Knowledge Base Question Answering via Encoding of Complex Query Graphs

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Abstract

Answering complex questions that involve multiple entities and multiple relations using a standard knowledge base is an open and challenging task. Most existing KBQA approaches focus on simpler questions and do not work very well on complex questions because they were not able to simultaneously represent the question and the corresponding complex query structure. In this work, we encode such complex query structure into a uniform vector representation, and thus successfully capture the interactions between individual semantic components within a complex question. This approach consistently outperforms existing methods on complex questions while staying competitive on simple questions.

1 Introduction

The knowledge-based question answering (KBQA) is a task which takes a natural language question as input and returns a factual answer using structured knowledge bases such as Freebase (Bollacker et al., 2008), YAGO (Suchanek et al., 2007) and DBpedia (Auer et al., 2007). One simple example is a question like this: "What's the capital of the United States?" A common answer to such question is to identify the focus entity and the main relation predicate (or a sequence) in the question, and map the question to a triple fact query (US, $capital$, ?) over KB. The object answers are returned by executing the query. The mapping above is typically learned from question-answer pairs through distant supervision.

While the above question can be answered by querying a single predicate or predicate sequence in the KB, many other more complex questions cannot, e.g. the question in Figure 1. To answer the question "What is the second longest river in United States", we need to infer several semantic clues: 1) the answer is contained by United States; 2) the answer is a river; 3) the answer ranks second by its length in descending order. Thus, multiple predicates are required to constrain the answer set, and we call such questions "complex questions" throughout this paper.

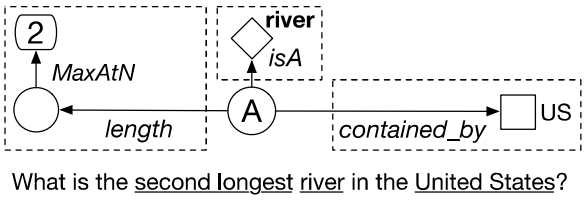

Figure 1: Running example of complex question.

For answering complex questions, it's more important to understand the compositional semantic meanings of the question. As a classic branch of KBQA solutions, semantic parsing (SP) technique (Berant et al., 2013; Yih et al., 2015; Reddy et al., 2016; Hu et al., 2018) aims at learning semantic parse trees or equivalent query graphs [1] for representing semantic structures of the questions. For example in Figure 1, the query graph forms a tree shape. The answer node A, serving as the root of the tree, is the variable vertex that represents the real answer entities. The focus nodes (*US*, *river*, *2nd*) are extracted from the mentions of the question, and they constrain the answer node via predicate sequences in the knowledge base. Recently, neural network (NN) models have shown great promise in improving the performance of KBQA systems, and SP+NN techniques become the state-of-the-art on several KBQA datasets (Qu et al., 2018; Bao et al., 2016). According to the discussion above, our work extends the current research in the SP+NN direction.

The common step of SP-based approaches

[1]The term "query graph" is interchangeable with "query structure" and "semantic parsing tree" throughout this paper.