

Commonsense Knowledge

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Today's AI lacks Common sense



Figure 1: An image from PASCAL and a high scoring car detection from CPM [8]. Why did the detector fail?



Common sense is the **common** knowledge about the world that is possessed by every schoolchild and the methods for making obvious **inferences** from this knowledge.

Davis, E. (2014). Representations of commonsense knowledge.

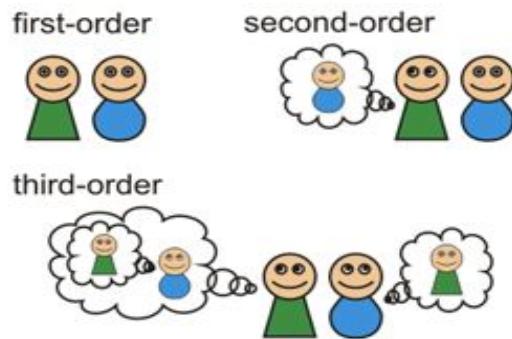
Commonsense knowledge includes the **basic facts** about events (including actions) and their effects, facts about knowledge and how it is obtained, facts about **beliefs** and **desires**. It also includes the basic facts about material **objects** and their properties.

McCarthy, J. (1989). Artificial intelligence, logic and formalizing common sense.

Aspects of common sense



Intuitive physics



Commonsense psychology



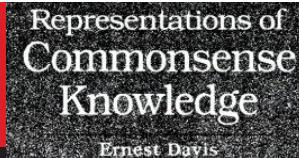
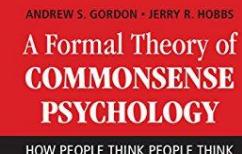
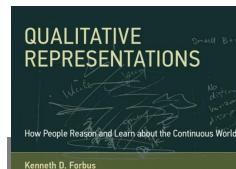
Common facts

PROGRAMS WITH COMMON SENSE

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1959

1 *The Second Naïve Physics Manifesto*

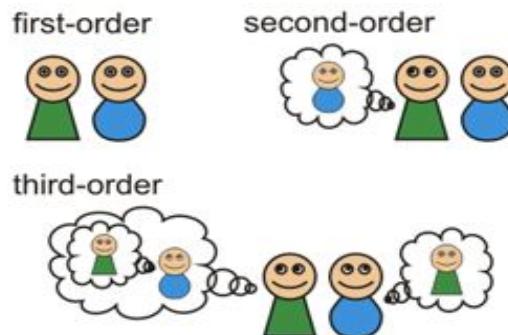
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Aspects of common sense



Intuitive physics



Commonsense psychology



Common facts

Common sense agents should know:

- how to do **all of these things**
- **when** they matter

On stage, a woman takes a seat at the piano. She

1. sits on a bench as her sister plays with the doll.
2. smiles with someone as the music plays.
3. is in the crowd, watching the dancers.
4. nervously sets her fingers on the keys.

(Zellers et al., 2018)

piano is used for...

en performing music →

en music →

en accompanying an orchestra →

Things located at piano

en keys →

en black keys →

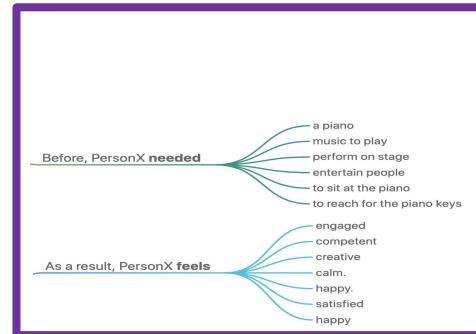
en hammers →

en a keyboard →

ConceptNet: pianos have keys, are used to perform music

- S: (n) piano, pianoforte, forte-piano (a keyboard instrument that is played by depressing keys that cause hammers to strike tuned strings and produce sounds)

WordNet: pianos are played by pressing keys



ATOMIC: to play piano, a person needs to sit at it, on stage and reach for the keys; feelings

On stage, a woman takes a seat at the piano. She

1. sits on a bench as her sister plays with the doll.
2. smiles with someone as the music plays.
3. is in the crowd, watching the dancers.
4. nervously sets her fingers on the keys.

