



Wikidata on MARS, or turning Wiki-data into Wiki-knowledge

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Abstract

Users (particularly programs) need to know far too much to reliably get the information they need from Wikidata. So Wikidata matches its name in that it contains data, not knowledge. An underlying formal basis can be provided for Wikidata, turning Wiki-data into Wiki-knowledge. Getting these formal bases used, so that Wikidata and other Knowledge Graphs contain knowledge, is a separate matter.

Purpose of This Talk

- Show that there is more to knowledge than just Knowledge Graphs
- Show a way of turning Knowledge Graphs into knowledge
- I'm using Wikidata as my example Knowledge Graph.
 - Wikidata is useful, available, and examinable.
 - Although Wikidata has differences from other Knowledge Graphs, it has much more in common with them, particularly when support for knowledge is considered.
- I'm being a bit harsh on Wikidata.
 - Wikidata is a community effort, which makes organization hard.
 - Wikidata is improving, but not in the way I think it should.

What is Wikidata

- Large community-driven repository
 - Over 93 million entities
 - Anyone can update
 - Anyone can use freely



The screenshot shows the Wikidata homepage. At the top, a network diagram with nodes and colored lines (red, green, blue) represents the interconnected nature of the data. A central grey box contains the text: "Welcome to Wikidata", "the free knowledge base with 93,368,742 data items that anyone can edit.", and links for "Introduction", "Project Chat", "Community Portal", and "Help". Below this, a green bar says "Welcome!" and a blue bar says "Learn about data". The main content area has two columns. The left column, under "Welcome!", describes Wikidata as a free and open knowledge base, its role as central storage for Wikimedia projects, and its support for other sites. The right column, under "Learn about data", encourages developing data literacy and includes three image-based examples: "Item: Earth (Q2)", "Property: highest point (P610)", and "custom value: Mount Everest (Q513)". A red bar at the bottom says "Get involved" and includes a link to the community portal.

Welcome to Wikidata
the free knowledge base with 93,368,742 data items that anyone can edit.
[Introduction](#) • [Project Chat](#) • [Community Portal](#) • [Help](#)
Want to help translate? [Translate the missing messages.](#)

Welcome!
Wikidata is a free and open knowledge base that can be read and edited by both humans and machines.
Wikidata acts as central storage for the **structured data** of its Wikimedia sister projects including Wikipedia, Wikivoyage, Wiktionary, Wikisource, and others.
Wikidata also provides support to many other sites and services beyond just Wikimedia projects! The content of Wikidata is available under a [free license](#), exported using [standard formats](#), and can be [interlinked](#) to other open data sets on the linked data web.

Learn about data
New to the wonderful world of data? Develop and improve your data literacy through content designed to get you up to speed and feeling comfortable with the fundamentals in no time.

Item: [Earth \(Q2\)](#) Property: [highest point \(P610\)](#) custom value: [Mount Everest \(Q513\)](#)

Get involved
For a complete starters' guide, visit the [community portal](#).

What is Wikidata

- Large community-driven repository
 - Over 93 million entities
 - Anyone can update
 - Anyone can use freely
- Display interface
Elizabeth Taylor

Elizabeth Taylor (Q34851)

British-American actress, businesswoman, and humanitarian

 [edit](#)

Elizabeth Rosemond Taylor | Liz Taylor | Dame Elizabeth Rosemond Taylor | Dame Elizabeth Taylor

► [Recoin: Most relevant properties which are absent](#)

▼ [In more languages](#)

Language	Label	Description	Also known as
English	Elizabeth Taylor	British-American actress, businesswoman, and humanitarian	Elizabeth Rosemond Taylor Liz Taylor Dame Elizabeth Rosemond... Dame Elizabeth Taylor
German	Elizabeth Taylor	britisch-US-amerikanische Schauspielerin	Dame Elizabeth Rosemond... Elizabeth Rosemond Taylor Liz Taylor
French	Elizabeth Taylor	actrice britannique	Elizabeth Rosemond Taylor Elisabeth Taylor Liz Taylor

