A Semantic Network based Vocabulary Learning System

Li Mengyu[1], Hu Daiping[2], Li Yinsheng[3], Shao Xiangru[3]

[1]Shanghai Xiandai Vocational & Technical School
Huayan Road 112, Shanghai 200042, P. R. China
dmyli@126.com

[2]Antai School of Management, Shanghai Jiaotong University
Fahuazhen Road 535, Shanghai 200052, P. R. China
dphu@sjtu.edu.cn

[3]Tianjin 707 Institute, China State Shipbuilding Corporation
Dizigu Sanhao Road, Tianjin 300131, P. R. China
{dysli,dxrshao}@126.com

ABSTRACT

Semantic networks are basically graphic descriptions of knowledge composed of nodes and links that show hierarchical relationships between objects. A semantic network is made up of a number of circles or nodes which represent objects and description information about those objects. Nodes can be physical items, concepts, events, actions or attributes. The nodes are interconnected by links or arcs. These arcs show the relationships between the various objects and descriptive factors. Knowledge can be represented through using semantic networks. Lexical item learning from contexts of texts is an efficient way better than memorizing many single words. In this paper, we propose a semantic network based vocabulary learning system (SNVLS) which is a knowledge based system. It can analyze the contexts of texts to parse lexical items as objects and relationships for semantic networks and draw the visual graphic networks to improve vocabulary learning efficiency and effect. We study how to use semantic networks to represent contexts for texts. And then we study the architecture and implementation of the SNVLS. At last we present an experiment of using this SNVLS to demonstrate the difference of efficiency and effect in vocabulary learning between two groups who using SNVLS or not.

Keywords: semantic network, knowledge based system, vocabulary learning

1. INTRODUCTION

A semantic network can be defined as a graphical representation relating concepts and information. Graphs for semantic networks consist of nodes with connecting arcs (links), which represent relationships between nodes [1,2]. The nodes are labeled with descriptive text, representing the concepts, which can be physical items, concepts, events, actions or attributes. And the arc is often labeled with a relationship type. Nodes may be represented using distinct visual attributes, such as shape and color, to distinguish node types; arcs may be similarly distinguished. As the aspects of simplicity and explicit graphic structures connecting objects, the semantic network is used as a method for knowledge representation [3]. It is also applied in knowledge reconstruction in vocabulary learning [4,5] and in information processing [6, 7, 8].

Vocabulary is the base of English language and the vocabulary acquisition should be a very important part of mastering English. How to learn vocabulary effectively and efficiently is always a hot research problem attracting many linguisticians and researchers. Memorizing single word by rote is common method to learning vocabulary, but it is difficult and is not effective for long term storage of learning words. So self-testing in the form of expanded retrieval practice is a very useful method. To improve the effectiveness and efficiency, learning new words from the context of a lesson is advocated. When the learnt words are found later, the context of that lesson is recalled, relationships between new words with old knowledge can help us to learnt vocabulary. Therefore, this idea would be more helpful, that is, all information for long term storage must be integrated into existing knowledge structures. Many explicit relationships between old and new knowledge structures must established. The integration of new material with prior knowledge can be implemented using the framework of the reconstruction or adaptation of semantic knowledge, which can be considerably enhanced by the structure of learning material used.

Recent years, there is an explosion of interest in using computers for language teaching and learning. A

decade ago, the use of computers in the language classroom was of concern only to a small number of specialists. However, with the advent of multimedia computing and the Internet, the role of computers in language instruction has now become an important issue confronting large numbers of language teachers throughout the world. There are many software packages developed for aiding language learning including vocabulary learning such as 'I like to memorize words' in China. Existing vocabulary learning systems are concentrated on repeating practice to memorize by rote. However, the semantic network based vocabulary learning system has not been studied and developed.

In this paper, we study a semantic network based vocabulary system (SNVL). This paper is organized as follows: In section 2 we introduce semantic network and propose an improved semantic network suitable for vocabulary learning. In section 3 we design the functions of the SNVL, study its architecture, components and implementation technology. In section 4, we demonstrate the effectiveness and efficiency of the SNVL for vocabulary learning with the experimentation results of two groups of students who using SNVL or not. In the last section, we give conclusions and prompt further work to do in the future.

