledge.com
- Install our IE or Firefox plugin

The screenshot shows a Google search interface. The search bar contains the text "what films has tom cruise starred in". Below the search bar, there are four movie posters: "Interview with the Vampire: The...", "Valkyrie", "Days of Thunder", and "Tropic Thunder". To the right of the posters, there are sponsored links for "Tom Cruise Films" from Play.com and Ask.com. At the bottom of the search results, there is a "TrueKnowledge" source link and a "Good answer?" rating section.

Google what films has tom cruise starred in Search Advanced Search
Search: the web pages from the UK

Web [+ Show options...](#) Results 1 - 10 of about 154,000,000 for what films has tom cruise starred in. (0.13 seconds)

[Interview with the Vampire: The...](#) [Valkyrie](#) [Days of Thunder](#) [Tropic Thunder](#)

Page 1 of 9 Good answer? [Yes](#) [No](#) source: [TrueKnowledge](#)

[Movie Lists - Tom Cruise Filmography](#)
Tom has been in 29 movies (as of 2005). Tom Cruise's first movie was Taps in 1981. The most movies to be released in a single year starring Tom Cruise has ...
www.ducksoftware.com/movies/tomcruisemovies.html - [Cached](#) - [Similar](#) - [🗨](#) [📄](#) [✕](#)

[Tom Cruise - Wikipedia, the free encyclopedia](#)
The film has been described as "A Generation-X classic, and a career-maker for Tom Cruise." A fourth film that was released in 1983 was the high-school ...
[Family and early life - Filmmaking - Popularity](#)
en.wikipedia.org/wiki/Tom_Cruise - [Cached](#) - [Similar](#) - [🗨](#) [📄](#) [✕](#)

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[Ask.com](#)

[Find Tom Cruise Films](#)
The Fastest Way to Find Any Tom Cruise Film in Any Format
www.findanyfilm.com/TomCruise
[See your ad here >](#)

*And Bing, Yahoo and Ask

Build on our technology

- Register for an API account at <http://www.trueknowledge.com/api/>
- Visit our Forum and Blog for code examples



True Knowledge Answer: Nicolas Paul Stéphane Sarközy de Nagy-Born of a Hungarian father and French mother, often nicknamed Sarko

Results 1 - 8 of about **84,000,000**

From: [Web](#) | [Blogs](#) | [Newsgroups](#) | [News](#) | [Video](#) | [Discussions](#) | [Buzz](#) | [Q&A](#)

Found no discussions about this link

[Who is the Member singer? /wt](#)

★ Kosmix

Full name

Matthew Paige Damon

Born

October 8th 1970
Cambridge
Massachusetts

Height

5 feet and 10 inches

Spouse

Luciana Boz n Barroso

Starred in

- Saving Private Ryan
- The Departed
- The Bourne Ultimatum
- Ocean's Thirteen

Produced

- The Battle of Shaker Heights
- Feast
- The People Speak
- 5 feet and 10 inches

BETA-ISH 
Kosmix

Questions?

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<http://www.trueknowledge.com/>