[All entered languages](#)

Statements



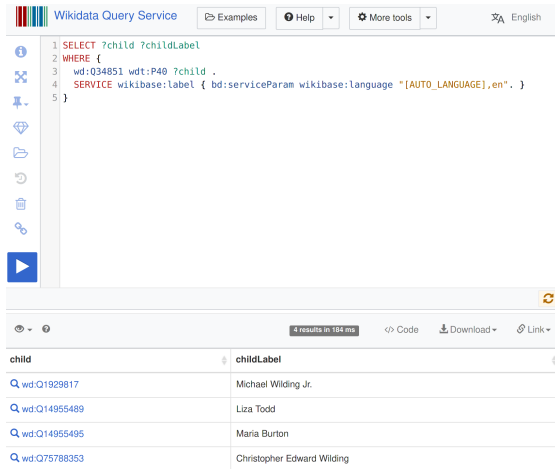
instance of	 human  edit
	► 3 references
	+ add value

image	   edit
-------	----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

What is Wikidata

- Large community-driven repository
 - Over 93 million entities
 - Anyone can update
 - Anyone can use freely
- Display interface
- SPARQL query interface
 - children of Elizabeth Taylor*
 - (Annoying to use because of numeric identifiers)



The screenshot shows the Wikidata Query Service interface. At the top, there's a header with the Wikidata logo, the text "Wikidata Query Service", and buttons for "Examples", "Help", "More tools", and a language selector set to "English". Below the header is a SPARQL query editor with a blue play button on the left. The query is as follows:

```
1 SELECT ?child ?childLabel
2 WHERE {
3   wd:Q34851 wdt:P40 ?child .
4   SERVICE wikibase:label { bd:serviceParam wikibase:language "[AUTO_LANGUAGE],en". }
5 }
```

Below the query editor, the results are displayed in a table. The table has two columns: "child" and "childLabel". There are four rows of results, each with a blue magnifying glass icon and a Wikidata ID in the "child" column.

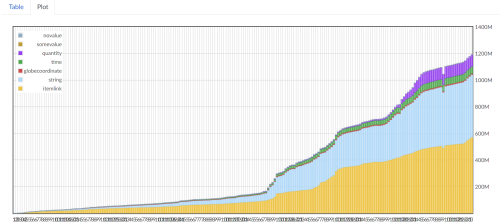
child	childLabel
Q1929817	Michael Wilding Jr.
Q14955489	Liza Todd
Q14955495	Maria Burton
Q75788353	Christopher Edward Wilding

At the bottom of the results table, there are links for "Code", "Download", and "Link".

Is Wikidata Useful?

- Absolutely
 - Large
1.3 billion “facts”

Referenced statements by statement type



Is Wikidata Useful?

- Absolutely
 - Large
 - High Quality
- both adopted and natural children of Elizabeth Taylor*

child	<div><div></div><div>Maria Burton</div></div>	<div><div></div><div>kinship to subject</div></div>	<div><div></div><div>adopted daughter</div></div>	<div><div></div><div>edit</div></div>
		<div><div></div><div>+ 1 reference</div></div>		
	<div><div></div><div>Michael Wilding Jr.</div></div>			<div><div></div><div>edit</div></div>
	<div><div></div><div>Christopher Edward Wilding</div></div>			<div><div></div><div>edit</div></div>
	<div><div></div><div>Liza Todd</div></div>			<div><div></div><div>edit</div></div>
		<div><div></div><div>+ 1 reference</div></div>		
				<div><div></div><div>+ add value</div></div>
number of children	<div><div></div><div>4</div></div>			<div><div></div><div>edit</div></div>
		<div><div></div><div>+ 1 reference</div></div>		
				<div><div></div><div>+ add value</div></div>

Is Wikidata Useful?