2. SEMANTIC NETWORKS

2.1 Classical semantic network

A semantic network is composed of nodes and links. Nodes can be treated as objects, which are drawn as circles with title description texts inside. Links are relationships between nodes, which are drawn as lines with relationship description texts beside them. Skimming nodes with the links of a semantic network graphs, we can grasp the main semantic meaning explicitly. In building up a semantic network, generally speaking, the nodes are simple and easy to identified, we treat physical items, concepts, events, actions or attributes as nodes. Node can be class and object. However, the links are more complex. The semantic network links can be divided into the following set of standardized types []:

(1) **IsA** (is a) - relates an object belong to a class. It defines an instance of a class.
(2) **AKindOf** (a kind of) – relates a class to another class, or may define a subset.
(3) **PartOf** (Part of) - represents how an object is composed of other objects, or inherits only part of the parent class. This link type demonstrates how a class may be associated with component parts.
(4) **HasA** (has-a) – relates an object to a property or attribute. This is not used to represent structural information. Instead it may be used to represent knowledge within a class.

For example, figure 1 is a classical semantic network. It includes five objects, John, boy, car, transport tool and wheel. Four relationships between them are appended to be four types of links described above. We can infer that John is a boy, and he has a car. A car is a kind of transport tool. The wheel is a part of a car.

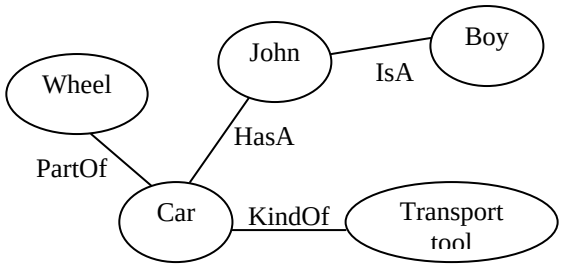

Fig.1 A classical semantic network

Four link types are competent for describing static nature of being. It is difficult to describe the dynamic action of an object. However, dynamic action links between objects are critical for reconstruction knowledge of contexts in vocabulary learning, so it is necessary for us to study some new semantic link types to improve semantic network for this purpose.

2.2 Improved semantic network

Action links between objects are required for building up semantic network to reconstruct context knowledge. We propose that the action links can include two sub types:

(1) **ActOn** (act on) – relates one object act on another object and has created effect. For example in the sentence of 'John plays table tennis.' Where 'John' is an object who acts on (plays) another object 'table tennis'.
(2) **Act** (Act) – relates the action of an object doesn't affect another object. It describes the state transfer of the object, or the action affects itself. Act action link will be abstract from the sentence without accusative or accusative omitted. For example 'John got tired.' and 'The enemies fled this morning.'

In order to building up vivid action links in semantic network, the adverbial modifiers can be displayed in the links.

We represent an action link semantic network by using a diamond with two lines linking their two

objects. Inside the diamond there is the link name. In act on action link, an arrow point to affected object or accusative will be drawn. See figure 2.

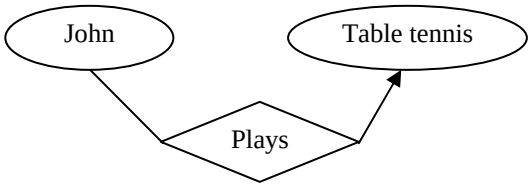

Fig.2 The representation of ActOn link

The adverbial modifiers are listed below the diamond on horizontal lines connected with a main vertical line to the rectangle. The adverbial modifiers may have link to another object can also be displayed. For example, 'I went to stadium by bicycle yesterday.' can be drawn as figure 3. If the action is affected each other, two arrows required to point every object. For example, 'The young man and the young women were talking loudly.' See figure 4.