FrameNet: performer entertains audience

Audience [Aud]

The Audience experiences the Performance.

Medium [Medium]

Medium is the physical entity or channel used by the Performer to transmit the Performance to the Audience.

Performance [Perance]

The Performer generates the Performance which the Audience perceives.

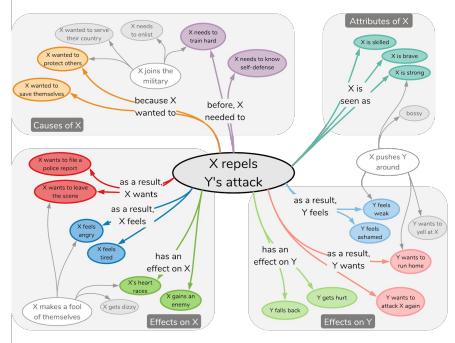
Performer [Perfer]

The Performer provides an experience for the Audience.

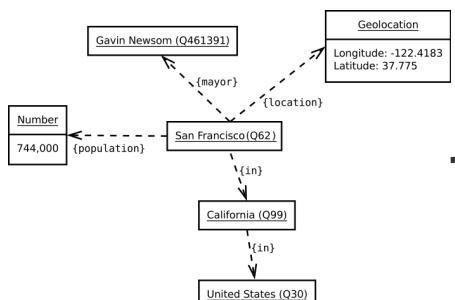
Visual Genome: person can play a piano while sitting, his hands are on the keyboard

man plays piano
keys ON piano
woman watches man
pillow ON couch
light ON wall
window IN room
person playing piano
guy ON bench
hands ON keyboard

Consolidated Commonsense Knowledge Graph (CSKG)

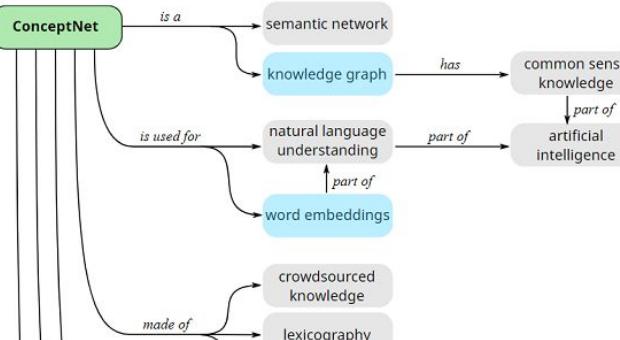
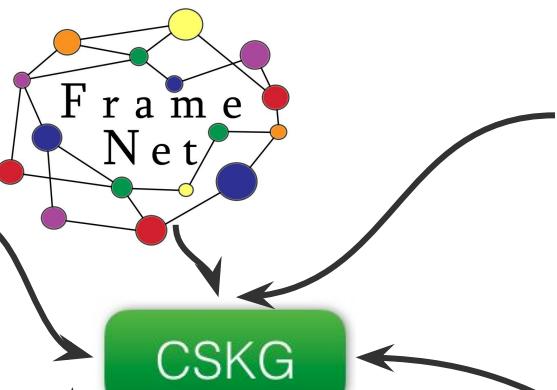


ATOMIC (Sap et al. 2019)



Wikidata (Vrandecic and Krotzsch 2014)

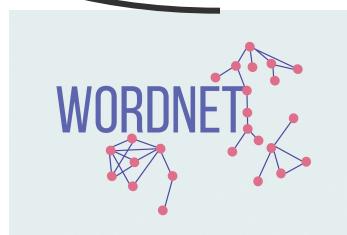
FrameNet (Baker et al., 1998)



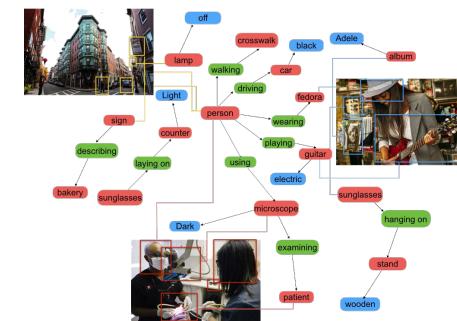
ConceptNet (Speer, Chin and Havasi 2017)

