Course: Common Sense Reasoning

11. Integrating Common Sense Knowledge

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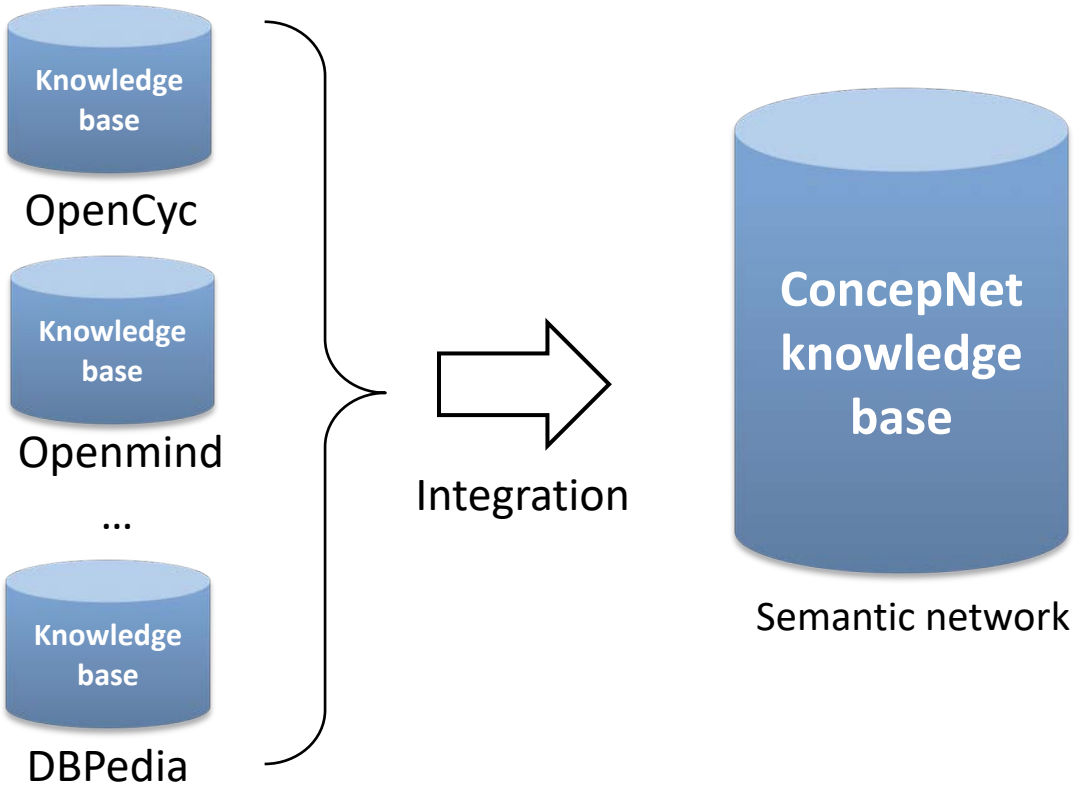
Integrating common sense knowledge bases can overcome some limitations

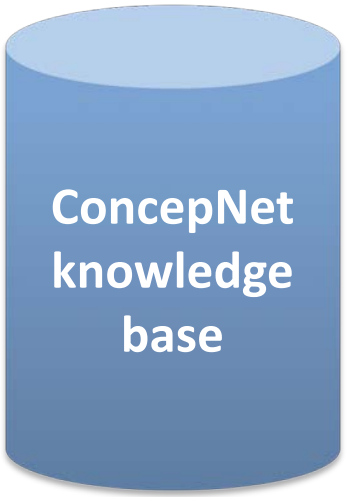
- All methods for building common sense knowledge bases have limitations
- A possible solution to overcome certain limitations is to integrate multiple knowledge bases
- Several representative cases are presented:
  - ConcepNet
  - Others: Yago-Sumo, Linked Open Data

ConcepNet is a public knowledge base that integrates knowledge from other bases



[Lio, Singh, 2004]
[Speer, Havasi, 2012]
[Speer, et al., 2017]

