Bringing Back Semantics to Knowledge Graph Embeddings: An Interpretability Approach

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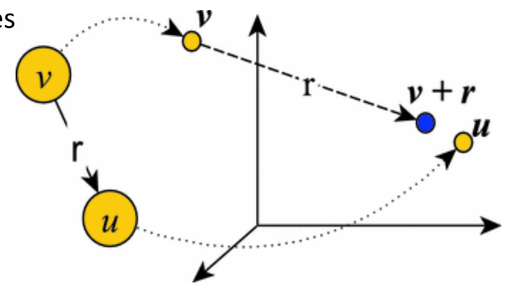
Knowledge Graph Embeddings

- Embed components of KG (entities, relations) into continuous vector spaces.
- Allow easy manipulation of data while preserving inherent structure of KG.
- Several popular models - TransE, RESCAL, DistMult, ComplEx, ConvE…

Main limitations

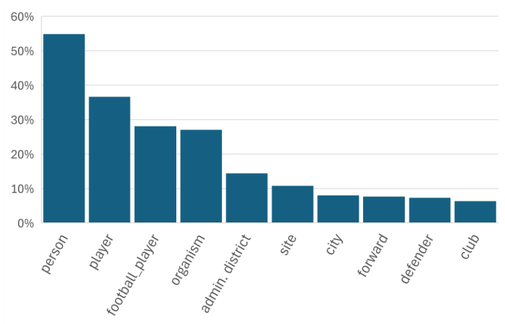
- The dimensions of learned vector spaces do not normally correspond to semantically meaningful properties.
- Similar entities cannot be clustered together.*



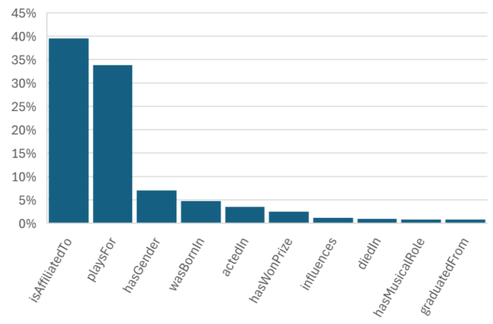
**Hubert et. al., Do Similar Entities have Similar Embeddings? ESWC 2024*

Selection of the features

- We followed the hypothesis: **the most prominent features of an entity in the KG need to be encapsulated in the corresponding entity embedding.**
- To select the features for different entity types, we performed a statistical analysis of the KG.



Distribution of entity types in YAGO3-10



Distribution of relations for type *Person* in YAGO3-10

Interpretation of the output vectors

Example of interpretation of an output vector: the entity Marie Curie

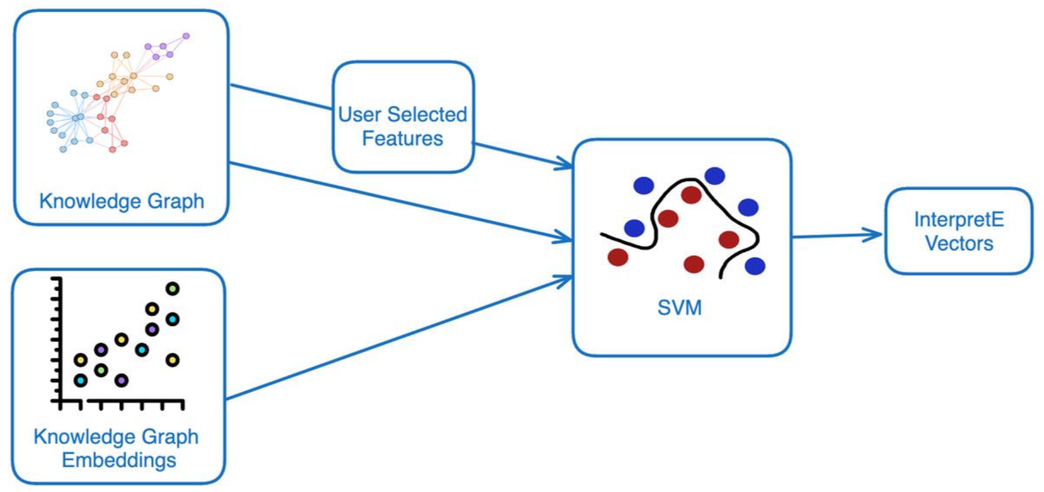
Corresponding feature	Gender	National medal of Science	Nobel Prize of Physics	…	Nobel Prize of Chemistry
Marie Curie's new embedding	0,85	-1,48	1,4	…	2,34
Coordinate's sign	>0	<0	>0	…	>0
Interpretation	The gender of Marie Curie is female	Marie Curie did not receive the National medal of Science	Marie Curie received the Nobel Prize in Physics	…	Marie Curie received the Nobel Prize in Chemistry

Conclusion and Future Work

- The new *InterpretE* embeddings encapsulate the entity features.
- Similar entities are clustered together.
- High flexible method that can be used with any other KG.
- Other binary methods (Logistic Regression…) can be tested instead of SVM.
- Scalibility to be tested on bigger datasets.