CSKG

CSKG (Ilievski et al. 2021)

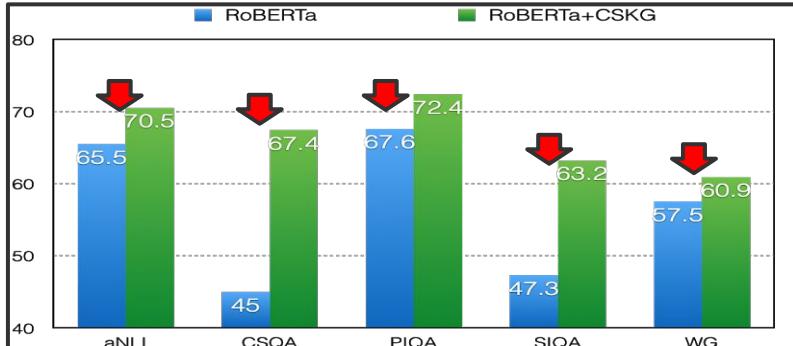
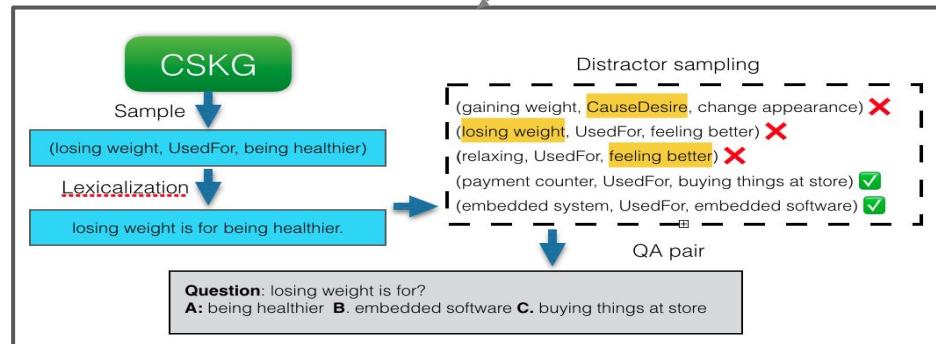
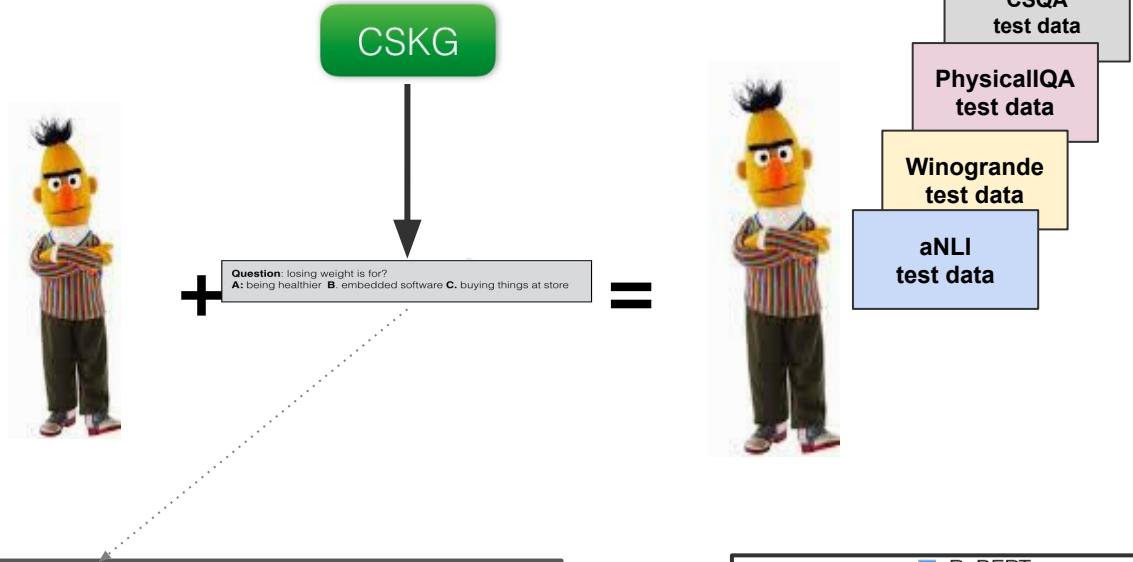


