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How high is 'good', how low is 'bad'? Do Word Embedding Spaces Encode Conventional Metaphor

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Motivation

1) Better understanding word embeddings
- word embeddings aim to model meaning in language
- figurative meaning is a part of how language means

2) Application: studying metaphor at scale
- more language data available
- semantic projection for modeling metaphor

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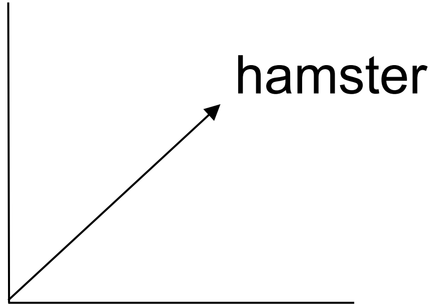
Outline

- Word Embeddings
- Semantic Projection for Literal Meaning
- Semantic Projection for Metaphor
- Results
- Conclusion and Future Directions

Word Embeddings

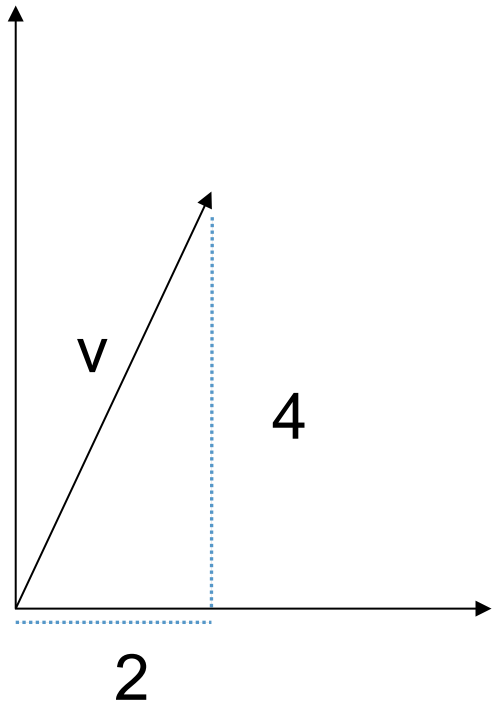
words as vectors

hamster →



What is a Vector?

$v = (2, 4)$



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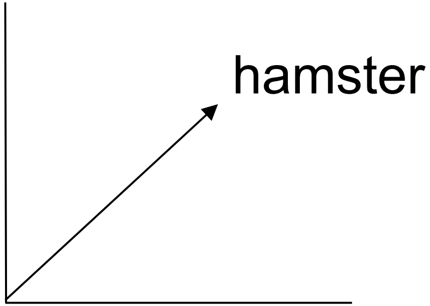
Word Embeddings

words as vectors

hamster $\xrightarrow{?}$



meaning in language $\xrightarrow{?}$ spatial, numeric representation

From Words to Vectors

The particular shape of a word’s vector is learned from the word’s distribution in a corpus.

Pre-trained GloVe embeddings:

- CommonCrawl corpus
- 42 billion tokens
- 300 dimensional vectors

Distributional Hypothesis

Words with similar distributions tend to have similar meanings (Firth, 1957; Harris, 1954)

↓

(The vectors of) words that have similar distributions are closer together in the word embedding space.