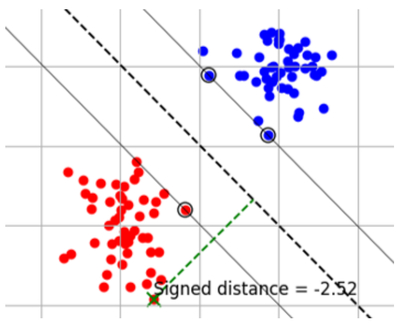
Overview of approach: *InterpretE*

InterpretE enables to generate fully interpretable vectors from a given KG and vectors

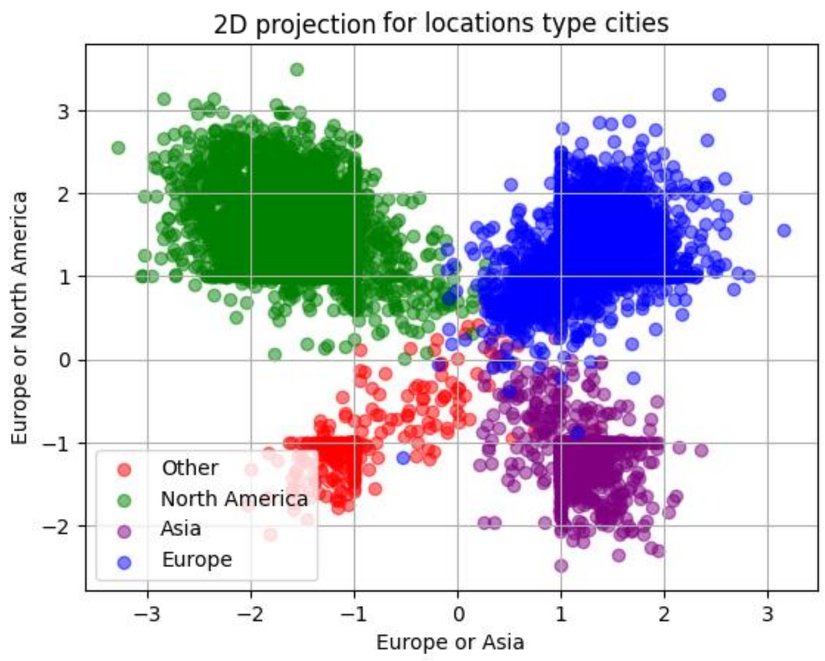


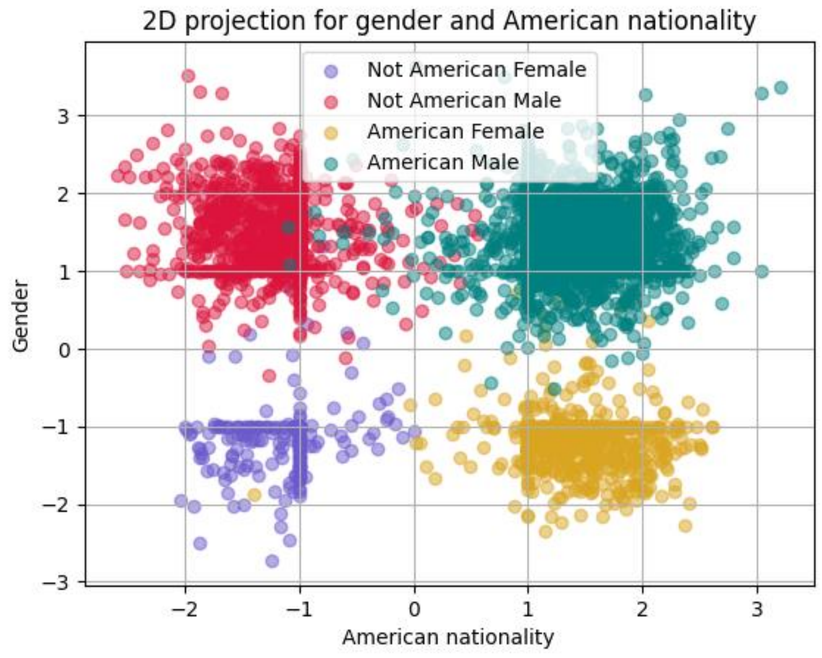
Projection into a new space

- For each entity type, the entities having a specific feature were seperated from others that did not, using SVM.
- Each new coordinate related to a feature was obtained by the decision function (signed distance from the estimated hyperplane).



Results





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