A Uniform Model for Generative and Discriminative Commonsense Knowledge Tuples

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1. Background

- Commonsense knowledge is possessed by most humans and helps them in everyday situations [1].
- Types of knowledge include generative (*apple is a fruit*) and discriminative (*apple is a fruit but a cucumber isn't*) [2]
- Both types can either be positive or negative: *cucumber is not a fruit* is negative generative knowledge and *a pear and an apple are both fruits* is negative discriminative knowledge (we can't differentiate them) [2].
- Existing models for commonsense knowledge are not fit for negative and discriminative knowledge

2. Research Question

How to organize discriminative and generative knowledge tuples into a unified model?

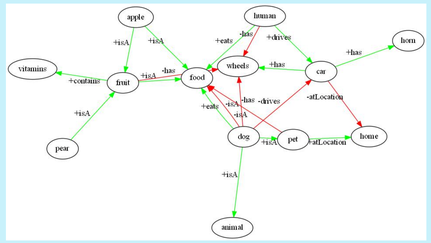
3. Methodology

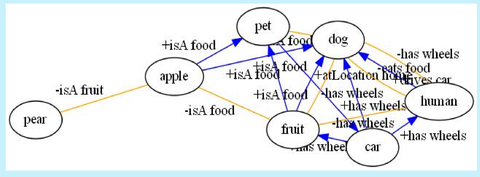
1. Create queries for evaluation
2. Create models
3. Evaluate models on criteria

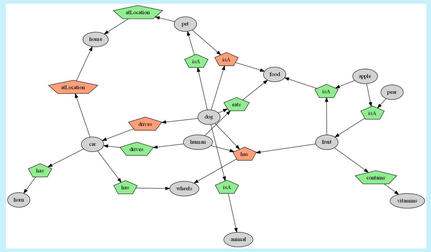
4. Queries

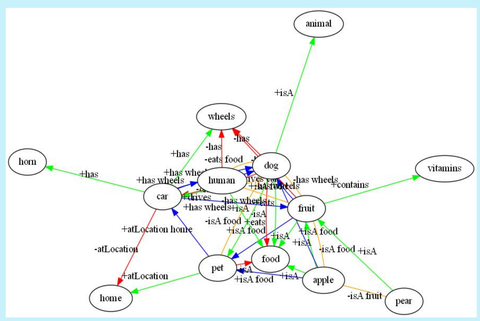
1. Given a concept and a sign, what are the relations and inputs?
2. Given a concept, relation and a sign, what are the inputs?
3. Given a concept, relation, sign and input does it exist?
4. On what relation-input combinations do two concepts differ?
5. On what relation-input combinations don't two concepts differ?
6. Can we differ two concepts for a specific relation and input?

5. Models









6. Results

Model:	Generative	Discriminative	Combined	Hypergraph
Query 1	O(E)	-	O(E)	O(HA)
Query 2	O(E)	-	O(E)	O(HA)
Query 3	O(E)	-	O(E)	O(A)
Query 4	$O(E^2)$	O(L)	O(L)	O(HA)
Query 5	$O(E^2)$	O(L)	O(L)	O(HA)
Query 6	O(E + E)	O(L)	O(L)	O(A)
Storage	|G|	|D|	|G| + |D|	|H|

7. Comparing

- Discriminative model can't execute all queries → not suitable
- Combined model fastest in executing queries but expensive in storage
- Generative and hypergraph model are relatively comparably cheap in storage
- Generative model is faster in executing queries than hypergraph and is therefore preferred.

8. Conclusions

- Two suitable models: Generative and Combined model
- Which model is more useful depends on the application and available resources

References

[1] F. Ilievski, A. Oltramari, K. X. Ma, B. Zhang, D. L. McGuinness, and P. Szekely, "Dimensions of commonsense knowledge," *Knowledge-based Systems*, vol. 229, p. 107 347, 2021, issn: 0950-7051. doi: 10.1016/j.knosys. 2021.107347.

[2] A. Balayn, G. He, A. Hu, J. Yang, and U. Gadiraju, "Ready Player One! Eliciting Diverse Knowledge Using A Configurable Game," in *Proceedings of the ACM Web Conference 2022*, ser. WWW '22, New York, NY, USA: Association for Computing Machinery, Apr. 25, 2022, pp. 1709-1719

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