Temporal Knowledge Graph Construction

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Abstract— **Knowledge Graphs play an important role in various AI applications, such as question-answering systems. However, most Knowledge Graph construction approaches do not consider the temporal aspect. Temporal information is crucial in various real-world scenarios, where relationships between entities and facts evolve over time. In this paper, we therefore propose an end-to-end system for temporal knowledge graph construction.**

I. Introduction

In recent years, Knowledge Graphs (KGs) have emerged as powerful tools for enhancing various Artificial Intelligence (AI) applications, including question answering systems, recommendation systems, and natural language understanding. A Knowledge Graph represents information in a structured way, capturing relationships between entities and allowing machines to reason and infer knowledge effectively. Nonetheless, while KGs have proven to be highly beneficial, a crucial aspect that has often been overlooked in existing research is the temporal aspect of knowledge.

The temporal aspect of knowledge plays a fundamental role in many real-world scenarios, as information and relationships between entities evolve over time. Traditional Knowledge Graphs could not model temporal aspects adequately, limiting their applicability in time-sensitive AI applications. To address this limitation, temporal KGs are introduced [1]. Nevertheless, most of the KG construction approaches focus on traditional KGs. In this study, we, therefore, propose an end-to-end temporal knowledge graph construction system. In our system, we capture temporal changes and dependencies between entities and their relationships to construct the temporal knowledge graph.

II. Methods

Our system is presented in Figure 1. There are two main steps are illustrated: 1) Temporal Knowledge Extraction and 2) Knowledge Graph Serialization. The details of each step are as follows:

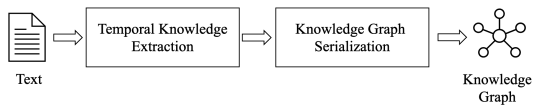

Figure 1. The pipeline of our system.

Temporal Knowledge Extraction is the process of extracting the relationships between entities along with their corresponding temporal information from text. Specifically, given a text *T*, we extract a quintuple *(h, r, t, st, ed),* where *h* and *t* represent the entities, *r* denotes the relationship between the entities, *st* indicates the start time of the relationship, and *ed* represents the end time of the relationship. To implement this step, we design a prompt for a large language model (LLM), providing *T* and *(h, r, t, st, ed)* as demonstration examples. The LLM utilized in this study is GPT-3.

Knowledge Graph Serialization involves transforming the quintuples obtained from Temporal Knowledge Extraction into a structured Knowledge Graph. In the process of Temporal Knowledge Extraction, the LLM could encounter ambiguity while matching an entity and a relation to the knowledge graph. To address this issue, we adopt knowledge integration from T2KG [2, 3] to disambiguate the entities and relations, ensuring a more accurate and reliable representation in the final Knowledge Graph. Our system aims to construct the knowledge graph using Wikidata as the target.

III. Results

We present example results of our system in Table 1, where the relationships from the text are extracted and used to form the knowledge graph.

TABLE I. EXAMPLE RESULTS OF OUR SYSTEM

Text	Donald John Trump is an American politician, media personality, and businessman who served as the 45th president of the United States from 2017 to 2021.			
KG	***Subject***	***Relation***	***object***	***Time***
	Wikidata: Q22686	Wikidata: P39	Wikidata: Q11696	(2017, 2021)
Text	From 1991 to 2008, Biden co-taught a seminar on constitutional law at Widener University School of Law.			
KG	***Subject***	***Relation***	***object***	***Time***
	Wikidata: Q6279	Wikidata: P108	Wikidata: Q3443325	(1991, 2008)

IV. Conclusion

In this study, we have introduced a novel approach for constructing Temporal Knowledge Graphs that capture the temporal dynamics of information and relationships between entities using LLMs. The preliminary examples show that the system has the potential to construct a temporal knowledge graph. In the future, we aim to systematically evaluate our approach.

*Research supported by JSPS Grant-in-Aid for Early-Career Scientists (Grant Number 21K17816)

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