Meaning Representation and Parsing in Natural Language Processing

Daniel Hershcovich

IFRO 4 May 2021

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Sentiment Classification

★ ★ ★ ★ ★ a year ago

Lovely experience. Always nice to see the animals up close.



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Sentiment Classification

★ ★ ★ ★ ★ a year ago

Lovely experience. Always nice to see the animals up close.



Sapiens: A Brief History of Humankind by Yuval Noah Harari

Sentiment Classification

★★★★★ a year ago

Lovely experience. Always nice to see close.

★★★★★ 8 months ago I was extremely disappointed. The entire 5 fllight. It is very difficult to see the exhibition. little when we came up on the 6th floor.

Zoological Museum

Customer reviews

★★★★★ 4.6 out of 5

39,742 global ratings

5 star	799
4 star	139
3 star	49
2 star	29
1 star	20



The Matrix (1999) User Ratings ★8.7 ☆Rate

IMDb Users

Write a review

1,692,465 IMDb users have given a weighted average vote of 8.7 / 10



• How long do visitors typically stay?

Image: A matched by the second sec

- How long do visitors typically stay?
- Do people typically come with their kids?

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- How long do visitors typically stay?
- Do people typically come with their kids?
- Are there more boys or girls visiting?

- How long do visitors typically stay?
- Do people typically come with their kids?
- Are there more boys or girls visiting?
- Do visitors with kids spend more time there?

- How long do visitors typically stay?
- Do people typically come with their kids?
- Are there more boys or girls visiting?
- Do visitors with kids spend more time there?

Me and my son spent 2 hours there.

Participants Action Time Location

Scaling Up Qualitative Studies



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Translate:

Dave Grossman and Jack Thompson argue that violent games are harmful

Dave Grossman og Jack Thompson hævder, at voldsomme spil er skadelige

Recognize entities:

Dave Grossman and Jack Thompson argue that violent games are harmful

Infer:

Violence in games hardens children to unethical acts ↓ entails Violent games are harmful

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IBM Debater

Al system that can debate humans on complex topics

	Pre-debate: both sides receive the motion and prepare Moderator introduces the motion to the audience	15 min
Opening speeches	Project Debater delivers the 'government' opening speech Human debater delivers the 'opposition' opening speech and replies	4 min 4 min
Second	Project Debater offers rebuttal and additional points	4 min
speeches	Human debater offers rebuttal and additional points	4 min
Summary	Project Debater provides final rebuttal and closing statements	2 min
speeches	Human debater provides final rebuttal and closing statements	2 min

Slonim et al. "An autonomous debating system." Nature (2021)

Image: A matrix and a matrix

Which Sesame Street ? is your favorite?



Which ? Street character is your favorite?



Which Sesame ?

character is your favorite?



? Sesame Street character is your favorite?



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Which Sesame Street character ? your favorite?



Which Sesame Street character is ?

favorite?



Which Sesame Street character is your ?





Which Sesame Street character is your favorite?

BERT, RoBERTa, XLM-R, ... GPT, GPT-2, GPT-3





Dave Grossman and Jack Thompson argue that violent games are harmful .

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Image: A matrix and a matrix

Dependency Parsing



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[Meaning], [Representation] and [Parsing]

1. What we mean, 2. How to represent (something), 3. How to parse (something)

or

[Meaning Representation] and [Parsing] 1. How to represent what we mean, 2. How to parse (something)

or

[Meaning [Representation and Parsing]] 1. How to represent what we mean, 2. How to parse what we mean

or

[Meaning Representation] and [Parsing *(to Meaning Representation)*] 1. How to represent what we mean, 2. How to parse (1)

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or

[Meaning [Representation and Parsing]] 1. How to represent what we mean, 2. How to parse what we mean

or

[Meaning Representation] and [Parsing *(to Meaning Representation)*] 1. How to represent what we mean, 2. How to parse (1)

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Meaning Representation Graphs

Abend and Rappoport. "Universal Conceptual Cognitive Annotation (UCCA)". ACL (2013)



Meaning Representation Graphs

Abend and Rappoport. "Universal Conceptual Cognitive Annotation (UCCA)". ACL (2013)