ConcepNet includes millions of concepts

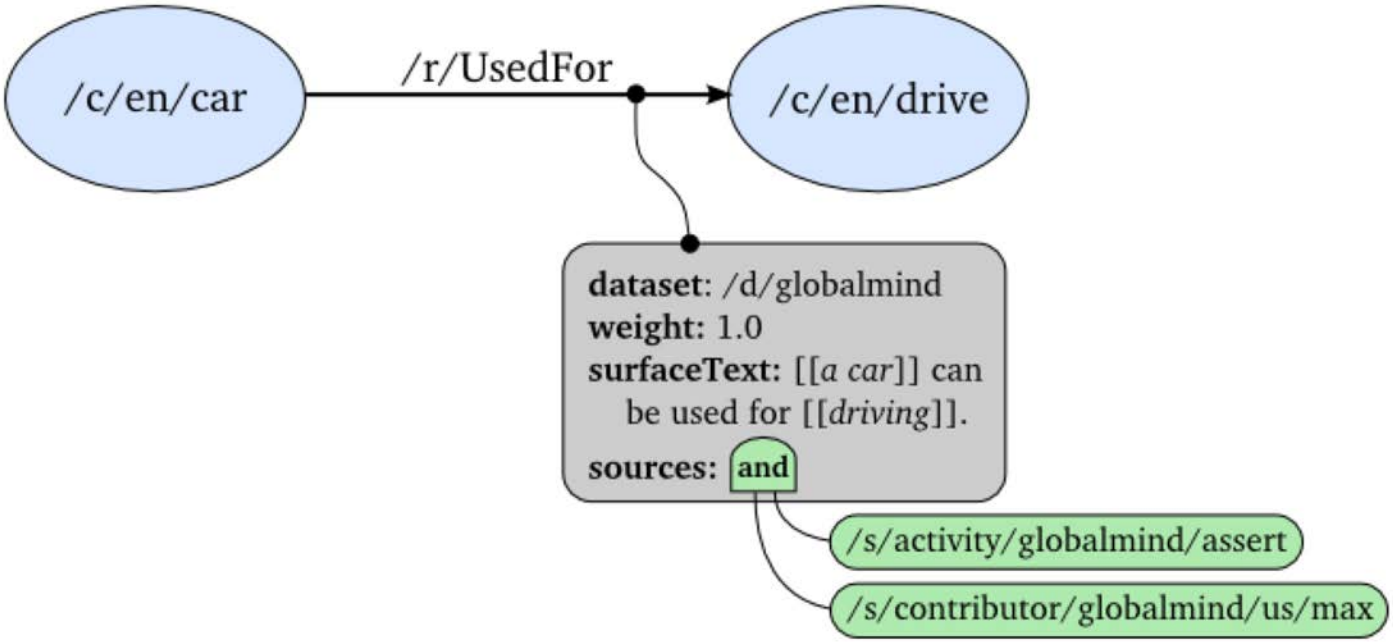


3.9 million concepts
12.5 million edges
30 types of relations
(Size in 2012)

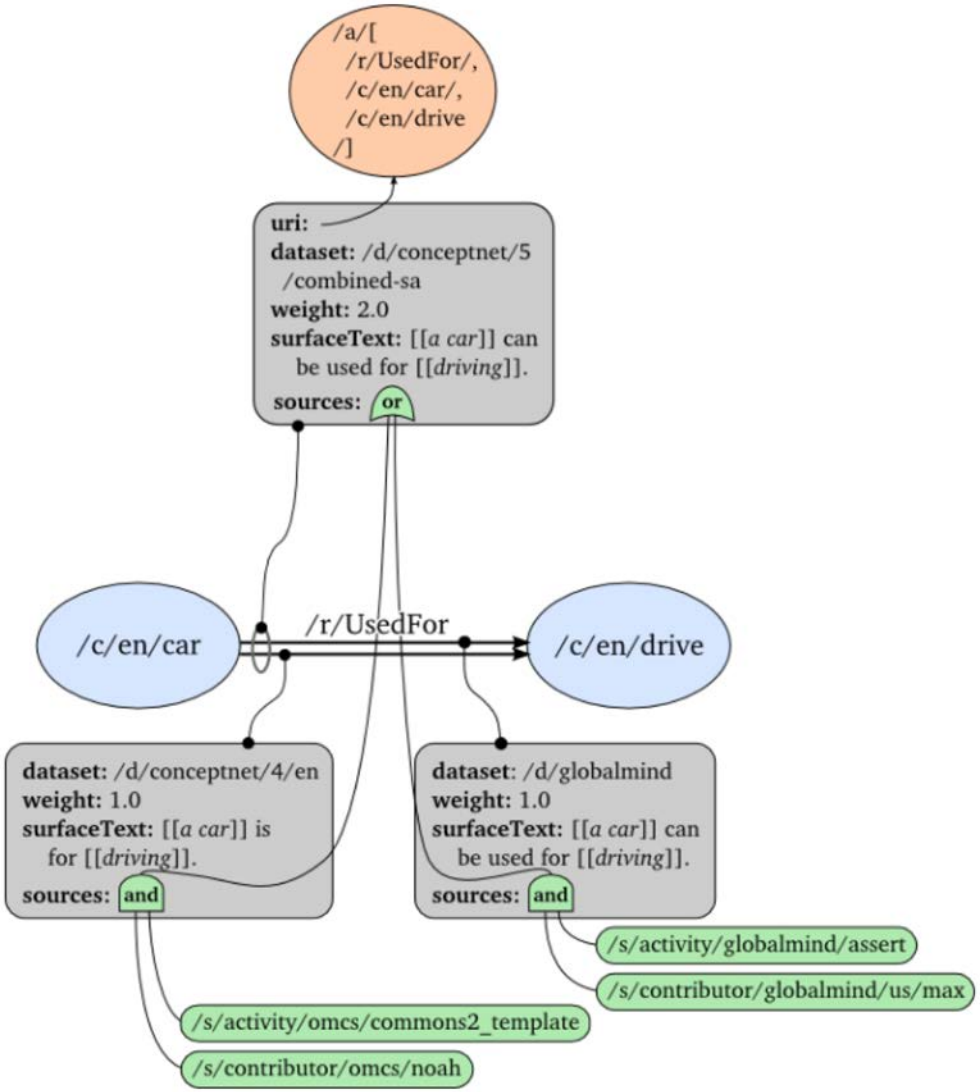
Concepts correspond to classes and instances

