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BRAIN TEXT PROCESSING MODEL BASED ON CONCEPTUAL DEPENDENCY THEORY

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Abstract: *The article describes a new approach to the text processing based on conceptual dependency stories. A possibility how to model text processing by the human brain is to model story processing. These stories include verbal communication. An interesting model of the story structure and format was introduced as Conceptual Dependency (CD) theory. The aim of this article is to find a new experimental text processing in human brain model based on CD theory.*
Key words: *Artificial intelligence, semantic network*

1. INTRODUCTION

This article is trying to understand the neural basis of language and though, to model knowledge storing and processing as in a human brain. This article deals with the cognitive science, natural language processing and generally with the artificial intelligence.
There are still many theories of the neural representation of knowledge and many valuable models of a knowledge storing and processing in the human brain. A few of the most significant models had been implemented in the programs like MARGIE, SAM and PAM. These programs are based on the Conceptual Dependency (CD) theory by Roger C. Schank (1969).

The programs SAM and PAM successfully showed how knowledge storing is important, but both programs were unable to process data out of their domain. SAM had difficulties with recognition plans and PAM had problems with understanding simple stories with events but without aims, e. g. in the following very short story because the wind and vase has no plan: “The wind blew the vase off the table. It broke.”

Method proposed here stores knowledge into the network similar to the CD diagrams. Proposed method has primitives and support for chronological order common with CD theory. The difference between proposed method and CD is that in proposed primitives are represented by predefined nodes and set of these primitives are dynamic. This set can be extended without impact on existing knowledge in the network. Structure of the proposed network better models the real human brain structure and it is more universal. This article describes this new method including its network structure. Additional information about the method can be found in (Kratochvil & Kleckova, 2009).

2. SIMILAR METHODS

Knowledge can be stored in different ways. Conceptual Dependency (CD) method mentioned above is similar to the method proposed here. With this method we are able to store knowledge to the universal network and this network also allows storing relations between objects and events in chronological sequence. More information about knowledge storing can be found in (Rich, 1983), (Grigorova & Nikolov, 2007).

2.1 Semantic networks

Semantic network is a network which represents semantic relations among concepts. It is a directed or undirected graph consisting of vertexes, which represent concepts, and edges. Semantic networks are often used for the knowledge representation. There are rules how knowledge is stored in a semantic network in the proposed method.

2.2 Conceptual Dependency

Roger C. Schank found a suitable model of how to write scripts to diagrams (Schank & Tesler, 1969; Schank, 1975). These diagrams are still too complicated and therefore far from human brain network. Here we present a developed model with simpler network.

2.3 Semantic networks vs. Conceptual Dependency

Semantic networks provide a structure into which nodes representing information can be placed. CD representation provides both: the structure and a specific set of primitives out of which representations of particular pieces of information can be constructed. Proposed method is similar to CD. Similar to CD primitives are interface nodes. This nodes and whole the proposed method will be explained in next sections.

3. PROPOSED METHOD

Proposed method of knowledge storing is comparable to the classic semantic networks, but edges have only weights and not semantic information. Proposed method is based on interaction between virtual agents in a virtual world. These agents are called avatars controlled by the computer program or by the user. Proposed method ensures storing events from the virtual world to the proposed semantic network.

For example, assume that we want to save information that avatar A see avatar B. On the Figure 1 it is shown, how this can be stored in a semantic network. However the proposed network has edges without any semantic information, which makes it more dynamic, universal and closer to the real brain. How this information will be stored in the proposed network is shown on the Figure 2. There is a simple event shown on the figure: agent A see agent B.