- Absolutely
 - Large
 - High Quality
 - Connections to other sources
- Elizabeth Taylor in other repositories*

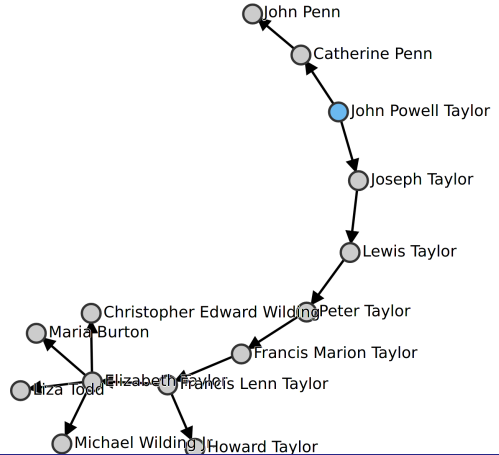
Identifiers

VIAF ID	 24624716  » 3 references + add value
ISNI	 0000 0001 2124 4985  » 1 reference + add value
BNMM authority ID	 000055929  » 0 references + add reference + add value
BIBSYS ID	 90544192  » 1 reference + add value
CANTIC ID	 a11572152  » 1 reference + add value
Biblioteca Nacional de España ID	 XX1130457   » 0 references

Is Wikidata A Knowledge Graph?

- It can be considered to be a graph
Descendants of John Powell Taylor

Abstracting from definitions in “Towards a Definition of Knowledge Graphs”, Lisa Ehrlinger and Wolfram Wöb, SEMANTiCS 2016, Leipzig.



Is Wikidata A Knowledge Graph?

- It can be considered to be a graph
- It has information about real-world entities and relationships
People, places, etc.

Abstracting from definitions in “Towards a Definition of Knowledge Graphs”, Lisa Ehrlinger and Wolfram Wöß, SEMANTiCS 2016, Leipzig.

Elizabeth Taylor (Q34851)

British-American actress, businesswoman, and humanitarian

Elizabeth Rosemond Taylor | Liz Taylor | Dame Elizabeth Rosemond Taylor | Dame Elizabeth Taylor







► [Recoin: Most relevant properties which are absent](#)

► [In more languages](#)

Language	Label	Description	Also known as
English	Elizabeth Taylor	British-American actress, businesswoman, and humanitarian	Elizabeth Rosemond Taylor Liz Taylor Dame Elizabeth Rosemond... Dame Elizabeth Taylor
German	Elizabeth Taylor	britisch-US-amerikanische Schauspielerin	Dame Elizabeth Rosemond... Elizabeth Rosemond Taylor Liz Taylor
French	Elizabeth Taylor	actrice britannique	Elizabeth Rosemond Taylor Elisabeth Taylor Liz Taylor

[All entered languages](#)

Statements

instance of	<div><div></div><div>human</div></div> <div>► 3 references</div> <div>+ add value</div>	
image	<div><div></div><div></div></div> <div></div>	

Is Wikidata A Knowledge Graph?

- It can be considered to be a graph
- It has information about real-world entities and relationships
- It defines interrelated classes and relations

Definition of the class human

Abstracting from definitions in “Towards a Definition of Knowledge Graphs”, Lisa Ehrlinger and Wolfram Wöß, SEMANTiCS 2016, Leipzig.

human ^(Q5)

common name of Homo sapiens, unique extant species of the genus Homo

human being | humankind | people | homosapiens | person | mankind | peoplekind | personkind | persons

Recoinn: Most relevant properties which are absent

in more languages

Language	Label	Description	Also known as
English	human	common name of Homo sapiens, unique extant species of the genus Homo	human being humankind people homosapiens person mankind peoplekind personkind persons
French	être humain	individu appartenant à l'espèce Homo sapiens, la seule espèce restante du genre Homo - distinct de « humain fictif » et de « humain possiblement fictif »	être humain Homme Homo sapiens sapiens Homo sapiens espèce humaine humaine humain