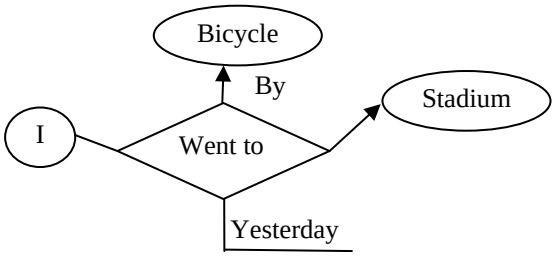

Fig.3 The representation of ActOn link with verbal modifiers

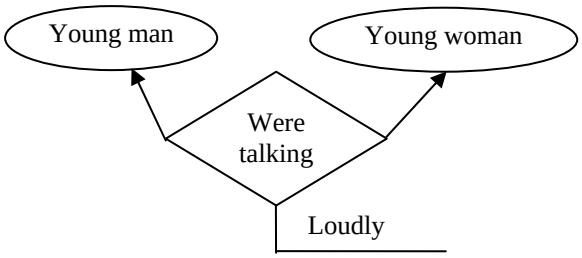

Fig.4 The representation of ActOn link with action affects two objects each other

The link of a sentence having direct object and indirect object can be drawn as figure 5. When the indirect object is an action, one more link should be added. For example, 'John asked Alier to buy a pen.' See figure 6.

Sometimes the combination of two objects and their relation between them would be an event. For example, 'I was angry. The young man and the young woman were talking loudly. See figure 7. We use their relationship as this event (circled with the dot-line).

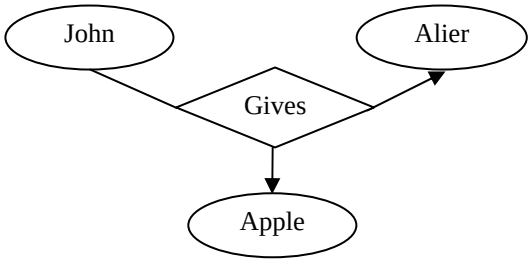

Fig.5 The representation of ActOn link with direct object and indirect object

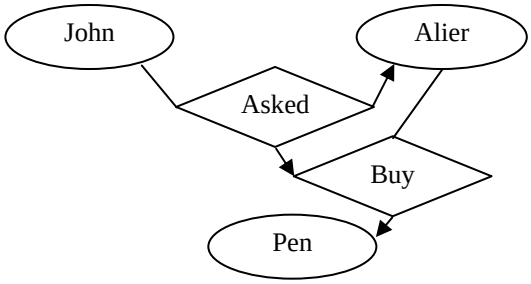

Fig.6 The representation of ActOn link when indirect object is an action

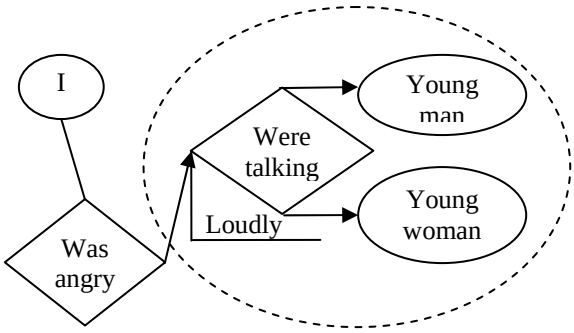

Fig.7 The combination of nodes and relationship

The Act link type without object to affect can be drawn as figure 8. Adverbial modifier can also be added just like the ActOn link type.

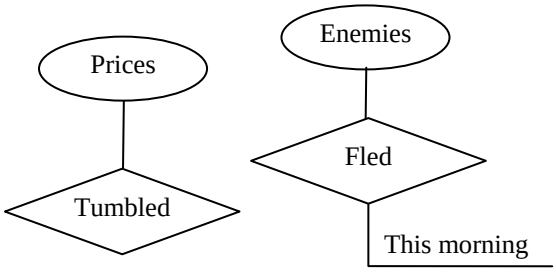

Fig.8 The representation of Act link

In the improved semantic network, four classic links

are represented as figure 9, which is updated from figure 1. In order to display a simple and explicit semantic network, the diamond can be omitted, leaving the link type names along with the link lines. However, the arrows must be drawn.

