

Semantic Interpretations of Multimodal Embeddings towards Explainable AI

Nitisha Jain

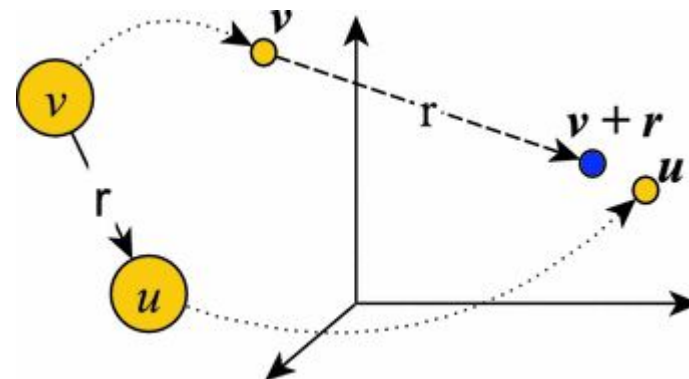
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Knowledge Graph Embeddings

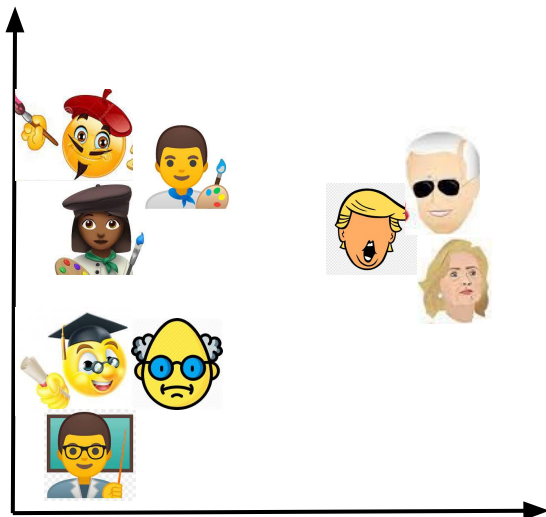
- Embed components of KG (**entities**, **relations**) into continuous vector spaces
- Allow **easy manipulation** of data while preserving **inherent structure** of KG
- Several popular models - TransE, RESCAL, DistMult, ComplEx, ConvE ..

KG triple $\langle v, r, u \rangle$

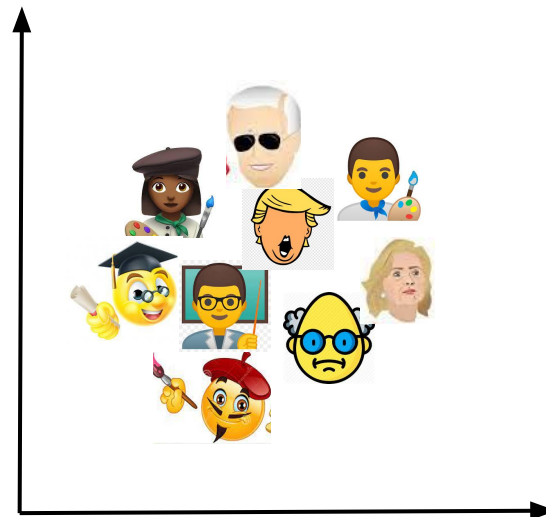


**Translation based KG
embedding**

Expectation vs. Reality



**Entity similarity reflected by
vectors**



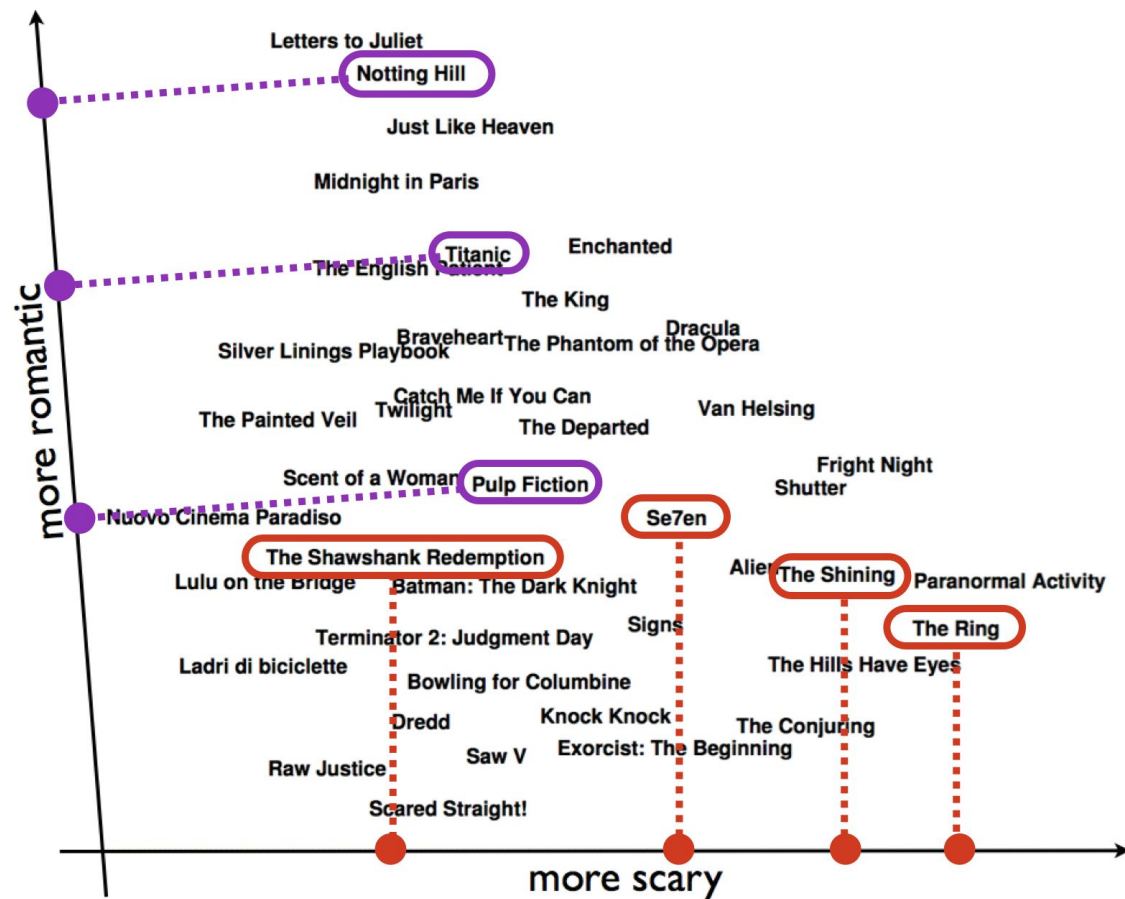
**Fine-grained semantics
not reflected***