All entered languages

Statements

instance of	<div><div><div><div><div></div></div><div><div></div></div></div><div><div><div></div></div><div><div></div></div></div><div><div><div></div></div><div><div></div></div></div></div></div> <div>organisms known by a particular common name of<div>Homo sapiens</div><div>Homo sapiens sapiens</div><div>Homo</div></div> <div>0 references</div> <div>add reference</div> <div>add value</div>
subclass of	<div><div><div><div><div></div></div><div><div></div></div></div><div><div><div></div></div><div><div></div></div></div></div></div> <div>person</div> <div>0 references</div> <div>edit</div>

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Definition of the class person, a superclass of human

Abstracting from definitions in “Towards a Definition of Knowledge Graphs”, Lisa Ehrlinger and Wolfram Wöß, SEMANTiCS 2016, Leipzig.

person (Q215627)

being that has certain capacities or attributes constituting personhood (avoid use with P31; use Q5 for humans)

[edit](#)

persons

[Recoin: Most relevant properties which are absent](#)

[In more languages](#)

Language	Label	Description	Also known as
English	person	being that has certain capacities or attributes constituting personhood (avoid use with P31; use Q5 for humans)	persons
French	personne	individu ou entité ayant certaines capacités et attributs constitutifs d'une personnalité. (Note: les éléments se rapportant à des êtres humains doivent utiliser « humain [Q5] » comme « nature de l'élément [P31] ».)	

[All entered languages](#)

Statements

subclass of	subject	edit
	0 references	+ add reference
	agent	edit
	0 references	+ add reference
	item with given name property	edit
	0 references	+ add reference
	individual	edit
	0 references	+ add reference

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Definition of the relation spouse

Abstracting from definitions in “Towards a Definition of Knowledge Graphs”, Lisa Ehrlinger and Wolfram Wöß, SEMANTiCS 2016, Leipzig.

spouse ^(P26)

the subject has the object as their spouse (husband, wife, partner, etc.). Use "unmarried partner" (P451) for non-married companions [edit](#)

wife | married to | marry | marriage partner | married | wedded to | wed | wives | husbands | spouses | husband | martial partner

[In more languages](#)

Language	Label	Description	Also known as
English	spouse	the subject has the object as their spouse (husband, wife, partner, etc.). Use "unmarried partner" (P451) for non-married companions	wife married to marry marriage partner married wedded to wed wives husbands spouses husband martial partner
French	conjoint	personne liée par le mariage ou une union civile	épouse mari femme conjointe marié à compagne compagnon époux

[All entered languages](#)

Data type

Item

Statements

Is Wikidata A Knowledge Graph?

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Definition of the relation child

Abstracting from definitions in “Towards a Definition of Knowledge Graphs”, Lisa Ehrlinger and Wolfram Wöß, SEMANTiCS 2016, Leipzig.

child (P40)

subject has object as child. Do not use for stepchildren

son | daughter | kid | has child | children | sons | daughters | kids | has children | has son | has sons | has daughter | has daughters | has kid | has kids | offspring | progeny | issue | parent of | descendants [edit](#)

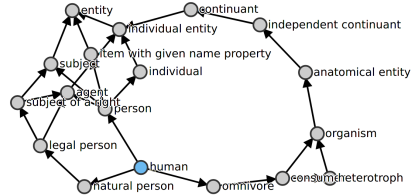
[In more languages](#)

Language	Label	Description	Also known as
English	child	subject has object as child. Do not use for stepchildren	son daughter kid has child children sons daughters kids has children has son has sons has daughter has daughters has kid has kids offspring progeny issue parent of descendants
French	enfant	lien familial direct indiquant que l'objet du lien est un fils ou une fille du sujet (indépendamment de son âge)	fils fille descendant filles descendants a pour fils Charles Antoine B... a pour fille a pour filles a pour descendants a pour descendant père de mère de

Is Wikidata A Knowledge Graph?

