Meta-path Reasoning of Knowledge Graph for Commonsense Question Answering

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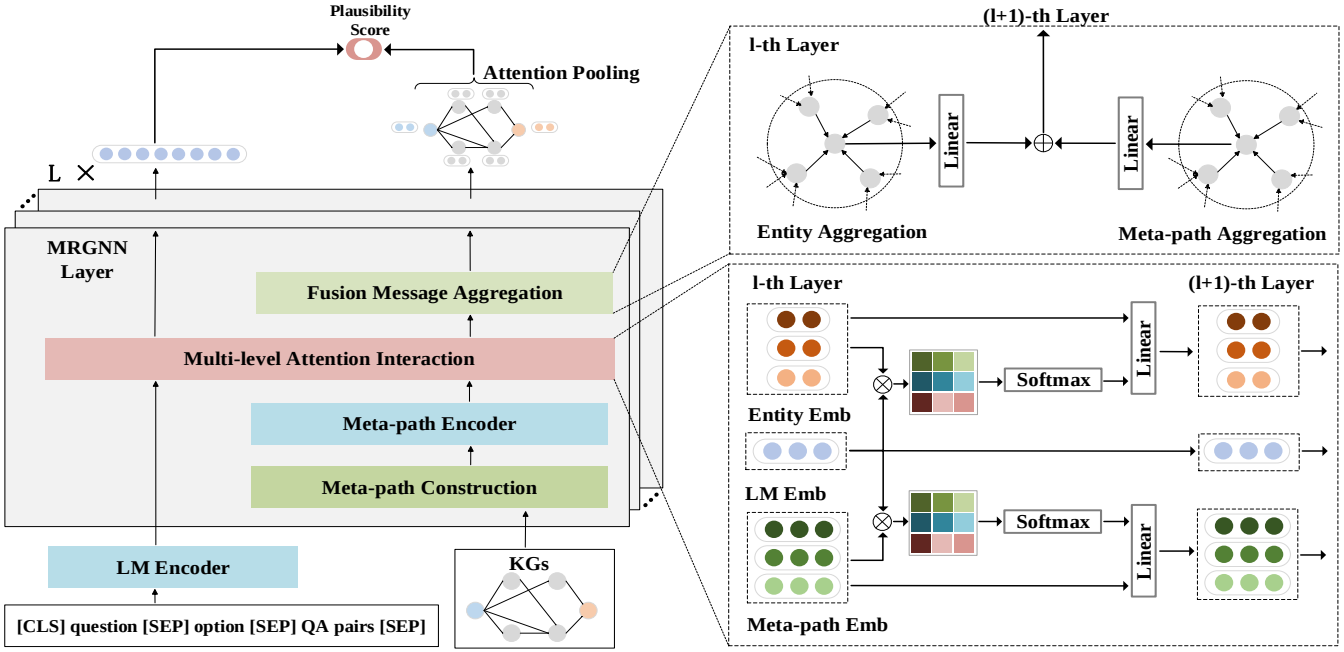
Problems & Ideas

- Problems of conventional commonsense QA approaches:
  - Pre-trained language models struggle with structured knowledge and lack sufficient interpretability for logical reasoning.
  - Existing GNN approach does not consider the reasoning path, which is limited in representing complex knowledge associations.
- Ideas: A multi-hop graph inference model that takes both knowledge graph and meta-paths in the inference process;



Overview of model architecture. Left: workflow of inference; Top right: Fusion of meta-paths and knowledge graph; Bottom right: Multi-level attention interaction in gnn.

Main Contributions

- Contributions:
  - A novel multi-hop graph inference model that fuses meta-paths for commonsense question answering;
  - Three meta-path patterns to align the forms of meta-paths and QA context, providing direct evidence for inference;
  - A multi-level attention-based neural graph network to aggregate the correct knowledge and complete inference.

Methods	BERT-Large		RoBERTa-Large	
	IHdev-Acc. (%)	IHtest-Acc. (%)	IHdev-Acc. (%)	IHtest-Acc. (%)
w/o KG	61.0(±0.8)	55.4(±0.4)	73.1±0.5)	68.7(±0.6)
RGCN	63.0(±0.3)	57.1(±0.4)	72.7(±0.2)	68.4 (±0.7)
GAT	63.4(±0.4)	58.2(±1.0)	74.0(±0.2)	71.2(±0.7)
GconAttn	62.3(±0.4)	57.2(±0.5)	72.6(±0.4)	68.6(±0.1)
KagNet	62.3(±0.4)	57.2(±0.5)	73.5(±0.2)	69.0(±0.8)
RN	63.4(±0.3)	58.9(±0.1)	74.6(±0.9)	69.1(±0.2)
MHGRN	63.3(±0.5)	60.6(±0.6)	74.45(±0.2)	71.1(±0.2)
PathGenerator	-	59.07(±0.3)	-	72.7(±0.4)
HGN	-	60.9(±0.2)	-	73.6(±0.3)
RaB-PR	63.3	60.8	75.6	73.7
QA-GNN	65.1(±0.2)	-	**76.5(±0.2)**	73.4(±0.4)
MRGNN(w/ concat)	65.4(±0.1)	61.8(±0.3)	75.5 (±0.6)	73.1(±0.6)
MRGNN(w/ retrieve)	65.0(±0.2)	62.0(±0.2)	75.3(±0.7)	**73.6(±0.5)**
MRGNN(w/ syntactic)	**65.7(±0.2)**	**62.3(±0.4)**	75.8(±0.8)	73.5(±0.4)

Methods	RoBERTa-Large	AristoRoBERTaV7
Fine-tuned w/o KG	64.8(±2.3)	78.4(±1.6)
RGCN	62.4(±1.6)	74.6(±2.5)
GconAttn	64.7(±1.5)	71.8(±1.2)
RN	65.2(±1.2)	75.3(±1.4)
GAT	65.0(±1.3)	78.2(±1.2)
MHGRN	66.8(±1.2)	80.6
PathGenerator	-	79.2(±0.8)
QA-GNN	67.8(±2.7)	82.7(±1.6)
HGN	66.2	84.3
RaB-PR	68.3	83.6
MRGNN(w/ concat)	68.4(±2.1)	83.1(±1.3)
MRGNN(w/ retrieve)	**69.5(±1.7)**	**83.6(±0.9)**
MRGNN(w/ syntactic)	69.0(±1.6)	83.4(±1.2)

Performance of baseline models. Left: the accuracy on CommonsenceQA in-house split; Right: the accuracy on OpenBookQA.