The knowledge representation is a semantic network with concepts and relations

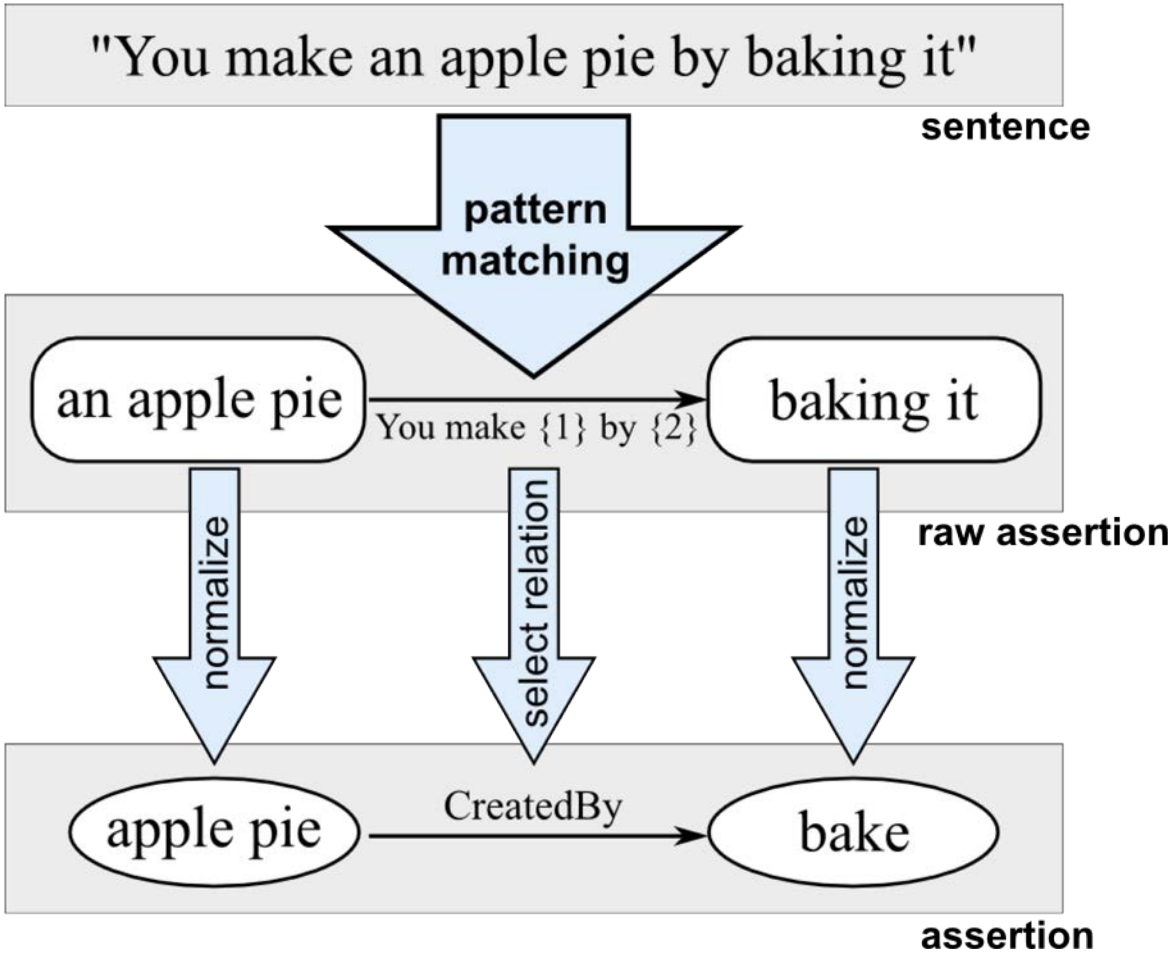
"A car is used for driving"