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Generalizations of human



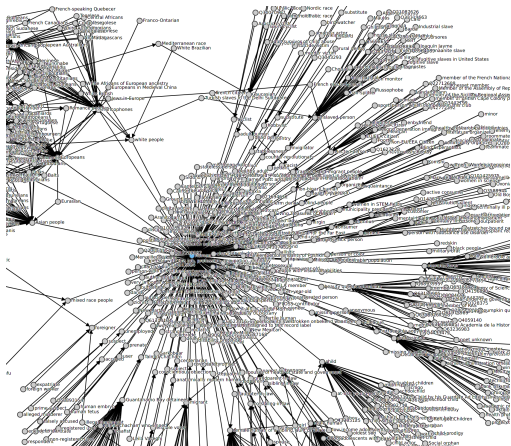
Abstracting from definitions in “Towards a Definition of Knowledge Graphs”, Lisa Ehrlinger and Wolfram Wöß, SEMANTiCS 2016, Leipzig.

Is Wikidata A Knowledge Graph?

- It can be considered to be a graph
- It has information about real-world entities and relationships
- It defines interrelated classes and relations

Some specializations of human

Abstracting from definitions in “Towards a Definition of Knowledge Graphs”, Lisa Ehrlinger and Wolfram Wöb, SEMANTiCS 2016, Leipzig.



Is Wikidata A Knowledge Graph?

- It can be considered to be a graph
- It has information about real-world entities and relationships
- It defines interrelated classes and relations

So, even though its name includes *data*, Wikidata meets requirements for Knowledge Graphs.

Abstracting from definitions in “Towards a Definition of Knowledge Graphs”, Lisa Ehrlinger and Wolfram Wöß, SEMANTiCS 2016, Leipzig.

Does Wikidata Have Knowledge?

- How Can It Not?

Well ...

Does Wikidata Have Knowledge?

- How Can It Not? *Well ...*
- Information in Wikidata doesn't mean what you think it means

- Consequences of information are not computed

How many humans in Wikidata?
9,067,016



The screenshot shows the Wikidata SPARQL query editor. The query is:

```
1 SELECT ( count(?item) as ?count )
2 WHERE {
3   ?item wdt:P31 wd:Q5 .
4 }
```

Below the query editor, the results are displayed in a table:

count
9067016

The interface includes a sidebar with icons for query management, a top bar with a play button, and a bottom bar with options to view code, download, or link to the query.

Does Wikidata Have Knowledge?

- How Can It Not? *Well ...*
- Information in Wikidata doesn't mean what you think it means

- Consequences of information are not computed

How many humans in Wikidata?

9,067,016 ... or 9,088,310?

Need to explicitly count transitive closure of subclasses.

Also affects properties.



```
1 SELECT ( count(?item) as ?count )
2 WHERE {
3   ?item wdt:P31/wdt:P279* wd:Q5 .
4 }
```

count
9088310

Does Wikidata Have Knowledge?

- How Can It Not? *Well ...*
- Information in Wikidata doesn't mean what you think it means
- Descriptions of classes are not correct *woman is described as female adult human*

woman (Q467)

female adult human

female human | women | lady | womyn

Recoin: Most relevant properties which are absent


In more languages

Language	Label	Description	Also known as
English	woman	female adult human	female human women lady womyn
French	femme	être humain adulte de sexe féminin	

All entered languages

Statements

subclass of	adult	edit
	0 references	+ add reference
	female human	edit
	0 references	+ add reference
		+ add value

image		edit
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Does Wikidata Have Knowledge?

