Primitive Knowledge Graph Construction Base on Event-element Driven

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Abstract. Knowledge graph is a popular research field in recent years. Starting from analyzing the dynamic needs and feasible ways of knowledge graph, A new idea of using matter elements as entities in the knowledge graph is proposed, and a dynamic evolution mechanism of knowledge graph driven by matter elements is established. Using the primitive theory to construct the framework structure of the primitive knowledge map.

Keywords: Knowledge Graph; Primitive; Primitive Knowledge Graph.

1. Introduction
In 2012, the concept of graphs was formally proposed by Google. Since 2013, the map has been popularized in the academic world, and the knowledge map has been widely studied in the following three aspects: One is the application of data mining, information retrieval, and knowledge representation in the field of computer science; The second is to apply to complex network analysis; The third is to apply to the literature analysis, citation visualization analysis, and knowledge clustering of library information. With the continuous development of intelligent information services, knowledge graphs have been widely used in intelligent search, intelligent question and answer, and personalized recommendation. The main purpose of constructing a knowledge graph is to obtain a large amount of computer-readable knowledge, and these knowledge have certain dynamic characteristics:

Firstly, take the electronic medical record data mining as an example. There are quite a lot of electronic medical record data with a certain time sequence. These data are constantly updated and changed over time, such as ECG images, 24h blood pressure measurement data, etc. For each patient (can be regarded as an individual) the entire diagnosis and treatment process is recorded, these data changes with time[1]. For another example, in the field of transportation, logistics has the characteristics of cross-regional and cross-time domain. This also determines the dynamic characteristics of the logistics network, and how to use the knowledge graph to effectively mine dynamic data is very important.

Secondly, in terms of network analysis, it is the science of studying network behavior from the two aspects of relationship and structure. The method of studying social network analysis is mainly to use graph theory and non-parametric statistical techniques to describe the mode and evolution of people and groups composed of people in the network. In a social network, data is represented in the form of a complex network, that is, information about who, what, where, how, and when is multimodal, Multi-link, multi-level network connection. This determines that the data is dynamic, and this dynamic description and its evolution process requires a dynamic knowledge graph[2].

Thirdly, network information resources have the characteristics of diversified manifestations, dynamic communication methods, and complex information sources. These characteristics are used to meet people’s needs for the dynamics of information resources. Library and information knowledge is
constantly updated in real time. Old knowledge and outdated knowledge cannot guarantee the reliability of information. Therefore, in the field of library and information, the problem that needs to be solved is the dynamic study of knowledge graphs[3].

The following introduces the way to realize the dynamics of the knowledge graph. The knowledge graph is a structural representation of facts, which is composed of entities, relationships, and semantic descriptions. The entity is the most basic element. The entity can be a physical object or an abstract concept; The relationship represents the association between entities; The semantic description of entities and their relationships includes well-defined types and attributes. In the development process of the knowledge graph, when the knowledge graph appears as a technical and nominal concept, new variants will appear. In <entity, entity relationship, entity>, we can get many different types after component replacement. In other words, there are different types of knowledge graphs for different designs of "entities".

The research team of Professor Liu Ting from the Research Center of Social Computing and Information Retrieval of Harbin Institute of Technology, they took the lead in proposing the concept of "Affair Atlas". In the affair map, "event" means "entity", and the affair map is defined as a directed graph of affair evolution logic that describes the causal relationship between events and the relationship between the city and the city. It also points out that nodes represent events, and directed edges represent succession and causality between events. Literature[4] makes a multi-dimensional comparison of affair graphs and knowledge graphs, and he analyzes the value of knowledge graphs for information science research.

Replacing entities in the knowledge graph with events forms various "alien" knowledge graphs, such as event knowledge graph, abstract event evolutionary graph, event logic knowledge graph, etc. The role of the concept of "event" in constructing a new type of knowledge graph. At present, there are many definitions of events. For example, ACE, TDT, and chambers are currently doing events in narrative event chain or scripts. Events have different meanings in different scenarios, but these events have a common feature. It is dynamic.