*Nitisha Jain, Jan-Christoph Kalo, Wolf-Tilo Balke, Ralf Krestel: Do Embeddings Actually Capture Knowledge Graph Semantics? ESWC 2021.

Learning Quality Dimensions in Vector Spaces

- The dimensions of learned vector spaces do not normally correspond to **semantically meaningful properties**.
- This limits the **interpretability** of learned vector space representations.
- Previous work* on mitigating this issue - identify **interpretable directions** in learned vector spaces, **quality dimensions**.

**Joaquín Derrac and Steven Schockaert. Inducing semantic relations from conceptual spaces: A data-driven approach to plausible reasoning. Artif. Intell., 66–94, 2015.*



Interpretable directions within a 2d projection of vector space embedding of movies (IMDB)



Multisensory, User-centred, Shared Cultural Experiences through Interactive Technologies 2022-2025



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MuseIT Use Case

- For KG embeddings of CH assets, the dimensions would correspond to the **attributes** of the entities.
 - E.g., **Movie** entities - attributes could be **awards**, **cost** ..
 - Artist** entities - attributes could be **art style**, **nationality** ..
- Enable completion of missing attributes of entities - especially helpful for **multimodal representations**.
- Increase **semantic interpretability** of the vectors - **explainable embeddings**!



Semantic Interpretations of Multimodal Embeddings towards Explainable AI

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 ...

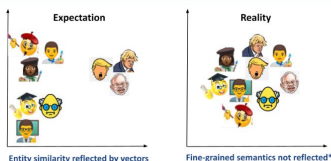
Premise: Vectors of entities, relations reflect their latent semantics

Similar entities E1, E2, E3

Similar vectors e1, e2, e3



Semantics in Knowledge Graph Embeddings

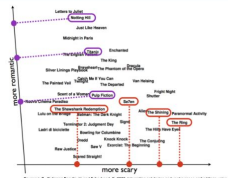


*Nitisha Jain, Jan-Christoph Kalz, Wolf-Tilo Balke, Ralf Krestel: Do Embeddings Actually Capture Knowledge Graph Semantics? ESWC 2021.

Learning Interpretable Quality Dimensions in Vector Spaces

- The dimensions of learned vector spaces do not normally correspond to semantically meaningful properties.
- This limits the interpretability of learned vector space representations.
- Previous work* on mitigating this issue - Identify interpretable directions in learned vector spaces, these directions can then play the role of quality dimensions.
- The central aim is to decompose the given vector space into a number of lower-dimensional spaces, each of which captures a different aspect of meaning.

*Joaquin Derrac and Steven Schockaert. Inducing semantic relations from conceptual spaces: A data-driven approach to plausible reasoning. Artif. Intell., 66-94, 2015.



MuseIT

Multisensory, User-centred, Shared cultural Experiences through Interactive Technologies
2022 - 2025

Objectives

- To investigate statistical and semantic models for multisensory representations of Cultural Heritage (CH) assets.
- To devise innovative methodologies to transform CH modalities (text, audio, video, haptics), and generate them automatically from existing ones with machine learning and crowdsourcing.

Applicability

- For embeddings of CH assets, the dimensions would correspond to the attributes of the CH entities.
 - E.g., **Movie** entities - attributes could be **awards**, **cost** ... **Artist** entities - **art style**, **nationality** ...
- This would increase semantic interpretability of the vectors.
- Use case for MuseIT - Enable completion of missing attributes of entities.
 - Especially helpful for enhancing multimodal representations with embeddings.

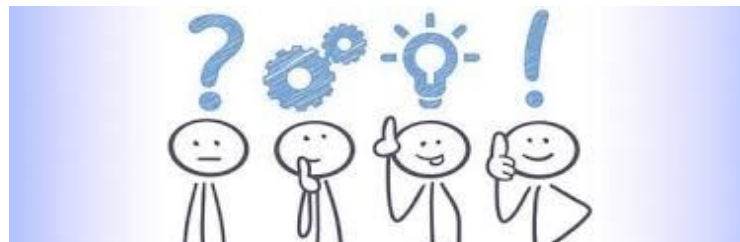


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Find us at the Poster session !

We would love to discuss more !



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