- How Can It Not? *Well ...*
- Information in Wikidata doesn't mean what you think it means
- Descriptions of classes are not correct
*But no (really 11) women in Wikidata
(At one time there were 42)*



The screenshot shows a Wikidata SPARQL query editor. The query is as follows:

```
1 SELECT ( count(?item) as ?count )
2 WHERE {
3   ?item wdt:P31 wd:Q467.
4   SERVICE wikibase:label { bd:serviceParam wikibase:language "[AUTO_LANGUAGE],en". }
5 }
```

Below the query editor, the results section shows a table with one column named 'count' and one row with the value '0'. The status bar indicates '1 result in 10 ms'.

Does Wikidata Have Knowledge?

- How Can It Not? *Well ...*
- Information in Wikidata doesn't mean what you think it means
- Descriptions of classes are not correct
*But no (really 11) women in Wikidata
(At one time there were 42)*



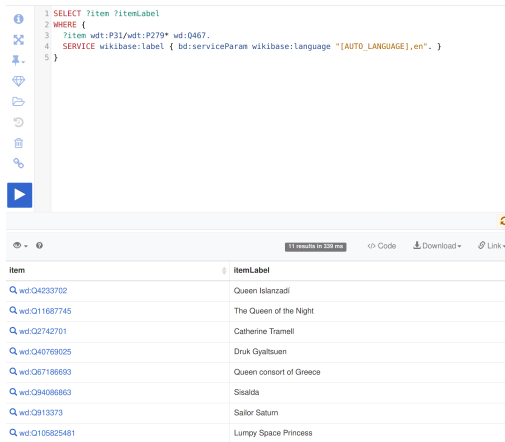
```
1 SELECT ( count(?item) as ?count )
2 WHERE {
3   ?item wdt:P31/wdt:P279* wd:Q467.
4   SERVICE wikibase:label { bd:serviceParam wikibase:language "[AUTO_LANGUAGE],en". }
5 }
```

1 result in 164 ms

count
11

Does Wikidata Have Knowledge?

- How Can It Not? *Well ...*
- Information in Wikidata doesn't mean what you think it means
- Descriptions of classes are not correct
*But no (really 11) women in Wikidata
(At one time there were 42)*



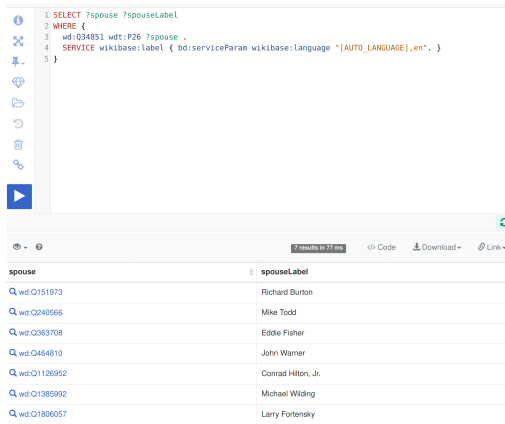
```
1 SELECT ?item ?itemLabel
2 WHERE {
3   ?item wdt:P31/wdt:P279* wd:Q467.
4   SERVICE wikibase:label { bd:serviceParam wikibase:language "[AUTO_LANGUAGE],en". }
5 }
```

11 results in 359 ms

item	itemLabel
wd:Q4233702	Queen Islanzadi
wd:Q11687745	The Queen of the Night
wd:Q2742701	Catherine Trammell
wd:Q40769025	Druk Gyalsuen
wd:Q67186693	Queen consort of Greece
wd:Q94086863	Sisalda
wd:Q913373	Sailor Saturn
wd:Q105825481	Lumpy Space Princess

Does Wikidata Have Knowledge?

- How Can It Not? *Well ...*
- Information in Wikidata doesn't mean what you think it means
- Descriptions of classes are not correct
- Context is not taken into account
 - Who are the spouses of Elizabeth Taylor?



