Knowledge-aware Topological Networks for Recommendation

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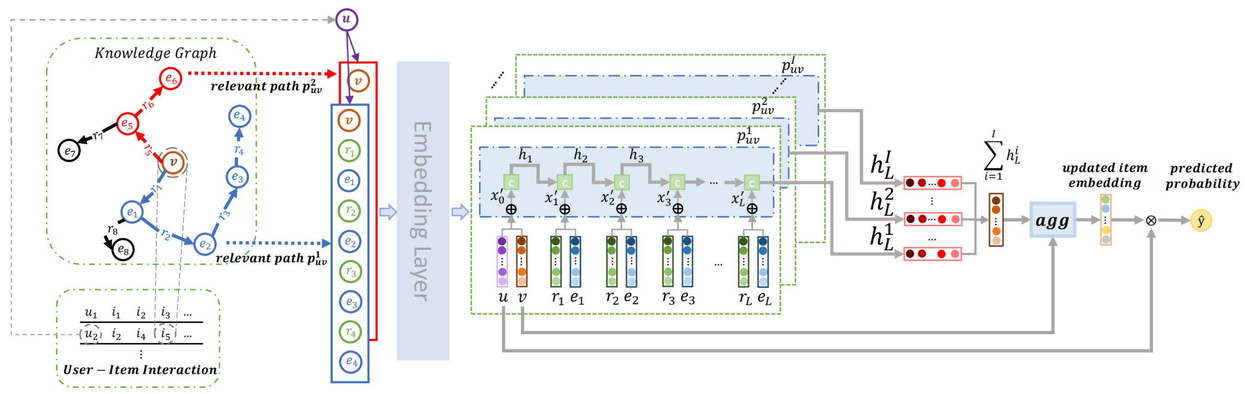
Introduction

- Currently, knowledge graphs (KGs) can reveal the structural and semantic information, as well as help to provide inferences for user choices.
- However, the information of the holistic topological structure in KGs has not been fully taken into account in most existing studies.
- To this end, we propose the Knowledge-aware Topological Recurrent Network (KTRN), an end-to-end network for recommendation with recurrent neural network and KG embedding.
- To simultaneously discover sequential dependencies and semantic information in a KG, we consider both relevant paths and triplets.
- Moreover, we focus on the importance of relation-entity pairs in learning representations.
- Extensive experimental results show that our method outperforms benchmark approaches.

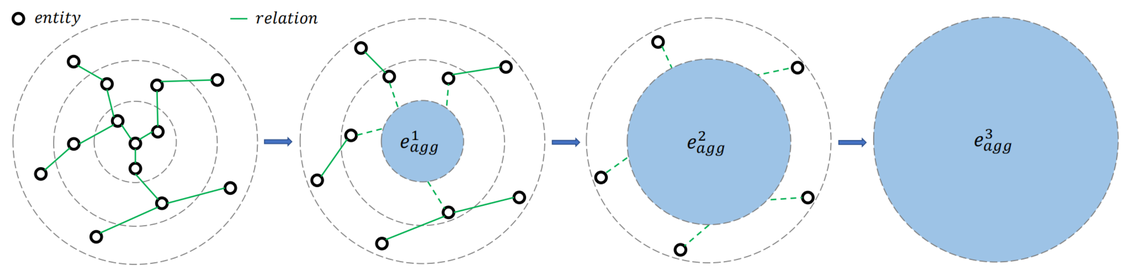
Model

- KTRN utilizes recurrent neural network to model sequential dependencies, and incorporates knowledge graph embedding to capture the information of the topological structure in KG.



The overall framework of KTRN consists of two main components:

- Topological graph network, which parameterizes each node as a vector by preserving the topological structure of the KG.



$$f(e_h, r, e_t) = \left\| e_h^{\perp} + r - e_t^{\perp} \right\| \qquad L_{kge} = \sum_{(e_h,r,e_t)\in G} \sum_{(e'_h,r,e'_t)\in G^-} [f(e_h, r, e_t) + \gamma - f(e'_h, r, e'_t)]_+$$

- Personalized entity embedding based on sequential relation-entity pairs.

$$\hat{y}(u, v) = \sigma\left(u^T \cdot agg\left(v, h'_L\right)\right) \qquad L_{rs} = \sum_{(u,v)\in Y} -\left(y_{uv} \log\left(\hat{y}\right) + \left(1 - y_{uv}\right) \log\left(1 - \hat{y}\right)\right)$$

- Final Loss: $L_{KTRN} = L_{rs} + \lambda L_{kge} + \mu \left\| \Theta \right\|_2^2$

Results

Model	MovieLens-1M		Book-Crossing		Last.FM	
	ACC	AUC	ACC	AUC	ACC	AUC
PER	0.662	0.705	0.576	0.613	0.576	0.633
CKE	0.735	0.796	0.630	0.671	0.674	0.764
KGCN	0.786	0.865	0.628	0.685	0.711	0.780
Wide&Deep	0.815	0.890	0.629	0.701	0.672	0.761
KGAT	0.824	0.895	0.631	0.704	0.686	0.771
KGIN	0.831	0.906	0.639	0.707	0.699	0.785
KTRN-add	0.835	0.911	0.636	0.702	0.711	0.782
KTRN-sum	0.840	0.917	0.642	0.705	0.711	0.792
KTRN-bi	0.833	0.910	0.635	0.701	0.713	0.783
KTRN-concat	**0.845**	**0.920**	**0.647**	**0.712**	**0.715**	**0.793**
KTRN-w/o r	0.829	0.910	0.634	0.702	0.710	0.779

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