The same knowledge may have different sources



The sentences of Openmind were used for building automatically part of ConcepNet



The representation uses a few dozens of relation types

Relation	Example sentence pattern
IsA	NP is a kind of NP.
UsedFor	NP is used for VP.
HasA	NP has NP.
CapableOf	NP can VP.
Desires	NP wants to VP.
CreatedBy	You make NP by VP.
PartOf	NP is part of NP.
HasProperty	NP is AP.
Causes	The effect of NP|VP is NP|VP.
MadeOf	NP is made of NP.
AtLocation	Somewhere NP can be is NP.
DefinedAs	NP is defined as NP.
SymbolOf	NP represents NP.
ReceivesAction	NP can be VP (*passive*).
HasPrerequisite	Before you VP, you must VP.
MotivatedByGoal	You would VP because you want to VP.
CausesDesire	NP would make you want to VP.
HasSubevent	One of the things you do when you VP is NP|VP.
HasFirstSubevent	The first thing you do when you VP is NP|VP.
HasLastSubevent	The last thing you do when you VP is NP|VP.

AP: adjectival phrase; NP: noun phrase; VP: verb phrase. | indicates a choice between phrase types.

ConceptNet can be used with analogical reasoning

- Divisi is a reasoning tool by analogy over semantic networks that uses a technique from linear algebra:
  - SVD (Singular Value Decomposition) used in:
    - Signal processing,
    - Dimensionality reduction using principal component analysis,
    - Latent semantic inference, etc.

[Speer, et al., 2008]
[Havasi, et al., 2009]

Divisi uses a matrix of concepts and features

	cat	dog	airplane	toaster
. . . IsA pet	+6	+5		
. . . AtLocation home	+8	+2		+1
. . . CapableOf fly	−3	−5	+9	
. . . MadeOf metal			+1	+1
fur PartOf . . .	+6	+5		

- The degree of similarity between two concepts is a scalar products of vectors
- SVD reduces dimensionality, capturing the most important correlations

http://conceptnet.io

ConceptNet

An open, multilingual knowledge graph

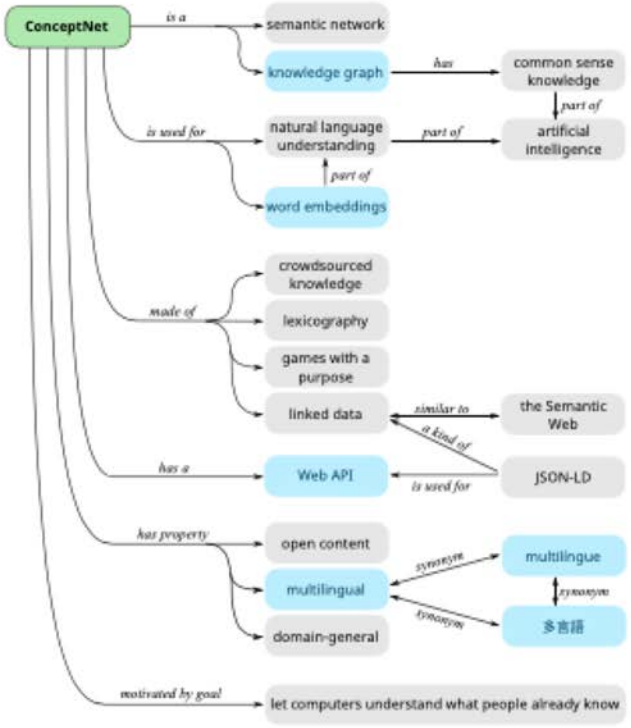
Documentation FAQ Chat Blog

Search for a word or phrase | English | Search

What is ConceptNet?