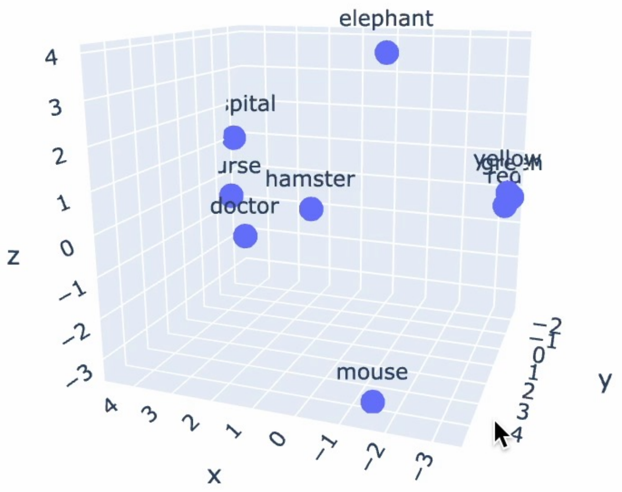
Word Embeddings in Action

<u>Some Words</u>

hamster, elephant, mouse

yellow, green, red

hospital, nurse, doctor



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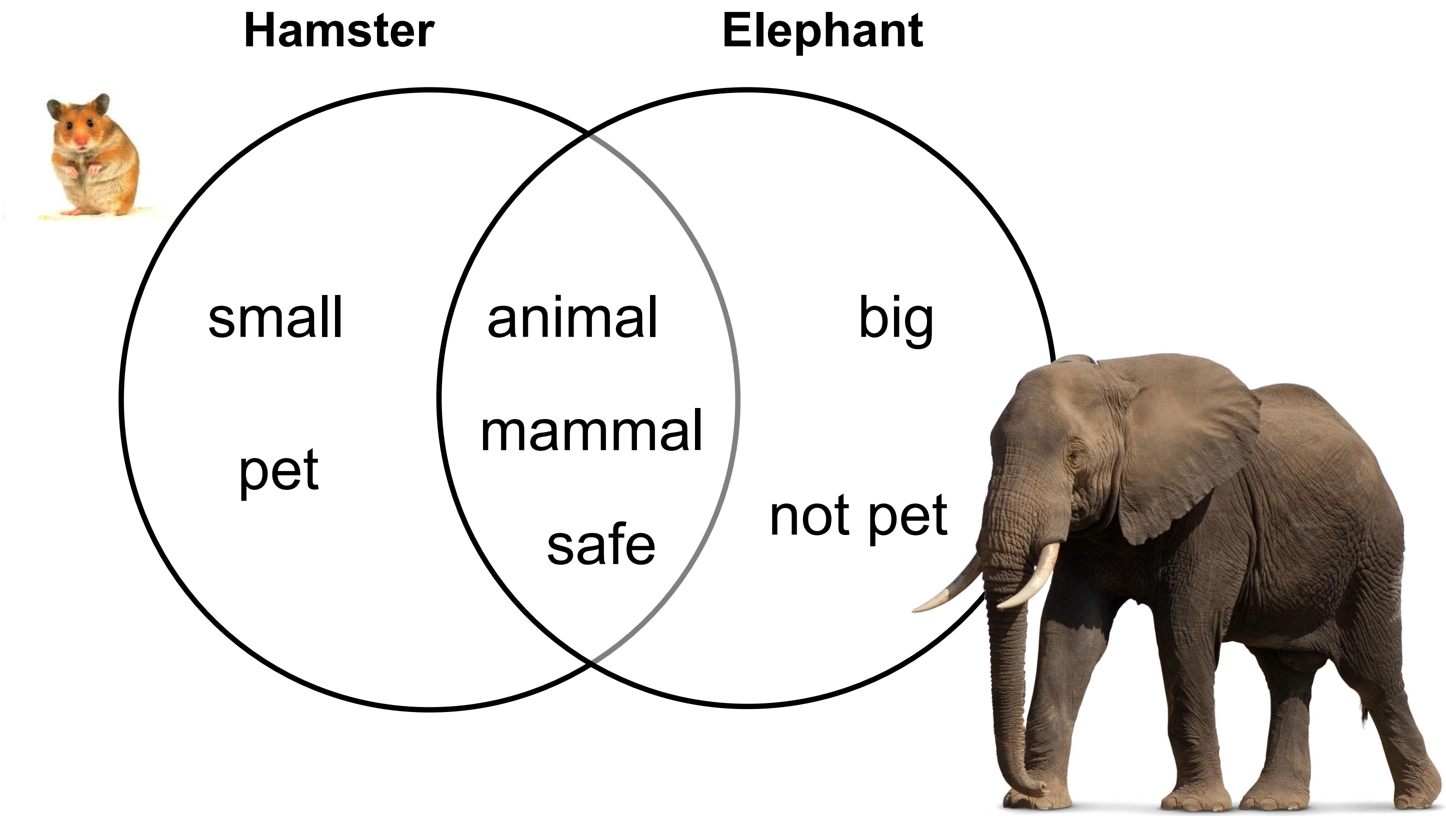
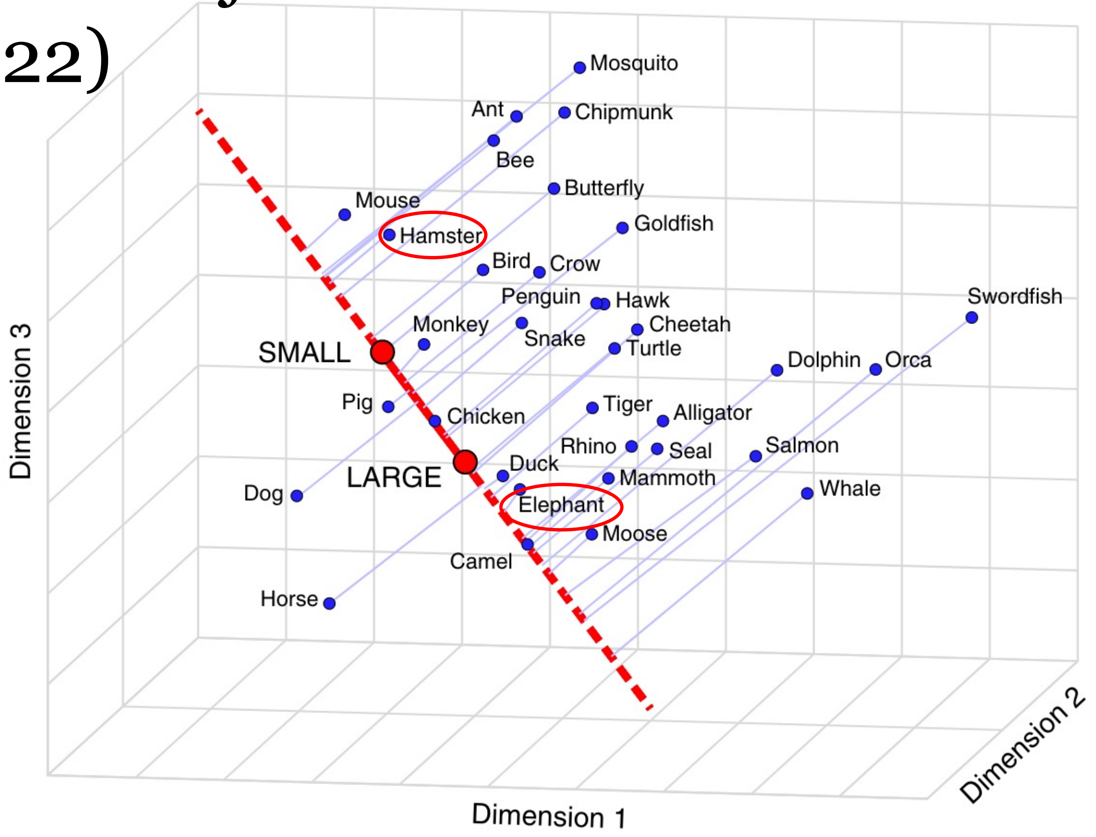
Problem: Similarity is Context-Dependant