The screenshot shows a Wikidata SPARQL query interface. The query is as follows:











```
1 SELECT ?spouse ?spouseLabel
2 WHERE {
3   wd:Q34851 wdt:P26 ?spouse .
4   SERVICE wikibase:label { bd:serviceParam wikibase:language "[AUTO_LANGUAGE],en". }
5 }
```

The results table shows 7 results in 77 ms. The table has two columns: **spouse** and **spouseLabel**.

spouse	spouseLabel
wd:Q151973	Richard Burton
wd:Q240566	Mike Todd
wd:Q363708	Eddie Fisher
wd:Q464810	John Warner
wd:Q1126952	Conrad Hilton, Jr.
wd:Q1385992	Michael Wilding
wd:Q1806057	Larry Fortensky

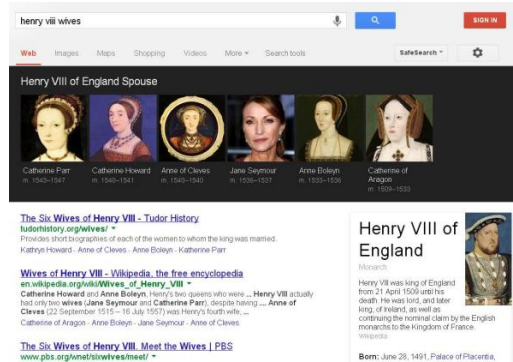
Does Wikidata Have Knowledge?

- How Can It Not? *Well ...*
- Information in Wikidata doesn't mean what you think it means
- Descriptions of classes are not correct
- Context is not taken into account
 - What context (qualifiers) needs to be taken into account is unclear

spouse	 Richard Burton	
	start time	15 March 1964
	end time	26 June 1974
	end cause	divorce
	series ordinal	5
	1 reference	
	 Richard Burton	
	start time	10 October 1975
	end time	29 July 1976
	end cause	divorce
	series ordinal	6
	1 reference	
	 Conrad Hilton, Jr.	
	end time	29 January 1951
	start time	6 May 1950
	end cause	divorce
	series ordinal	1
	1 reference	
	 Michael Wilding	
	end time	30 January 1957
	start time	21 February 1952
	end cause	divorce
	series ordinal	2
	1 reference	
	 Mike Todd	

Does Wikidata Have Knowledge?

- How Can It Not? *Well ...*
 - Information in Wikidata doesn't mean what you think it means
 - Descriptions of classes are not correct
 - Context is not taken into account
 - Few sanity checks are made
- A picture of a wife of Henry VII?*
(from Google)



What is Knowledge?

Adapted from Russell Ackoff, “From Data to Wisdom” (1989).

- Data: Simple findings and figures
- Information: Collected and analyzed data
- Knowledge: Information organized and ready to put to use
- Wisdom: Proper use of knowledge

See also T. S. Eliot, *The Rock* (1934).

Does Wikidata Have Knowledge

Using Wikidata requires knowledge that is not in the data

- Humans can (often? sometimes?) determine what is needed
- Programs generally can't

So information in Wikidata isn't ready to use.

Thus Wikidata doesn't really have knowledge.

Turning Wikidata Into Wiki-knowledge

- Add in consequences of data (but what, exactly are they?)
 - Design a logic for Wikidata to define consequences
 - Implement a reasoner for the logic
- Incorporate information from descriptions
 - By turning them into expressions in the logic
- Take context into account
 - By providing simple ways to combine qualifiers in the logic
 - By augmenting query interfaces with a current context
not considered further here

MARS, MARPL, eMARS, eMARPL

- A family of logics for Knowledge Graphs
 - Augment regular logic with qualifiers on facts
 - Add Wikidata datatypes
 - Add rules for handling qualifiers
 - Add constraints
- MARPL and eMARPL can be implemented using forward-chaining rules
 - Complexity of inference is not too bad

