Construction of Domain Knowledge Ontology Map Based on Concept Learning of Neural Networks

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Abstract: In order to improve performance enhancement for spectrum construction algorithm of domain knowledge ontology, a construction method for spectrum of domain knowledge ontology based on concept study of self-organizing neural network shall be proposed. Firstly, according to structure model for domain ontology graph, frame of ontology learning shall be set up. Then relation mapping for knowledge term-term shall be established; secondly, model for self-organizing neural network shall be adopted for construction of fuzzy clustering method to realize sorting algorithm for KLSeeker knowledge ontology of dichotomy relation. Semi-supervised learning of ontology graph shall be realized based on concept clustering to decrease human intervention; finally, effectiveness of algorithm can be verified through experiment analysis.

1. Introduction

Domain knowledge refers to set of concept, correlation, constraint set, state and its change rule in some domain, and it covers inferential mode and evolutionary relationship within domain, which is knowledge and content of some application and industry background. At present, researches related to domain knowledge home and abroad are mainly focused on three aspects of knowledge discovery, knowledge sharing and knowledge application, and scholars are widely concerned about domain knowledge distance (domain knowledge similarity) which is taken as core problem of knowledge discovery.

2. Formalization expression of knowledge structure

5 tuples of knowledge ontology can be divided into 2 aspects: abstract element and formalization element. Abstract element is equivalent to connotation of knowledge, and it is made up of concept and its related information. Formalization element corresponds to extension of knowledge, and it is formalization expression of things. It is with the aid of feature of specifically describing things oriented at concept attribute assignment, and it is an instance of concept. Relation between concept and instance is shown in Fig.1.

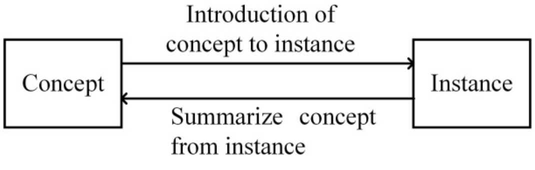


Figure 1 Relation between concept and instance

Abstract element of knowledge ontology is core of knowledge ontology, and it is more originated from expression of human to prior knowledge. But for knowledge in a certain domain, it has already constituted a relatively completed knowledge structure. Therefore domain knowledge structure can be used to describe abstract element of knowledge ontology at the time of discussing knowledge ontology. In knowledge structure, knowledge element can be used to express concept, and proving mechanism of knowledge correlation and knowledge inference shall be established. Their relation is shown in Fig.2.

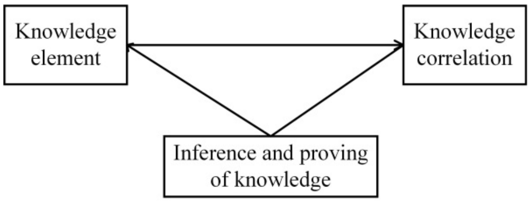


Figure 2 Relations between inference and proving of knowledge, knowledge correlation and knowledge element

1) Knowledge element. Knowledge element refers to a knowledge concept in some domain knowledge structure (including basic definition, theorem and axiom etc.). Every knowledge element is subject to set K for description:

$$K = \{a_i \mid a_i \text{ is a attribute of knowledge element}\} \quad (1)$$

Elements in sets express basic characteristics of the knowledge element. Extension of knowledge element is instance. In order to describe evaluation for every instance to attribute of knowledge element, one set V_{a_i} is used for expression for range of every attribute. The whole range V of concept for knowledge element:

$$V_{a_i} = \{v_j \mid v_j \text{is a value of attribute } a_i\} \quad (2)$$

In (2) form, $V = \bigcup_{a_i \in A} V_{a_i}$

2) Knowledge correlation. Different knowledge elements need to be defined or proved in a completed domain knowledge structure. Some of those knowledge elements need to be defined firstly, but others are based on knowledge element defined previously. One set C can be used to describe various knowledge elements in knowledge structure:

$$C = \{A_i \mid A_i \text{ is a knowledge element in knowledge structure}\} \quad (3)$$