ConceptNet is a freely-available semantic network, designed to help computers understand the meanings of words that people use.

ConceptNet originated from the crowdsourcing project Open Mind Common Sense, which was launched in 1999 at the MIT Media Lab. It has since grown to include knowledge from other crowdsourced resources, expert-created resources, and games with a purpose.



Examples

To explore what's in ConceptNet, try browsing what it knows about any of these terms:

en word
fr mot
nl woord
es palabra
pt palavra
ja 単語

en graph
en knowledge
en learn
en natural language
en semantic network
en meaning

Word vectors and recent publications

ConceptNet is used to create word embeddings -- representations of word meanings as vectors, similar to word2vec, GloVe, or fastText, but better.

These word embeddings are free, multilingual, aligned across languages, and designed to avoid representing harmful stereotypes. Their performance at word similarity, within and across languages, was shown to be state of the art at SemEval 2017.

The process for learning these word vectors is described in our AAAI 2017 paper, which also shows state-of-the-art results on solving analogy problems.

Support and discussion

chat on gitter

Detailed documentation about ConceptNet appears on its GitHub wiki.

You can chat with ConceptNet developers and users on Gitter, or join the conceptnet-users mailing list.

Updates to ConceptNet and its supporting technologies appear on the ConceptNet blog.

ConcepNet provides a web API

- Look up
  - Find the concept "toast", with URI /c/en/toast (number of results = 5):

    http://api.conceptnet.io/c/en/toast?limit=5
- Search
  - Find 10 things that are parts of a car:

    http://api.conceptnet.io/search?rel=/r/PartOf&end=/c/en/car&limit=10
- Association
  - Finf terms related to "tea kettle”

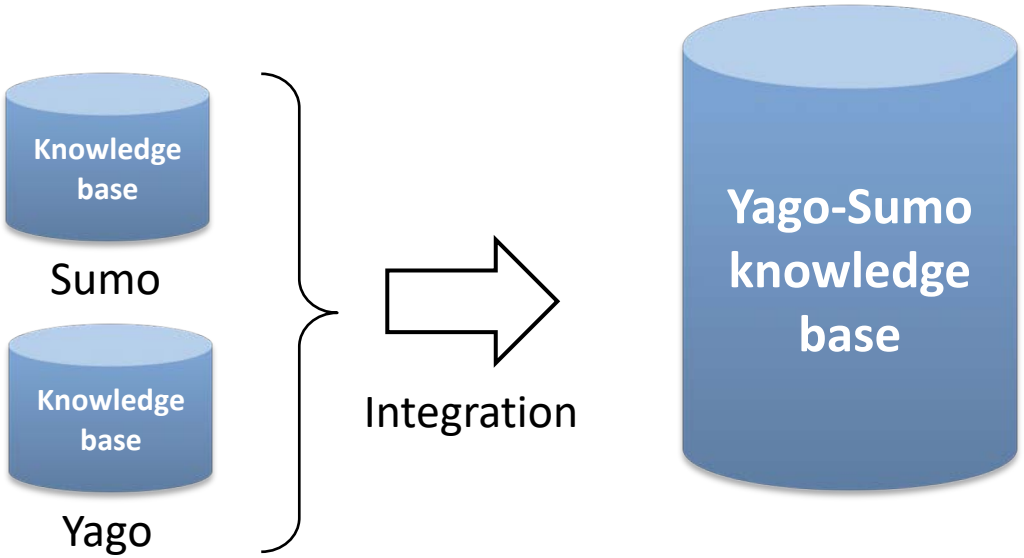
    http://api.conceptnet.io/related/c/en/tea_kettle

What are the strengths and the weaknesses of ConceptNet?