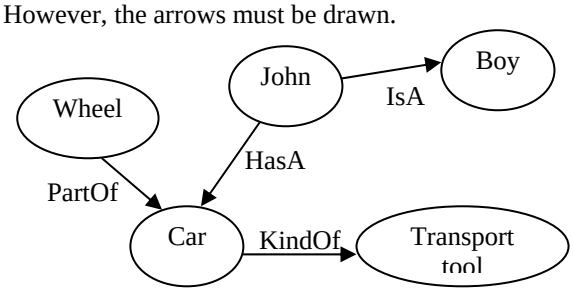

Fig.9 Using the improved method to represent the classical semantic network

A semantic network for vocabulary learning can be built up through selecting words from a lesson in a textbook. It can mark out a curricular conceptual framework, which enables students to image the complete scene of this lesson visually. This method is simple but effective and efficient. Students will profit by using the structured graphics of semantic networks.

3. SEMANTIC NETWORK BASED VOCABULARY LEARNING SYSTEM

3.1 Functions of the SNVL

We study the semantic network based vocabulary learning system (SNVL), which is computer aided vocabulary learning software system through improved semantic network method. The SNVL has the main functions:

(1) Text input and edit: It can open the TXT, MS Word document files. Texts except graphs and tables can be read and display in an edit window. User can also input a new text as he requires. Edit texts can be saved in files.
(2) Building up semantic network: It can analyze the text in the edit window and draws the improved semantic network. It also allows user to modify the nodes and links of the created semantic network or even build up a new semantic network. Semantic networks can be stored.
(3) Vocabulary learning practice: It can store the new words for the purpose of creating word practice for user. Vocabulary is arranged according to the textbooks and lessons. In the word practice, a semantic network will be displayed with some blanks for missing words such as names of nodes, links. Another practice is rewriting the lesson by the given semantic network.

3.2 Architecture of the SNVL

We design the architecture of the SNVL as the figure 10. The SNVL are composed of the following components:

(1) User interface: The user interacts with SNVL by using this interface, which is a GUI.
(2) Text process module: It is the module for text input and edit.
(3) Building up semantic network module: It is the main components of the SNVL to build up semantic network according to the text acquired from text process module.
(4) Vocabulary learning practice module: This module is responsible for creating practice for user.
(5) Database: Texts of lessons, semantic network and information of user practice are stored in database.
(6) Knowledge Base: Rules for building up semantic network and rules for analyzing text sentences are stored in the knowledge base. Knowledge includes facts and if-then-else rules. In the process of building up a semantic network, the knowledge will be used.
(7) Inferer module: It is applying knowledge for reasoning to analyze texts and build up semantic networks.

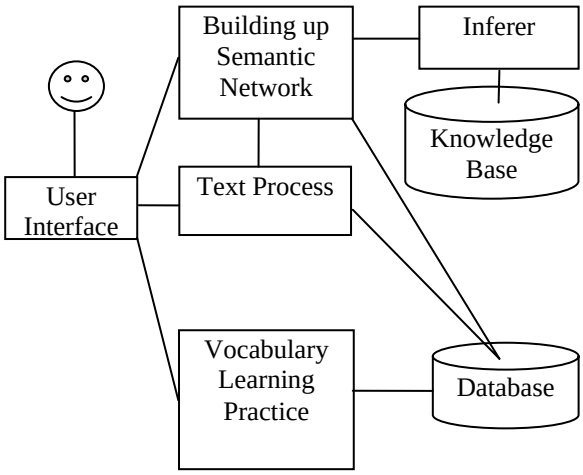

Fig.10 The Architecture of the SNVL

3.3 Steps of building semantic networks

A semantic network for vocabulary learning can be built up by using the SNVL. The process is described as follows:

(1) Split the sentences from paragraphs of a lesson.

For each sentence, find the subject and predicate. If there is an accusative, pick it out. If the accusative includes direct object and indirect object, distinguish them.