Solution: Semantic Projection (Grand et al., 2022)

Category: Animals

Feature: Size



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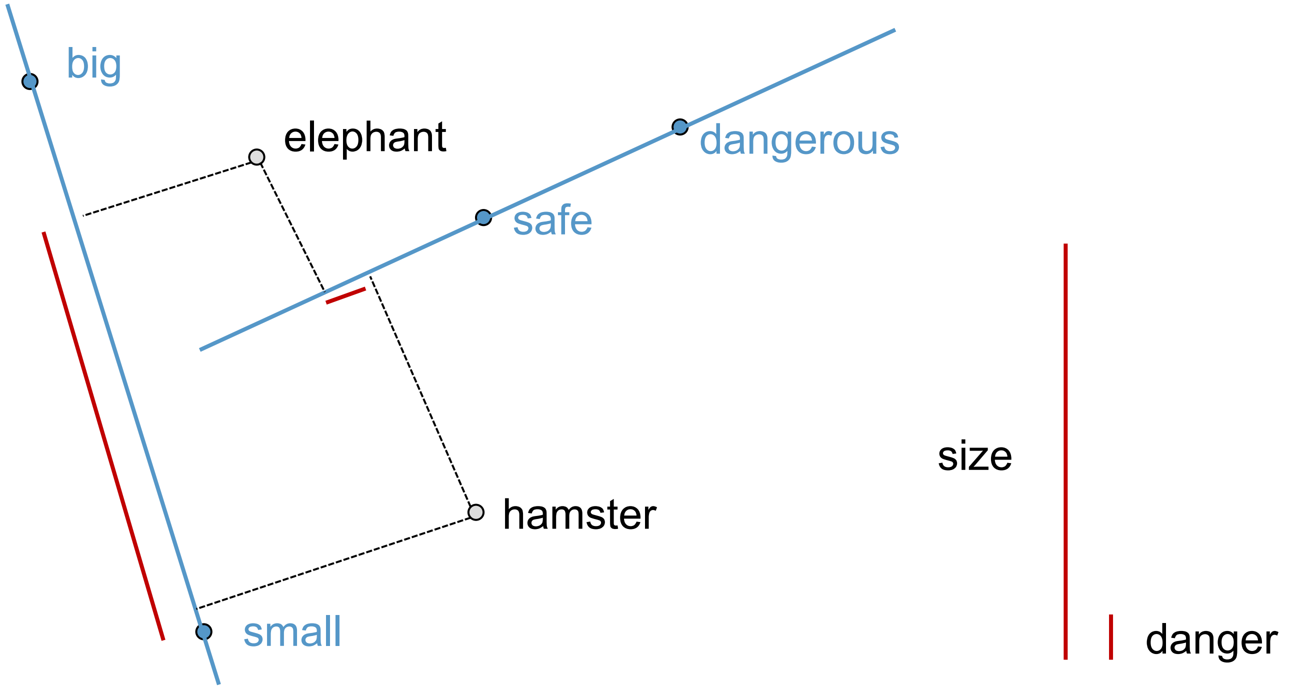
Solution: Semantic Projection (Grand et al., 2022)



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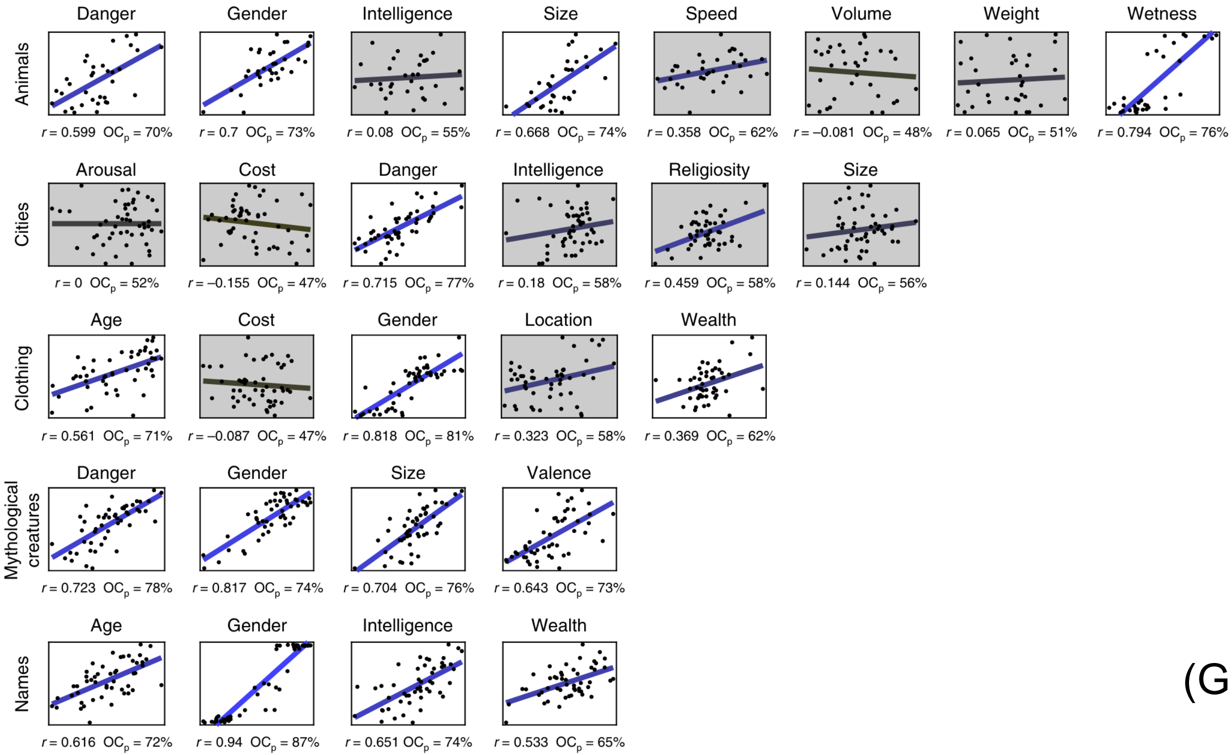
Do Word Embeddings Correlate with Human Ratings? (Grand et al., 2022)