WordNet (Miller 1995)



Visual Genome (Krishna et al. 2017)

Question Answering with CSKG



Category	Source	# Relations	Subject	Relation	Object
Commonsense KG	ConceptNet*	34	food	capable of	go rotten
	ATOMIC	9	person X bakes bread	xEffect	eat food
	GLUCOSE	10	someone makes something that is food	Causes/Enables	someone eats something
	WebChild	4 groups	restaurant food	quality	expensive
	Quasimodo	78,000	pressure cooker	cook faster	food
	SenticNet	1	coldfood	polarity	negative
	HasPartKB	1	dairy food	has part	vitamin
	Probase	1	apple	is a	food
	Isacore	1	snack food	is a	food
Common KG	Wikidata	6,700	food	has quality	mouthfeel
	YAGO4	116	banana chip	type	food
	SUMO*	1,600	food	hyponym	food product
Lexical resource	WordNet	10	food	hyponym	comfort food
	Roget	2	dish	synonym	food
	FrameNet	8	cooking	has frame element	creation
	MetaNet	14	Food	has role	food
	VerbNet	36	feed.v.01	Arg1	PPT
Visual source	Visual Genome	42,000	food	on	plate
	Flickr30k	1	a food buffet	corefers with	a food counter
Corpora and LMs	LMs		Aardvarks search for food		
	GPT		Food causes a person to be hungry and a person to eat		

Dimensions of common sense

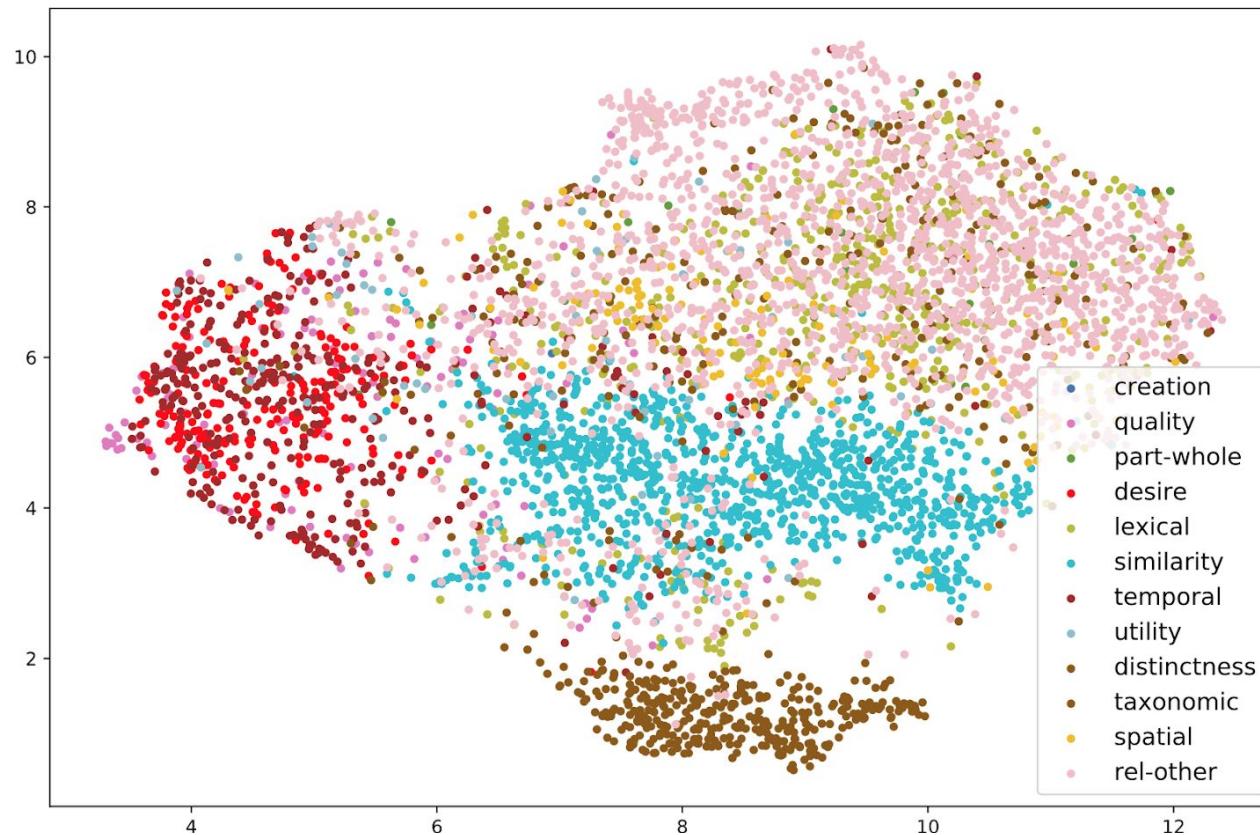
Dimension	Example (food)	Source
lexical similarity	derivationally related form: nutrient	WordNet
distinctiveness	synonym: dish	ROGET
taxonomic	opposite of: non-food item	Wikidata
part-whole	hypernym: substance	WordNet
spatial	things with food: minibar	ConceptNet
creator	located near: plate	Visual Genome
utility	is created by: cook	COMET
motivational	used for: pleasure	ConceptNet
quality	xWant: watch movie together - get some food	ATOMIC
comparative	has the property: tasty	COMET
temporal	healthier: home cooking - fast food	WebChild
relational-other	has effect: food allergy	Wikidata
	related to: refrigerator	ConceptNet