(2) Analyze the predicate and Adverbial modifiers. Identify the type of the predicate as one of six types as IsA, HasA, KindOf, PartOf, ActOn1, ActOn2, Act.

(3) Draw the nodes and their links.

(4) If there is a combination of two objects and their link to be a node of another link, treat their link as a node.

3.4 Implementation of the SNVL

To store a semantic network in database, we define the node, link, Adverbial modifier, link-node as figure 11, which is deprived from figure 3. We don't store a semantic network as a graphic format data. However, we keep the data of nodes and their links to redraw the graphs.

Link

Id	Name	Type
1	Went to	ActOn1
.	.	.
i	.	.

Node

Id	Name
1	I
2	Stadium
3	Bicycle
.	.
m	.

Link-Node

	Link Id	Node Id
1	1	1
2	1	2
3	1	3
.	.	.

Verbal Modifier

Id	Name
1	By
2	Yesterday
.	.
n	.

Fig. 11 Data Structure of Node, Link and Verbal Modifier

ActOn1 is the link type with one direction arrow. ActOn2 is the link type with two-direction arrow such as 'talking with each other'. We don't figure out the Link-Verbal Modifier and Link-Link which just like the Link-Node.

We have developed a prototype of SNVL by using C++ builder 6. Figure 12 is the main frame.

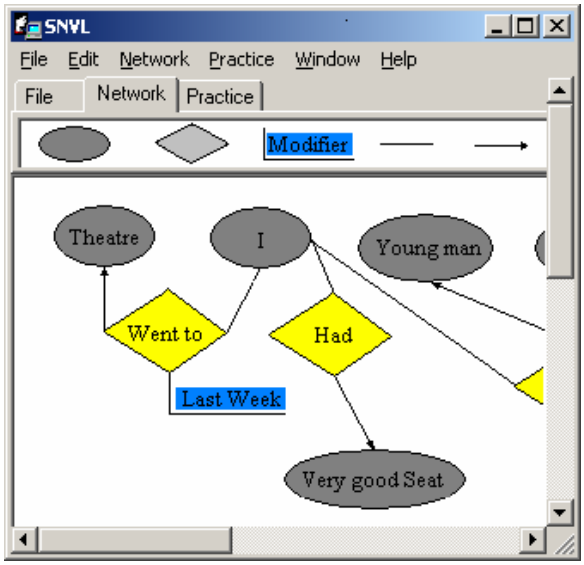

Fig. 12 The Main frame of the SNVL

4. EXPERIMENTS OF USING THE SNVL

We did an experiment in a middle school about the prototype of the SNVL. Two classes of students took part in. Both classes learnt English using textbook of new concept English, book 2. To learn vocabulary, one class used the SNVL and the other class did not, and this experiment period lasted a term. Two group of students. Almost the students in the both classes spent the same time to study. In the vocabulary test at the end of the term demonstrated the effectiveness and efficiency of the SNVL. Table 1 is the statistic information of two classes' grades.

Tab.1 Grade rates of two classes in vocabulary test

Grades	Class used the SNVL	Class didn't use the SNVL
A(>=90)	26%	10%
B(75-89)	63%	57%
C(60-74)	10%	30%
D(<60)	1%	3%

There are more students who using the SNVL got A and B, presenting the SNVL is more effective and efficient by using semantic network to learning vocabulary. Some students using the SNVL told us that the semantic network could help them image the complete meaning of a lesson, and recall the entire sentence in new words learning. It also helps them improve their comprehensive and writing abilities in English learning.

5. CONCLUSIONS

In this paper, we propose an improved semantic

network for vocabulary learning. Based on the improved semantic network, we design a vocabulary learning system and develop a prototype. Experiment has demonstrated the effectiveness and efficiency. But the SNVL can only deal with simple sentences in texts. Complex text is difficult for it to build up a perfect semantic network because of its weak intelligent ability and manual operation is required in that situation. So the SNVL is not mature. In the future, we will use more achievements of nature language processing to improve the SNVL.

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