(Grand et al., 2022, p. 5)

Grand et al. (2022) Findings

"These results demonstrate that semantic knowledge about context-dependent similarities is explicitly represented in the structure of word embeddings."
(Grand et al., 2022, p. 7)

Semantic Projection for Conventional Metaphor?

- Case Study: UP/HIGH IS GOOD, DOWN/LOW IS BAD
- feeling *up*, feeling *low;* thumbs *up*, thumbs *down*
- vertical orientation (source domain) → emotional valence (target domain)
- experimental evidence: participants prefer vertical axis when ordering emotional valence words *best, better, worse, worst* (Woodin and Winter, 2018)

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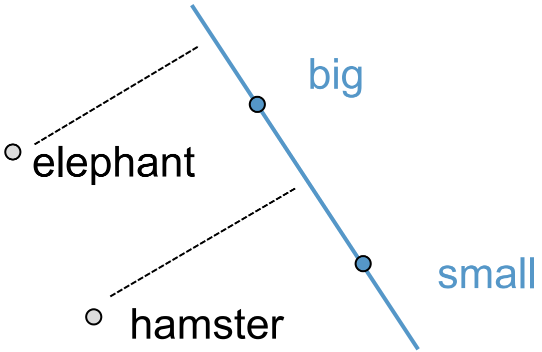
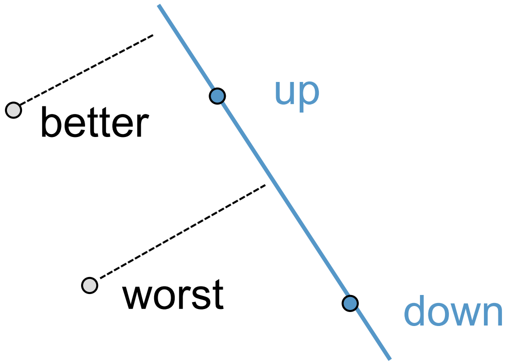
Literal

Feature: literal attribute (e.g. size)
Category: objects (e.g. animals)



Figurative

Feature: source domain (e.g. vertical orientation)
Category: target domain vocabulary (e.g. emotional valence words*)*



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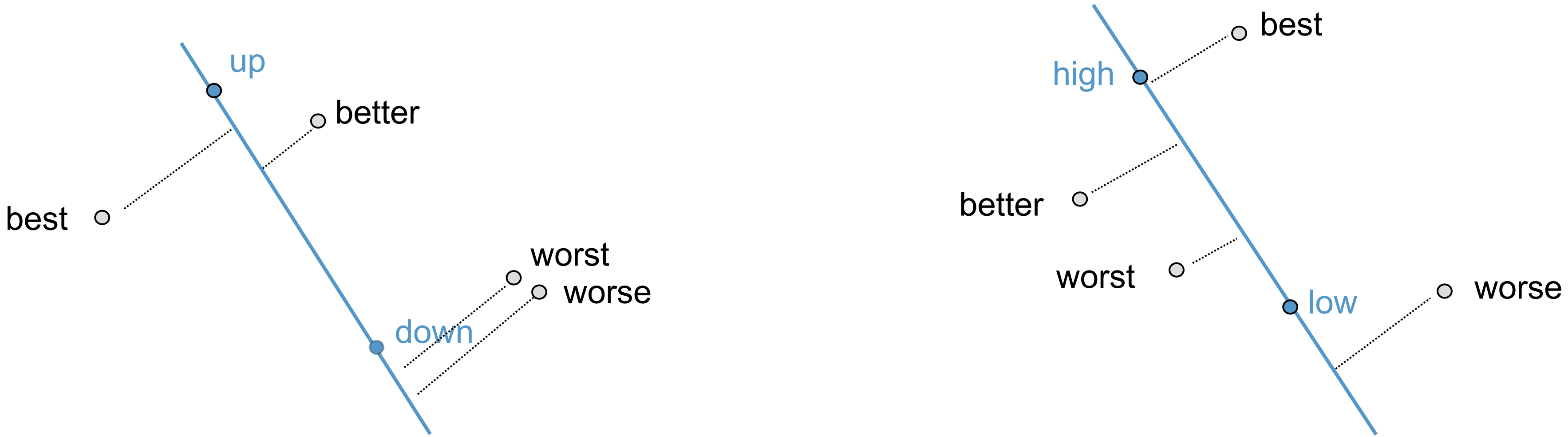
Methods