Meaning Representation Graphs



Hershcovich et al. "Content Differences in Syntactic and Semantic Representations". NAACL (2019)

Hershcovich et al. "Comparison by Conversion: Reverse-Engineering UCCA from Syntax and Lexical Semantics". COLING (2020)

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Implicit Elements



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Implicit Elements



Cui and Hershcovich. "Refining Implicit Argument Annotation for UCCA." *DMR* (2020)

Different Frameworks to Represent Meaning



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Parsing



SHIFT, RIGHT-EDGE_A, SHIFT, SWAP, RIGHT-EDGE_P, REDUCE, SHIFT, SHIFT, NODE_R, REDUCE, LEFT-REMOTE_A, SHIFT, SHIFT, NODE_C, REDUCE, SHIFT, RIGHT-EDGE_P, SHIFT, RIGHT-EDGE_F, REDUCE, SHIFT, SWAP, RIGHT-EDGE_D, REDUCE, SWAP, RIGHT-EDGE_A, REDUCE, REDUCE, SHIFT, REDUCE, SHIFT, RIGHT-EDGE_C, FINISH

Hershcovich et al. "A Transition-Based Directed Acyclic Graph Parser for UCCA". ACL (2017)

TUPA: Transition-based UCCA Parser

Parses text to graph incrementally by applying transitions to its state.

TUPA: Transition-based UCCA Parser

Parses text to graph incrementally by applying transitions to its state.

Initial state:

stack

buffer

They	thought	about	taking	a	short	break
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TUPA: Transition-based UCCA Parser

Parses text to graph incrementally by applying transitions to its state.

Initial state:



Transitions:

{Shift, Reduce, $NODE_X$, Left-Edge_X, Right-Edge_X, Left-Remote_X, Right-Remote_X, Swap, Finish}



\Rightarrow Right-Edge_A





 \Rightarrow Swap



\Rightarrow Right-Edge_P



 \Rightarrow Reduce







 $\Rightarrow \text{NODE}_R$



 \Rightarrow Reduce



 \Rightarrow Shift



\Rightarrow Left-Remote_A





 $\Rightarrow \text{NODE}_{\mathcal{C}}$



 \Rightarrow Reduce





\Rightarrow Right-Edge_P





 \Rightarrow Right-Edge_F



 \Rightarrow Reduce





 \Rightarrow Swap



\Rightarrow Right-Edge_D



 \Rightarrow Reduce



 \Rightarrow Swap



 \Rightarrow Right-Edge_A



 \Rightarrow Reduce



 \Rightarrow Reduce





 \Rightarrow Reduce





$\Rightarrow \operatorname{Right-Edge}_{\mathcal{C}}$


Example: TUPA Transition Sequence

 \Rightarrow Finish



TUPA Model

Learns to predict next transition based on current state.



Sharing



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Sharing



Improves UCCA parsing in English, French and German.

Hershcovich et al. "Multitask Parsing Across Semantic Representations". ACL (2018)

Parsing Competitions

Improvements in 5 frameworks and 5 languages (English, French, German, Chinese and Czech).



- Hershcovich et al. "SemEval-2019 task 1: Cross-lingual semantic parsing with UCCA". SemEval (2019)
- Oepen et al. "MRP 2019: Cross-Framework Meaning Representation Parsing". CoNLL (2019)
- Oepen et al. "MRP 2020: The Second Shared Task on Cross-framework and Cross-Lingual Meaning Representation Parsing". *CoNLL* (2020)

Meaning Representations Explain *Human* Language Processing



Abdou et al. "Does injecting linguistic structure into language models lead to better alignment with brain recordings?". (2021)

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Meaning Representations Help Answering Questions



Image: A mathematical states and a mathem

What Else Can We Do?

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What Else Can We Do?

Average amount of fruits and vegetables available per person per year (kg)



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What Else Can We Do?



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Conclusion

Symbolic meaning representation

- Scales qualitative studies
- Can be generated accurately by parsers
- Makes NLP interpretable
- Facilitates question answering

Conclusion

Symbolic meaning representation

- Scales qualitative studies
- Can be generated accurately by parsers
- Makes NLP interpretable
- Facilitates question answering
- Can do a lot more!

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