- Strengths
  - Knowledge acquired automatically by integrating other bases
  - Very large size (12.5M edges)
  - Resources on line: knowledge base download, web API
- Weaknesses
  - Limited expressivity (semantic network)
  - Limited inference (analogy)
  - Incomplete and heterogeneous

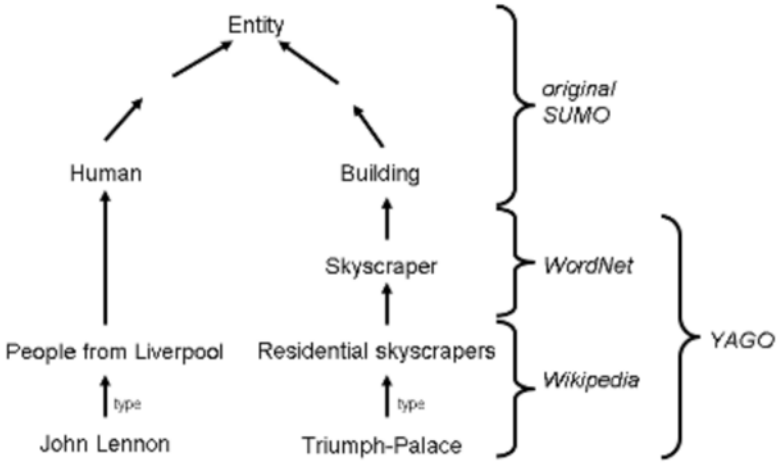
Yago-Sumo integrates two common sense knowledge bases

http://gerard.demelo.org/yagosumo/



[De Melo, et al., 2018]

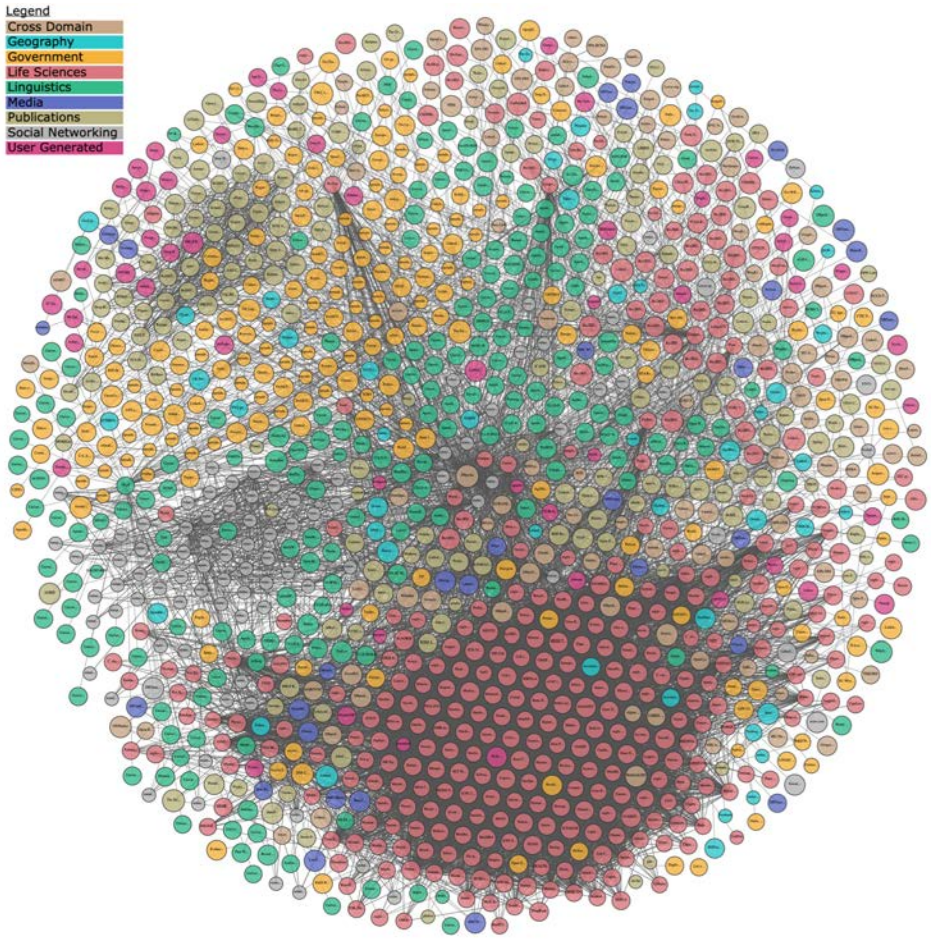
More advanced reasoning is possible compared to the separate version