There may be correlation between knowledge elements in knowledge structure, and there may be no correlations. In general, correlations of knowledge element are subject to the following circumstances (providing that there are knowledge elements x, y, z in knowledge structure):

① x< y: shows knowledge element x is preface knowledge of y, and y is subsequent knowledge of x. ② in case x< y and y< z, x< z: it shows that in case x is preface knowledge of y and y is preface knowledge of z, x is preface knowledge of z. ③ in C, x< x is false, then that knowledge element x is its own preface knowledge is not allowed to appear. ④ in case x is not preface knowledge of y and y is also not preface knowledge of x, and x and y is mutually independent.

3) Inference and proving of knowledge. Knowledge in one knowledge structure shall be correct and consistent. At the same time, completion of one knowledge structure is relative, and it shall continuously improve itself with the increase and upgrading of knowledge. In order to guarantee the above characteristics of knowledge structure, mechanism for inference and proving of knowledge shall be established. Then it can be subject to logical form to judge whether relations of knowledge elements in domain knowledge structure and relations between knowledge elements are correct and consistent or not, and self-improvement of knowledge structure shall be completed. Correctness and consistency of and between knowledge elements and self-improvement of knowledge structure are related. Initial relations of and between knowledge elements are planned according to prior knowledge of human. They are extracted from information acquired by human, and its treatment to these pieces of information shall be guaranteed correct. But when information continuously increases and changes, new knowledge needs to be summarized. At the same time, it can affect original knowledge, which can cause changes for correctness and consistency of knowledge.

Inference and proving of knowledge is an important support for assuring completion of one domain knowledge structure.

3. Construction for self-organizing neural network of graph of domain knowledge ontology

How to generate ontology graph (DOG) is described in this section and classification of domain knowledge (DocOG) based on domain ontology graph can be realized. KLSeeker is a completed system frame, and it defines and realizes four components; research contents are shown in the following: (1) modeling of ontology graph (ontology graph structure); (2) ontology learning (learning algorithm); (3) ontology generation (generation process); (4) ontology searching (operation for information searching system). KLSeeker system can be used to develop various modules for intelligent applications based on ontology which is subject to four definitions. Therefore, the whole KLSeeker system frame is divided into four modules for disposing process for ontology of different kinds, and it is shown in Fig.3.

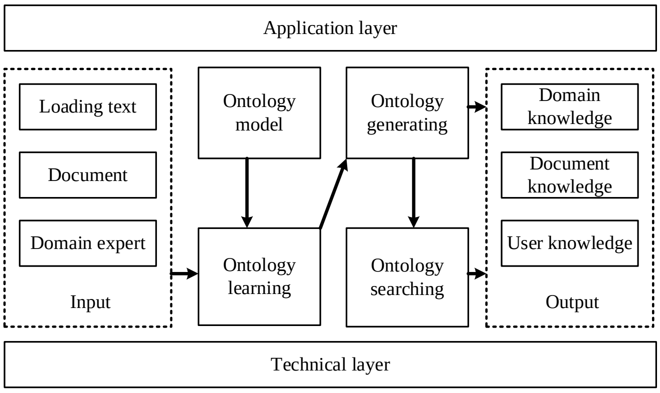


Figure 3 Basic frame for klseeker system

Ontology graph is a new method used in KLSeeker system model for establishing of domain knowledge ontology. Ontology graph is made up of concept unit of different layers, and it is subject to different types of relations for correlation. Its essence is one vocabulary system, and it expresses concept set through mutual relations. Network model is formed through different concept units.

