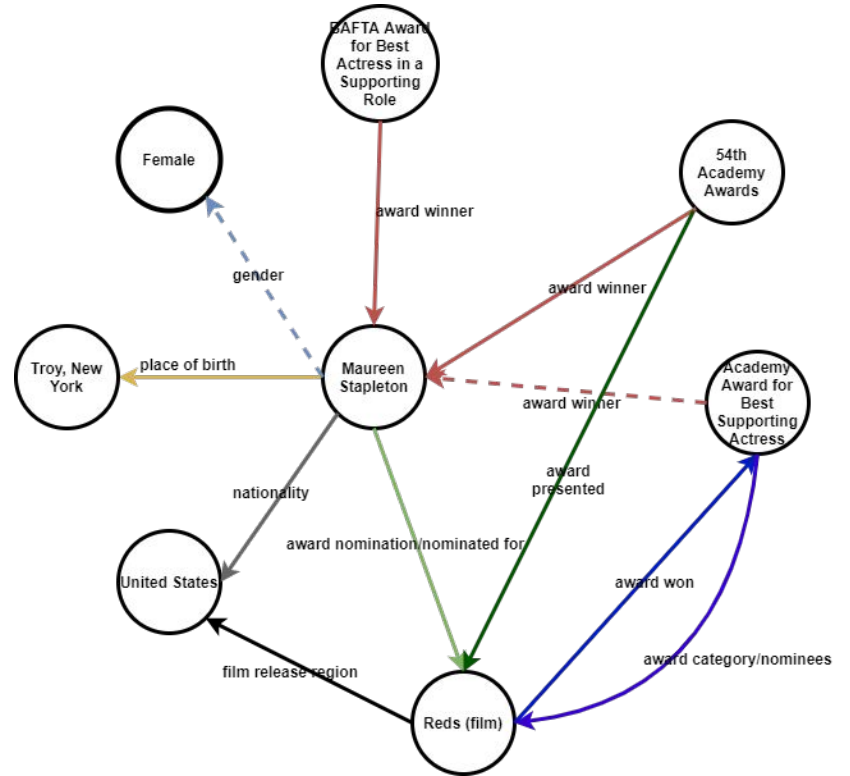# Relation Prediction as an Auxiliary Training Objective for Improving Multi-Relational Graph Representations

Yihong Chen, Pasquale Minervini, Sebastian Riedel, Pontus Stenetorp

UCL NLP
Facebook AI Research London
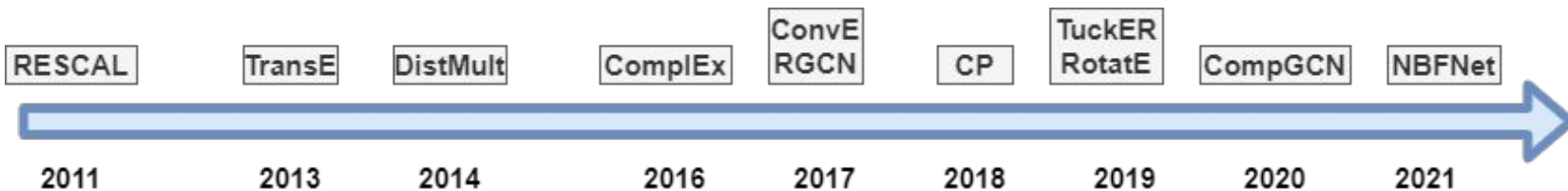
FACEBOOK AI

Knowledge Base Completion (KBC)

The task of KBC demands good representation learning on multi-relational graphs.

History of KBC Models

Models get more and more complex …

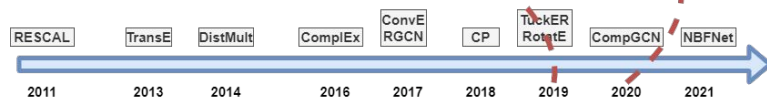| RESCAL		TransE	DistMult		ComplEx	ConvE RGCN		CP	TuckER RotatE	CompGCN	NBFNet
2011		2013	2014		2016	2017		2018	2019	2020	2021

Re-evaluation of KBC Models

A Re-evaluation of Knowledge Graph Completion Methods

Zhiqing Sun[1*]   Shikhar Vashishth[1,2*]   Soumya Sanyal[2*]
Partha Talukdar[2]   Yiming Yang[1]
[1] Carnegie Mellon University, [2] Indian Institute of Science

Loss Function   Reciprocal

1vsAll   Optimizer

Negative Sampling   Regularizer

Knowledge Base Completion: Baseline Strikes Back (Again)

Prachi Jain[1], Sushant Rathi[1], Mausam[1] and Soumen Chakrabarti[2]
[1] Indian Institute of Technology Delhi
[2] Indian Institute of Technology Bombay

| RESCAL | | TransE | DistMult | | ComplEx | ConvE RGCN | CP | TuckER RotatE | CompGCN | NBFNet |

2011   2013   2014   2016   2017   2018   2019   2020   2021

Simple Models with Appropriate Training Strategies

≈

Complicated Models
?!