CS knowledge by dimension

(thousands of triples)

Dimension	ATOMIC	ConceptNet	WebChild	Roget	WikidataCS	WordNet	FrameNet
lexical		704			0.5	207	14
similarity		255	343	1,023	1	152	0.4
distinctiveness		22		381	7	4	
taxonomic		244	783		73	89	23
part-whole		19	5,752		8	22	
spatial		28	660		0.5		
creation		0.3			0.2		
utility		69	2,843		2		1
motivational	244	20					
quality	143	9	6,510		1		11
comparative			813				
temporal	346	71	2,135		3		0.6
relational-other		1,969	291		6		0.7

Little agreement with RoBERTa embeddings



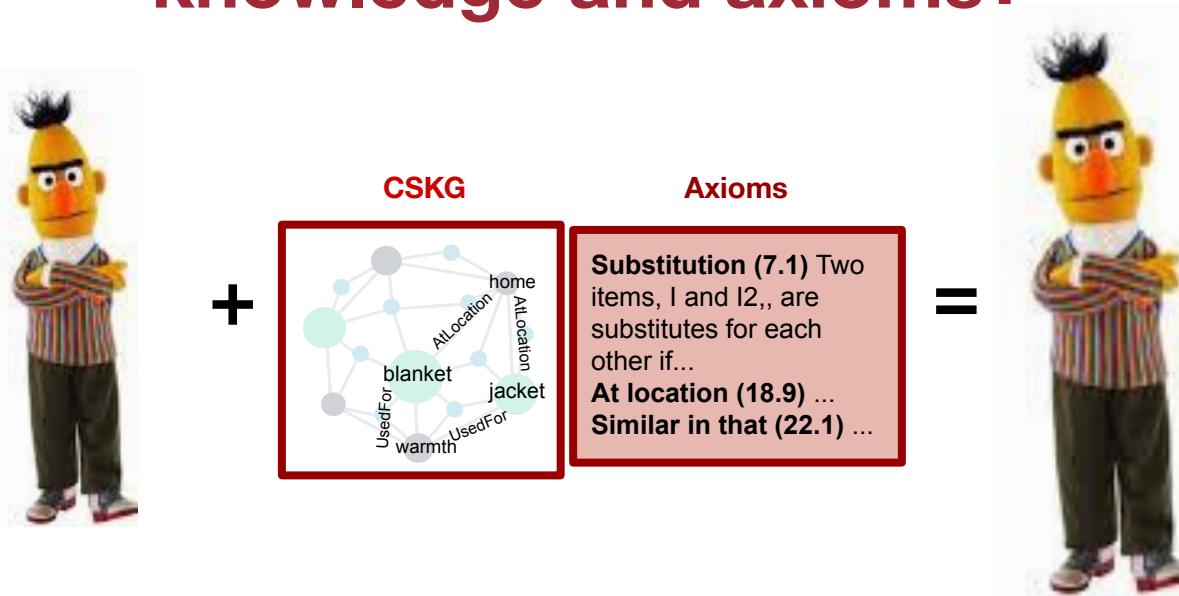
Pre-training models with one dimension at a time