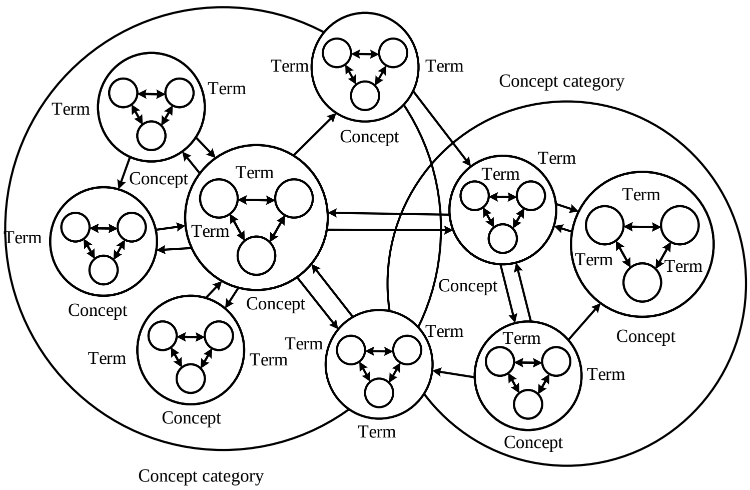


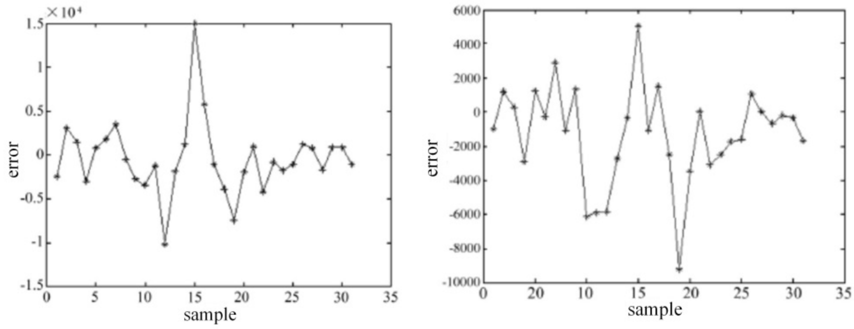
Figure 4 Concept view

It is further shown in Fig.4 that establishing and learning process for concept view and algorithm of ontology graph model based on nodes and relation structure. According to complexity degree of its knowledge representation, ontology graph can be divided into concept unit of four types (CU). It is defined herein that ontology graph of four customers of any object and its domain knowledge representation. All customers contact through related concepts, including region (domain) knowledge representation for the whole concept structure and model of ontology graph.

4. Experiment analysis

4.1. Performance experiment for self-organization neural network

Hardware parameters: processor i7-6800HQ, internal storage 6G ddr3-1600, system win7 flagship version. Contrast algorithm shall be subject to BP neural network algorithm. Samples of test set shall be input into model for self-organization neural network and model for BP neural network respectively to conduct simulation test, and error sum, root-mean-square error and error percentage of two model tests output are shown in Fig.5.



(a) Prediction error of BP neural network (b) Prediction error of self-organization neural network

Figure 5 Comparison of prediction error

It can be known according to Fig.5 data that performance for algorithm of self-organization neural network increases about 25% compared with algorithm of BP neural network in error sum index, which represents performance advantages of self-organization neural network in evaluation. Extracted algorithm of self-organization neural network is better than that of BP neural network in fitting degree of true expectation curve, and it has lower prediction error.

5. Conclusion

A construction method for spectrum of domain knowledge ontology based on concept study of self-organization neural network is presented in this Text. According to structure model for domain ontology graph, frame of ontology learning shall be constructed. It shall be subject to model for self-organization neural network for construction of fuzzy clustering method to realize sorting algorithm for KLSeeker knowledge ontology of dichotomy. Algorithm effectiveness is verified in experiment results. Therefore, for ontology graph is simplification of application, and conceptual relationship type can not be provided with ontology study through semi-supervision mode. In addition, effective ontology verification is not enough to measure completion of generating DOG.

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