- Semantic scales: *up-down*, *high-low*
- Words projected: *worst, worse, better, best*
- *good* and *bad* excluded following Woodin and Winter (2018)

Results

best, better, worst, worse



Conclusion

The GloVe word embedding space explicitly represents the context-dependent semantic relationship between source domain and target domain.

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Conclusion

Semantic projection as a method for analysing metaphor at scale.

- develop and test semantic projection ”in the wild”
- study metaphor variation at scale across two sub-reddits:

  r/depression and r/depression_partners

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Thank you.

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References

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- Grand, G., Blank, I. A., Pereira, F., & Fedorenko, E. (2022). Semantic projection recovers rich human knowledge of multiple object features from word embeddings. *Nature human behaviour*, *6*(7), 975-987.
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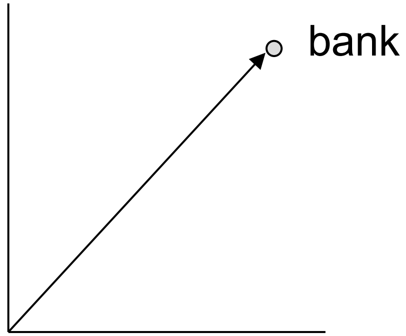
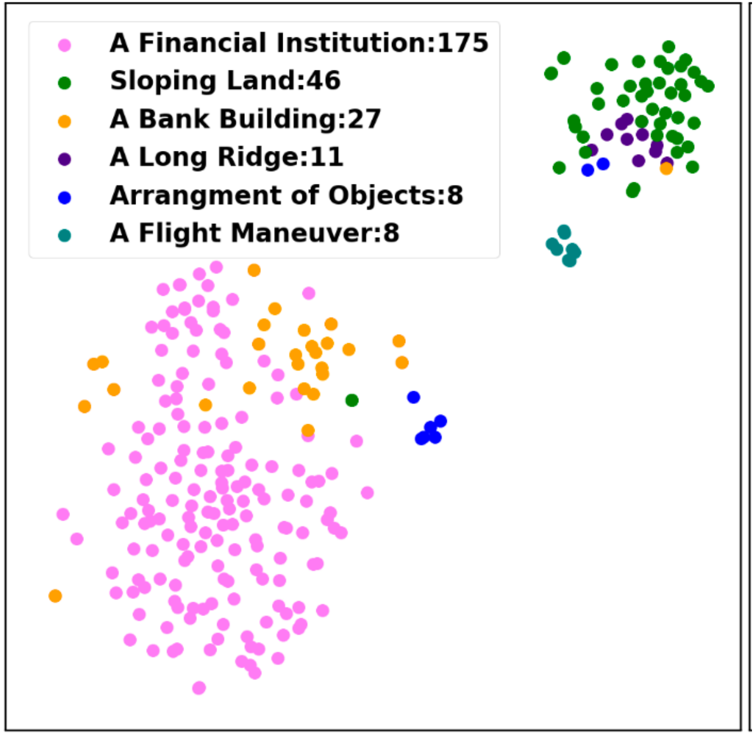
- Pennington, J., Socher, R., & Manning, C. D. (2014). Glove: Global vectors for word representation. In *Proceedings of the 2014 conference on empirical methods in natural language processing (EMNLP)* (pp. 1532-1543).
- Wiedemann, G., Remus, S., Chawla, A., & Biemann, C. (2019). Does BERT make any sense? Interpretable word sense disambiguation with contextualized embeddings. *arXiv preprint arXiv:1909.10430*.