CSQA = Commonsense QA

S/QA = Social/QA

Dimension	CSQA	SIQA
lexical	45.0	47.3
similarity	61.4	53.5
distinctiveness	57.2	50.2
taxonomic	62.6	52.2
part-whole	63.0	52.6
spatial	63.3	53.1
creation	49.9	47.8
utility	67.4	54.8
motivational	65.0	60.0
quality	65.7	60.0
temporal	67.3	62.6
relational-other	58.2	51.3
all	66.2	61.0

Can we generate stories with commonsense knowledge and axioms?



Prompt	Our method
I went to the street corner.	<i>There was a mailbox but it had no letter slot. (S, I)</i>
There was clock in the table.	<i>I wanted to use it to keep a(n) time. (S)</i>
I went to the city.	There was a runway but it had no plane.

Comparison with vanilla GPT-2:

- Much more reasonable
- Similarly interesting

Far from perfect

Remaining **ambiguity** and variance

Sparse **overlap** and mappings

Lack of **context** and boundaries

Wide span of **granularities** of relations and nodes

Low-quality or low-recall **acquisition** methods

Representation methods with limited semantics or expressivity

Diversity of source **intents** and perspectives

Confirmed Keynote Speakers

AAAI'21 Workshop on Commonsense Knowledge Graphs...

Organizers

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Confirmed Panelists

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Confirmed Keynote Speakers:

- Jejin Choi, University of Washington
- Joshua Tenenbaum, MIT
- Filip Ilijevski
- Alessandro Oltra...
- Deborah McGuinness, Rensselaer Polytech.
- Pedro Szekely, Vrije Universiteit Brussel
- Eduard Hovy, University of Southern California
- Antoine Bosselut, Stanford University
- Simon Razniewski, MPI for Intelligent Systems
- Mayank Kejriwal, Vrije Universiteit Brussel

Confirmed Panelists:

- Watch on YouTube
- Filip Ilijevski, Google Brain & CNRS
- Eduard Hovy, University College D...
- Tony Veale, University College D...

AAAI'21
Workshop on
CSKGs

Thanks!

Commonsense Knowledge Acquisition & Representation



Special Issue on Commonsense Knowledge and Reasoning



Guest editors

The guest editors can be reached at commonsense-swj@googlegroups.com.

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Commonsense Knowledge Graphs

ISWC'20 Tutorial



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AI Futures Symposium

AI with Common Sense

December 7-8, 2021

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Research Presentations

Commonsense Reasoning

Filip Ilijevski Open-World Agents

Manuel Ciosici Predicting Events

Ram Nevatia Visual Grounding

Xiang Ren Explaining with Common Sense

Common Sense for Creativity

Mayank Kejriwal Generating New Ideas

Fred Morstatter Biases in Common Sense

Jay Pujara Explaining Stories and Dialogues

Emmanuel Johnson Negotiating Agents

Commonsense Knowledge

Pedro Szekely Dimensions of Common Sense

Marjorie Freedman Learning Common Sense

Muhao Chen Robust Knowledge Acquisition

Yolanda Gil Crowdsourcing Common Sense

Common Sense in AI Agents and Robots

Jon Gratch Modeling Emotions

Stefanos Nikolaidis Self-Diagnosis of Robot Failures

Maja Matarić Trust and Deception in Robots

Michael Pazzani User-Centric Explainable AI

Keynote

Models of core common sense in infancy

Tomer Ullman, Harvard University

Artificial General Intelligence and Common Sense

Catherine Havasi, Kenneth Forbus, Vered Schwarz

Panel

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