RatVec: A General Approach for Low-dimensional Distributed Vector Representations via Rational Kernels

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Motivation

Limitations of ”classical” word embedding approaches

- Implicit similarity/relatedness concept only derived from co-occurrence (distributional hypothesis)
- We may force artificially our data to be sequential
    - Graph node embeddings for link prediction via random walks

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Main idea

1. Apply kernel PCA on a representative subset of the dataset
    - A suitable similarity function (rational kernel) substitutes the dot product.
    - Projection matrix from eigendecomposition of kernel matrix
2. Derive full computing similarity with representative vocabulary and using the the projection matrix
3. Solve particular task with simple algorithms (e.g. *k*-nearest-neighbors).

Dutch Spelling Correction

Idea

1. Pick a suitable string similarity (e.g. n-gram similarity)
2. Generate a vector representation for each word in the vocabulary
3. Generate a vector for detected misspelling
4. Pick closest word in vocabulary from precomputed representations (1-nearest neighbor classification)

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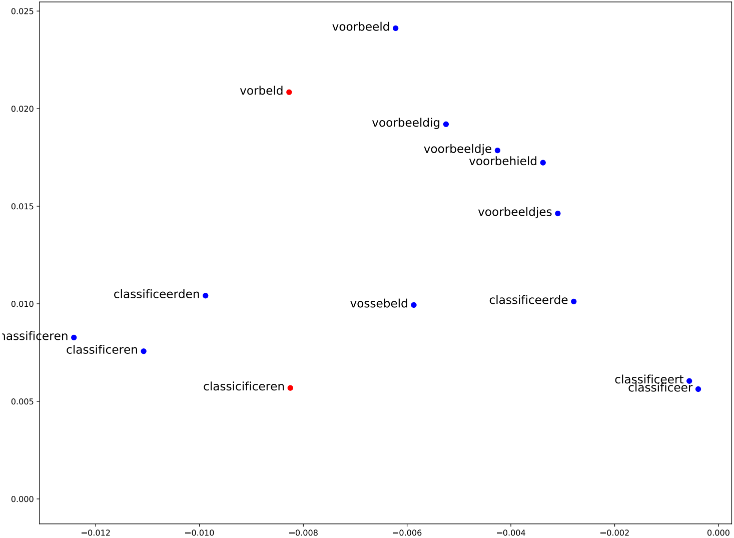
Evaluation

- CLIN28 shared task on spelling correction in Dutch wikipedia texts
- Our team achieved best F1 score among the participants

Dutch Spelling Correction



Protein Family Classification

Idea

- Protein with similar aminoacid sequences belong to the same protein family
- Proteins can be modeled as aminoacid sequences (i.e. strings)
- String similarities applicable

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Evaluation

- Binary classification on balanced datasets extracted from Swiss-Prot
- Weighted average accuracy: 0.93

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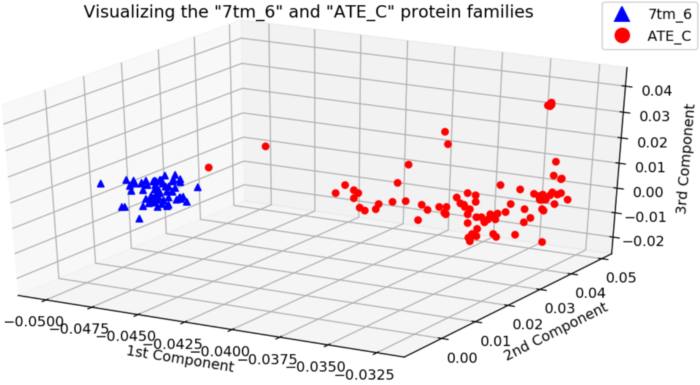

Conclusion

Main Advantages

- Framework for general (non-numeric) entities including text, proteins, and DNA
- Based on explicit similarity functions (rational kernels)
- Resource-aware (representative vocabulary size is adjustable)

Future Work

- Learning optimal similarity metric
- Determine optimal representative vocabulary
- Other uses cases: information retrieval, chemical interaction prediction

Thank you!

Check out our code (available as a PyPi package!):

`https://github.com/ratvec/ratvec`

Questions?

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