Knowledge Base Completion: Baselines Strike Back

Rudolf Kadlec and Ondrej Bajgar and Jan Kleindienst
IBM Watson
V Parku 4, 140 00 Prague, Czech Republic

You CAN TEACH AN OLD DOG NEW TRICKS!
ON TRAINING KNOWLEDGE GRAPH EMBEDDINGS

Daniel Ruffinelli*
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University of Mannheim, Germany

Samuel Broscheit*
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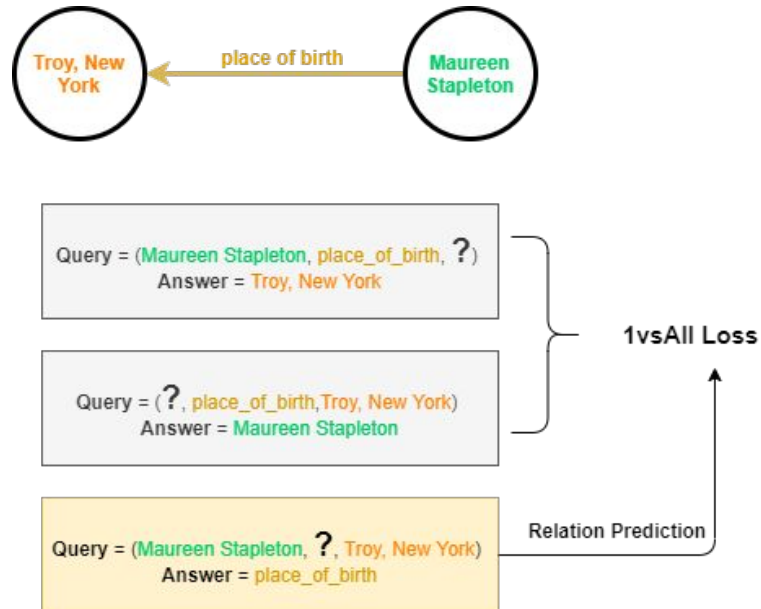
Relation Prediction as An Auxiliary Training Objective for KBC

A new self-supervised training objective
- not only predicting entities
- but also predicting relations

Including Relation Prediction into 1vsAll Objective

$$\arg\max_{\theta \in \Theta} \sum_{\langle s,p,o \rangle \in \mathcal{G}} [\log P_\theta(s \mid p, o) + \log P_\theta(o \mid s, p) + \lambda \log P_\theta(p \mid s, o)]$$

$$\text{with} \quad \log P_\theta(p \mid s, o) = \phi_\theta(s, p, o) - \log \sum_{p' \in \mathcal{R}} \exp\left[\phi_\theta(s, p', o)\right],$$

λ : hyper-parameter balancing the entity prediction and relation prediction

Test Performance on All Datasets

Dataset	Entity Prediction	Relation Prediction	MRR	Hits@1	Hits@3	Hits@10
Kinship	✗	✔	**0.920**	**0.867**	**0.970**	**0.990**
	✔	✗	0.897	0.835	0.955	0.987
	✔	✔	0.916	0.866	0.964	0.988
Nations	✗	✔	0.686	0.493	0.871	0.998
	✔	✗	0.813	0.701	**0.915**	**1.000**
	✔	✔	**0.827**	**0.726**	**0.915**	0.998
UMLS	✗	✔	0.863	0.795	0.914	0.979
	✔	✗	0.960	0.930	**0.991**	**0.998**
	✔	✔	**0.971**	**0.954**	0.986	0.997

Dataset	Entity Prediction	Relation Prediction	MRR	Hits@1	Hits@3	Hits@10
WN18RR	✗	✔	0.258	0.212	0.290	0.339
	✔	✗	0.487	0.441	0.501	**0.580**
	✔	✔	**0.488**	**0.443**	**0.505**	0.578
FB15K-237	✗	✔	0.263	0.187	0.287	0.411
	✔	✗	0.366	0.271	0.401	0.557
	✔	✔	**0.388**	**0.298**	**0.425**	**0.568**
Aristo-v4	✗	✔	0.169	0.120	0.177	0.267
	✔	✗	0.301	0.232	0.324	0.438
	✔	✔	**0.311**	**0.240**	**0.336**	**0.447**

Ablation Study: Embedding Size & Number of Relation Types
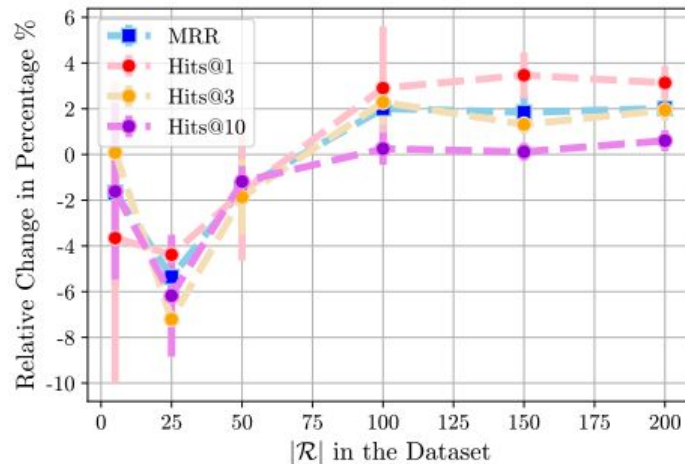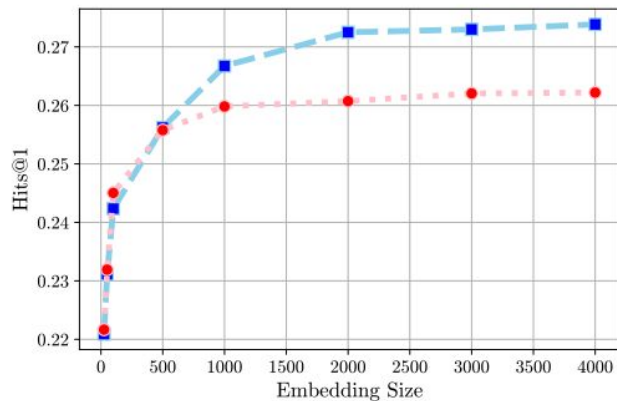
Summary

Relation Prediction as an Auxiliary Objective for Training KBC Models

Conclusion

- a new self-supervised objective for training KBC models
- up to 9.9% boost in Hits@1 on FB15k-237

Future Work

- extend to more complex models
- downstream applications besides link prediction