Additional Slides

Type vs. Token Based Word Embeddings





(a) BERT

(Wiedemann et al. 2019, p.8)

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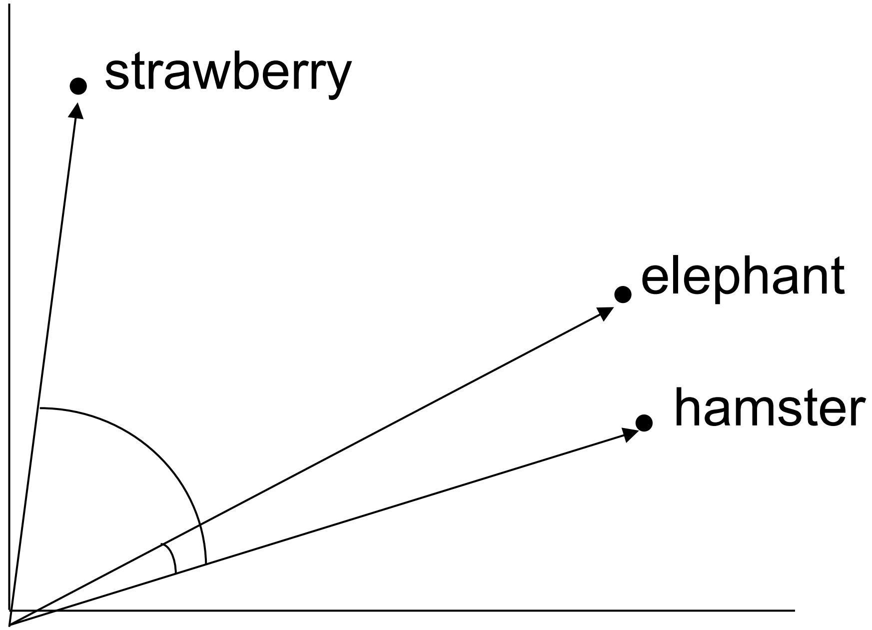
Measuring Word Similarity



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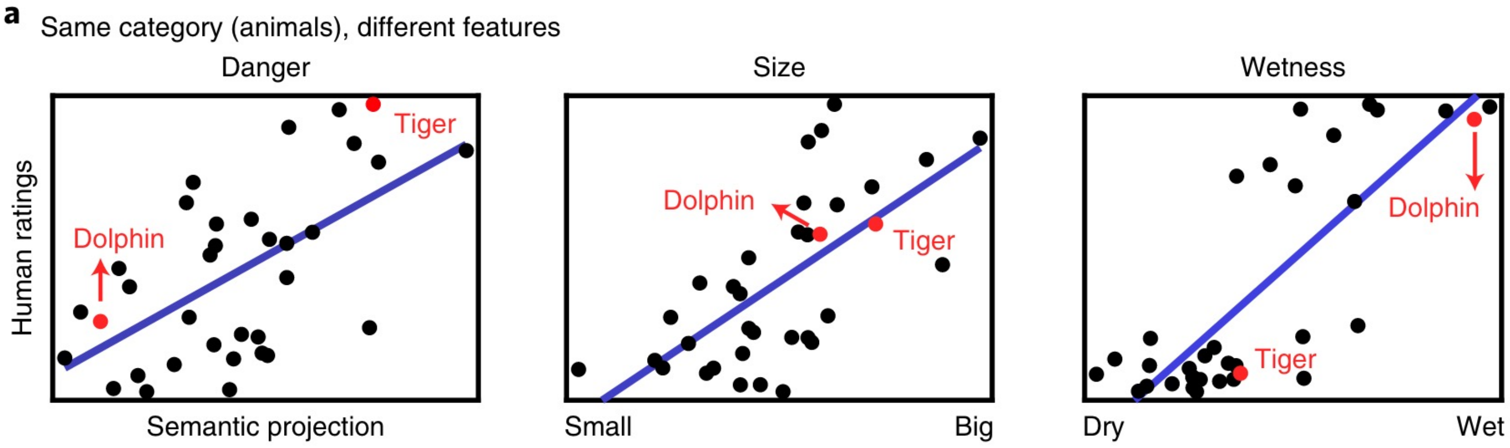

(Grand et al., 2022, p. 3)

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