If one word is used to express an event, it will be too thin and abstract. So the best way is to use less text to express more information, Primitives in Extenics are sufficient to use triples to represent the rich information of events [5-8]. It is feasible to construct a primitive knowledge graph with primitives as entities. This kind of thinking can open up a new type of knowledge graph. For some special fields, it may be more convenient and effective to use this primitive knowledge graph. In particular, if various intelligent transformations can be further added, it will provide a possible method and approach for the development of intelligent knowledge graphs.

2. Primitive Knowledge Graph

Triples are a general representation of the classic knowledge graph, \( G = (E, R, S) \). Among them, \( E = \{e_1, e_2, \ldots, e_n\} \) is a collection of entities in the knowledge base, including \( |E| \) types of different entities; \( R = \{r_1, r_2, \ldots, r_m\} \) is a collection of entities in the knowledge base, including \( |R| \) types of different entities; \( S \subseteq E \times R \times E \) is a collection of relationships in the knowledge base, a total of kinds of different relationships; Everything in our object world is composed of concrete things, which we call referent entities. Entities are the most basic elements in the knowledge graph. In order to realize the dynamics of the knowledge graph, We replace the entities of <entity, entity relationship, entity> in the knowledge graph with the concept of primitives in Extenics, and the knowledge graph formed by taking primitives as entities is called primitive knowledge graph. Primitives in Extenics are defined in three forms, namely matter-element, matter-element and relational element[9-10]

(1) Matter-element

Things can have individual things and kinds of things, such as a certain person, a certain city, a certain kind of plant, a certain commodity, and so on. The category is a concept, such as a country, a person, a school, a nation, a book, a computer, and so on. Among them, \( O_m \) is the physical matter element. \( C_m \) is a certain feature of the matter element, \( V_m \) is the value of the feature \( C_m \). When the matter-element \( O_m \) has multiple features, for example, the matter-element \( O_m \) has \( n \) features \( C_{m1}, C_{m2}, \ldots, C_{mn} \) and the
corresponding feature value of \( O_a \) constitute an \( N \)-dimensional matter element. which is used to represent by \( M \).

\[
M = \begin{bmatrix}
O_m, & c_{m1}, & v_{m1} \\
& c_{m2}, & v_{m2} \\
& \vdots & \vdots \\
& c_{mn}, & v_{mn}
\end{bmatrix} = (O_m, C_m, V_m)
\]

Called n-dimensional matter element, where

\[
C_m = \begin{bmatrix}
c_{m1} \\
c_{m2} \\
\vdots \\
c_{mn}
\end{bmatrix},
\quad V_m = \begin{bmatrix}
v_{m1} \\
v_{m2} \\
\vdots \\
v_{mn}
\end{bmatrix}
\]

Taking matter element as one of the entities in the knowledge graph, The setting of its characteristics can express a variety of connotations of the node, so that it can express both the homogenous characteristics of the "entity" node and its heterogeneous characteristics.

(2) affair-element

\[
A = \begin{bmatrix}
O_a, & c_{a1}, & v_{a1} \\
& c_{a2}, & v_{a2} \\
& \vdots & \vdots \\
& c_{an}, & v_{an}
\end{bmatrix} = (O_a, C_a, V_a)
\]

Called n-dimensional matter element, where

\[
C_a = \begin{bmatrix}
c_{a1} \\
c_{a2} \\
\vdots \\
c_{an}
\end{bmatrix},
\quad V_a = \begin{bmatrix}
v_{a1} \\
v_{a2} \\
\vdots \\
v_{an}
\end{bmatrix}
\]

The basic characteristics of the affair element can be the dominating object, the acting object, the receiving object, time, place, degree, method and tool, and so on.

In the primitive knowledge graph, changes in the structure of entities caused by changes in the environment can be represented by event elements, which can provide a convenient way to change the network knowledge structure and dynamic evolution.

(3) Relational element

In the study of extenics, we have discovered that in the real world, anything, person, information, knowledge, etc. are inextricably related to any other thing, thing, person, information, knowledge. Changes in these relationships will also produce interaction and mutual influence. The relational element is a formalized representation tool.