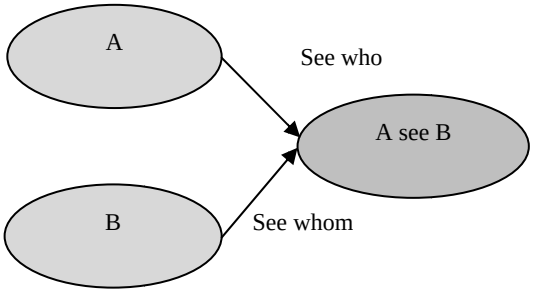

Fig. 1. Classic semantic network

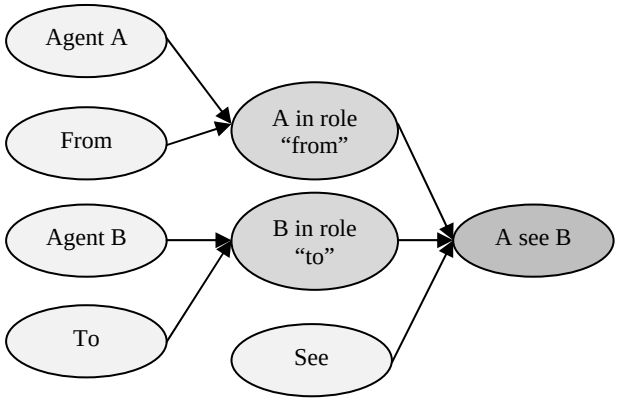

Fig. 2. Network without semantic on edges

Difference between proposed method and CD is in the meaning of nodes. There is a constant set of primitives in CD, but there is an unlimited dynamic set of primitives in the proposed one.

Semantic meaning of nodes is defined by connected ones. There are two types of nodes: created nodes in learning process and predefined ones. The predefined ones are basic nodes defining meaning of other nodes. The predefined nodes are atomic nodes, e. g. quantity or count (numbers 1, 2, 3, …), type of interaction (see, message, …) and direction (from, to, …). These predefined nodes represent concrete or abstract objects, events, etc and these objects can be in different types of virtual world, e. g. 2D virtual world, 3D virtual world or chessboard.

3.1 Proposed network

Proposed network is oriented graph and in this graph each node has a meaning. This meaning is constant or dynamically created during learning process and connected to an event or an object in the virtual world or defined with other nodes.

The network is a simulator of the semantic neural network described in (Dudar & Shuklin, 2000).

Knowledge stored in the network is stored in the story trees. These stories are built by processing events received from virtual world.

The network is divided into areas. These areas are predefined and respond to predefined nodes categories like: numbers, directions, speeds of change, directions, etc.

3.2 Proposed interface

Proposed interface between the virtual world and the algorithm controlling avatar allows transferring events from the virtual world to the semantic network and actions deduced from the semantic network to the virtual world.

3.3 Storing of knowledge

Interface is used to receive events from the virtual world. The storing of events in a semantic network is proposed. Each story has own root node. There are nodes connected to this root node. These nodes define events in the story. These event nodes are defined with other nodes. If appropriate node exists, then it is used, otherwise there is created and defined a new one.

3.4 Stored knowledge processing

A new algorithm will be implemented. This algorithm will be able to complete stories. There will be possible to mark any event as "to guess". Before it read and process these events, the program will try to guess them. This is the way how the program can be tested. There will be statistics how many marked events were successfully guessed by the program.

The algorithm is partially proposed at this time and is under development. Main idea of the algorithm is to copy activation potential from one node to connected ones.

The algorithm is based on spreading activation theory described in (Dudar & Shuklin, 2000).

3.5 Data file format

Input stories are manually written in files in XML format at this time. Story editor will be a part of the program created in near future. Stories consist of sequence of events in a virtual world. File format is XML, but events themselves are stored as a plain text. Each event record has a special format where first word means event type and numeric or text parameters follow.

File format for semantic network storing will be proposed later. Because proposed semantic network is universal, it would not be necessary to modify proposed file format after it would have been proposed. These files will be used for storing the semantic network or they may be user to cache analyzed stories.

4. FUTURE PLANS

In the near future the implementation of storing events will be finished. Editing of the stories will be implemented and it will be one of the main features. This program is under development at this time and it is already partially finished.

The program should demonstrate handling at least with functions like: basic story completing, logics, social understanding, grammar, knowledge transmission between avatars. There are more functions in future plans, e. g. fuzzy logic and trustfulness.

In the near future the program will allow implementations of the new virtual worlds with different set of events and actions. This gives us a possibility to replace the virtual world with the real world using cameras and microphones as input devices and speakers or also engines as output devices.

5. CONCLUSIONS

This article proposes a new method, which provides processing of story knowledge into semantic network. This network is different from others by its structure. Structure of the network is more like structure of real human brain. Nodes and edges models real neurons and synapses and also are divided into areas similar to real human brain. Proposed method is partly implemented and tested at this time. Implementation will be finished and more tested in the near future.

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