Turning Wikidata Into Wiki-knowledge

- Use eMARPL as the logic for Wikidata

`instance_of(Elizabeth_Taylor, human)`

`spouse(Elizabeth_Taylor, Richard_Burton)@{start_time : '15 March 1964', ...}`

Turning Wikidata Into Wiki-knowledge

- Use eMARPL as the logic for Wikidata
- Prohibit context qualifiers in the ontology
 - Not absolutely necessary, but makes the process easier

Turning Wikidata Into Wiki-knowledge

- Use eMARPL as the logic for Wikidata
- Prohibit context qualifiers in the ontology
- Add rules that determine consequences of ontology properties

$$\text{subclass_of}(c, d) \wedge \text{subclass_of}(d, e) \rightarrow \text{subclass_of}(c, e)$$

$$\text{instance_of}(y, c)@X \wedge \text{subclass_of}(c, d) \rightarrow \text{instance_of}(y, d)@X$$

$$\text{subproperty_of}(c, d) \wedge \text{subproperty_of}(d, e) \rightarrow \text{subproperty_of}(c, e)$$

Turning Wikidata Into Wiki-knowledge

- Use eMARPL as the logic for Wikidata
- Prohibit context qualifiers in the ontology
- Add rules that determine consequences of ontology properties
- Add rules that determine consequences of domain properties

$$\text{spouse}(x, y)@X \rightarrow \text{spouse}(y, x)@X$$

Turning Wikidata Into Wiki-knowledge

- Use eMARPL as the logic for Wikidata
- Prohibit context qualifiers in the ontology
- Add rules that determine consequences of ontology properties
- Add rules that determine consequences of domain properties
- Convert Wikidata constraints to logic constraints

$\text{property_constraint}(p, \text{distinct_values_constraint}) \wedge p(s1, o1) \wedge p(s2, o2) \wedge s1 \neq s2 \rightarrow o1 \neq o2$

Turning Wikidata Into Wiki-knowledge

That was the easy part, now for the hard part

Turning Wikidata Into Wiki-knowledge

That was the easy part, now for the hard part

- Provide rules for combining qualifiers

start_time : *max(start_time)*

end_time : *min(end_time)*

Turning Wikidata Into Wiki-knowledge

That was the easy part, now for the hard part

- Provide rules for combining qualifiers

start_time : $\max(\text{start_time})$

end_time : $\min(\text{end_time})$

Difficult to determine desired meaning of some combinations

Turning Wikidata Into Wiki-knowledge

That was the easy part, now for the hard part

- Provide rules for combining qualifiers
- Provide recognition rules for many classes

$$\text{instance_of}(\text{human}, h) \wedge \text{sex_or_gender}(h, \text{female}) \rightarrow \text{female_human}(h)$$

Turning Wikidata Into Wiki-knowledge

That was the easy part, now for the hard part

- Provide rules for combining qualifiers
- Provide recognition rules for many classes

$$\text{instance_of}(\text{human}, h) \wedge \text{sex_or_gender}(h, \text{female}) \rightarrow \text{female_human}(h)$$

Very many such classes, some may not have good recognition conditions

Status (Implementation)

- Just a proposal . . .
- There are implementations of property graphs that can store Wikidata statements
- Some graph databases have rules, e.g., Ontotext GraphDB
- No system implements rules as described above.
- Considerable work would be required to implement the logic here
- But it's just forward chaining rules
 - Could implement by encoding in RDF and using RDF rule engine

Status (Community)

- Wikidata community is fragmented
- Portions of Wikidata community not friendly to this kind of effort
 - Seem to want to put more work on consumers of Wikidata
- Support group for Wikidata (Wikimedia Deutschland) is resource constrained

Summary

- Wikidata is a useful knowledge graph
- Like other knowledge graphs, Wikidata doesn't quite qualify as providing knowledge
- A formal account can be given for (most of) Wikidata that adds the missing pieces
 - Needs implementation
 - Not too much pain to implement
 - Computational aspects not horrible
 - Consumers see knowledge, much less pain
- Buy-in for this approach is missing

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