The relationship element refers to the relationship \( O_r \). It have \( n \) features \( C_{r1}, C_{r2}, \cdots, C_{rn} \) and \( O_r \) of the action are composed of the magnitude \( V_{ri} \) \( (i = 1, 2, \cdots, n) \) corresponding to \( C_a \) \( (i = 1, 2, \cdots, n) \).

\[
R = \begin{bmatrix}
O_r, & c_{r1}, & v_{r1} \\
& c_{r2}, & v_{r2} \\
& \vdots & \vdots \\
& c_{rn}, & v_{rn}
\end{bmatrix} = (O_r, C_r, V_r)
\]

Called n-dimensional relational element, where
Using the primitive concepts and expressions in extenics, we construct a kind of primitive knowledge graph. In this kind of knowledge graph, the "entity" can be matter element or matter element (or even relation element), relation element is the combination of matter element, matter element, and relation element. The intertwined relationship, the overall recognition of the characteristics of the event.

3. Preliminary Study of Model

For the question of how to describe the dynamics of events, this paper puts forward the concept of the extension of the knowledge spectrum, that is, the extension of the primitive knowledge graph. It is divided into an extension model layer and a primitive data layer. The constituent elements of the primitive data layer are events, and the facts are expressed in triples (primitive 1, relationship, primitive 2), primitive element can be any of matter element, matter element and relation element. Then all the triples of the database form an entity relationship network, forming a "graph" of knowledge. Primitives are conceptual templates for structured knowledge bases. The knowledge base formed through primitives not only has a strong hierarchical structure, but also facilitates dynamic evolution.

The extension model layer is based on the primitive data layer. It is the model layer that uses the thing element library to manage the knowledge graph. Among them, affair-driven is used to provide support for axioms, rules, constraints, so as to standardize the types and attributes of entities.

Let's discuss the matter in detail below. We consider the event as the driving force of the knowledge graph. Below we will conduct a comprehensive analysis from the following three aspects: First, define the exterior of the event. The expression event can be represented by nouns, verbs, subject-predicate two-tuples, verb two-tuples and subject-predicate-object triples. Generally speaking, events should be multi-groups that include more information. Secondly, the internal information representation of the event is defined. The info-schema of the event, the semevent ontology representation framework abroad, is represented by 5-tuple events in China. Regarding the standard expression of internal information, we hope to use as few characters or fields as possible to express as much event-related information as possible. The third is the definition of the relationship between events. The relationship between them includes the relationship between time and space. Different time and space relationships determine different logical relationships. Based on the above three aspects, we sorted out several issues of concern.

First, the event has its own role (dominating object, acting object, receiving object) structure, and points to several entities in the knowledge graph through the role;
Second, events have their own spatiotemporal attributes (time, place), and certain characteristics of entities in the knowledge graph are linked through spatiotemporal attributes;
Third, events have their own manifestations (degrees, methods, and tools), which in turn must correspond to certain characteristics of other entities;
Fourth, there are inheritance, causality, relevance relationships between events, events, and events have time parameters. This relationship drives the logic of the event's reasoning, dissemination and evolution, thereby affecting related entities in the knowledge graph;
Fifth, Underst, the upper, lower positions of the incident, and break it down;
Sixth, events are driven. The occurrence of events will inevitably lead to changes in certain characteristics of event participating entities or changes in the relationships between participating entities.

To sum up, the framework of the matter element in extenics is very suitable for these requirements. The event element not only contains the elements of the event, but also connects the physical knowledge base. Taking matter as the theme, the constructed matter library can become the extension model layer of the extension primitive knowledge graph. If various extension transformations in
extenics are introduced into the knowledge graph, then an extension primitive knowledge graph driven by matter can be constructed. Hopefully it will develop into a new type of intelligent knowledge graph. Since the matter element in the extension model layer is characteristically related to the matter element and relation element of the primitive data layer, it also drives the change of the matter element and relation element in the primitive data layer. The effect of the matter element on the node is equivalent. To add or delete nodes.

4. Summary
Starting from the analysis of the dynamic requirements and feasible ways of the knowledge graph, this paper introduces primitives into the knowledge graph, proposes a new idea of using matter elements as entities in the knowledge graph, establishes an event-driven dynamic evolution mechanism of the knowledge graph, uses primitive theory. The framework structure of the primitive knowledge graph is constructed. In the future research, the various extension transformations in extenics can be more strongly supported to support the driving ability of matter elements to construct an extension primitive knowledge graph driven by matter elements, which is hopefully developed into a new type of knowledge graph.

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