- Sumo provides additional knowledge represented in first order logic.
- The knowledge base can be downloaded using two alternative languages:
  - SUO-KIF (logic-based language used by Sumo)
  - TPTP used by many theorem provers

Linked Open Data helps integrate the content from different knowledge bases

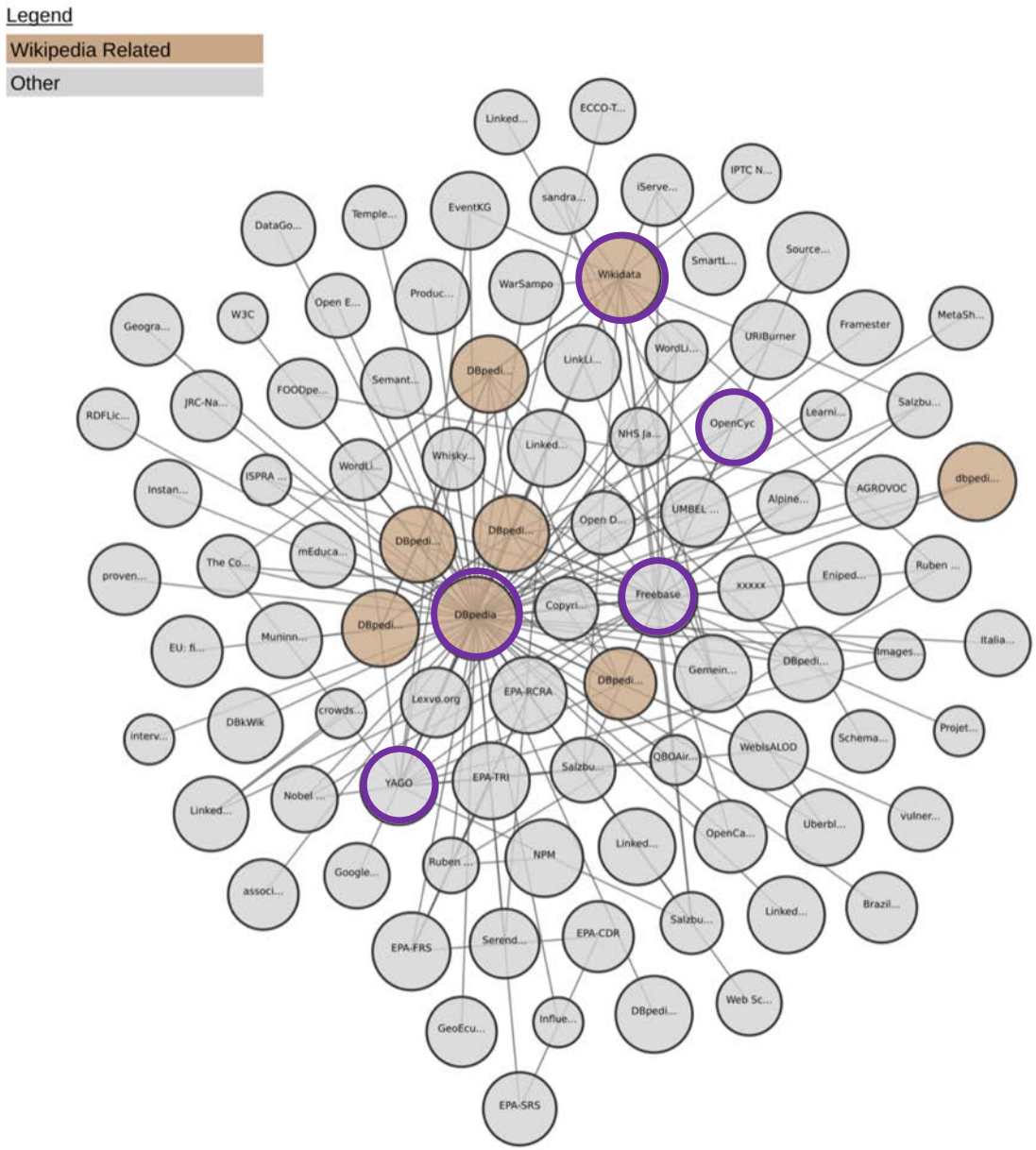
The Linked Open Data Cloud



https://lod-cloud.net/clouds/lod-cloud.svg

Subclouds by domain

Cross-Domain | Geography | Government | Life Sciences | Linguistics | Media | Publications | Social Networking | User-Generated



Course “Common sense reasoning”.

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