World Academy of Science, Engineering and Technology
International Journal of Mathematical and Computational Sciences
Vol:17, No:01, 2023

On the Existence of Homotopic Mapping Between Knowledge Graphs and Graph Embeddings

Authors : Jude K. Safo

Abstract : Knowledge Graphs KG) and their relation to Graph Embeddings (GE) represent a unique data structure in the landscape of machine learning (relative to image, text and acoustic data). Unlike the latter, GEs are the only data structure sufficient for representing hierarchically dense, semantic information needed for use-cases like supply chain data and protein folding where the search space exceeds the limits traditional search methods (e.g. page-rank, Dijkstra, etc.). While GEs are effective for compressing low rank tensor data, at scale, they begin to introduce a new problem of 'data retreival' which we observe in Large Language Models. Notable attempts by transE, TransR and other prominent industry standards have shown a peak performance just north of 57% on WN18 and FB15K benchmarks, insufficient practical industry applications. They're also limited, in scope, to next node/link predictions. Traditional linear methods like Tucker, CP, PARAFAC and CANDECOMP quickly hit memory limits on tensors exceeding 6.4 million nodes. This paper outlines a topological framework for linear mapping between concepts in KG space and GE space that preserve cardinality. Most importantly we introduce a traceable framework for composing dense linguistic strcutures. We demonstrate performance on WN18 benchmark this model hits. This model does not rely on Large Langauge Models (LLM) though the applications are certainy relevant here as well.

Keywords : representation theory, large language models, graph embeddings, applied algebraic topology, applied knot theory, combinatorics
Conference Title : ICMMNPM 2023 : International Conference on Mathematical Modelling and Nonlinear Programming Models
Conference Location : New York, United States
Conference Dates : January 30-31, 2023