Semantic Neuro Knowledge Representation

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Abstract

This work present an approach for knowledge representation based on neural network, named Semantic Neuro Knowledge Representation system (SNKR). The proposal system represents knowledge as objects and relation between them, like semantic net. Each neural network in the system response to an input object by classifying it to a specific relation, more than one object can share the same relation. (SNKR) system can represent complicated knowledge which has complex relations, like propositional networks, more easily than conventional methods. Back propagation (BP) neural network learning method are used to build neural networks of (SNKR) System because of its simplicity & easy of obstruction.

1. Introduction

In order to solve the complex problems encountered in Artificial Intelligence (AI), one needs both a large amount of knowledge and some mechanisms for manipulating that knowledge to create solution to new problems. [1]. A variety of ways of representing knowledge have been exploited in A.I, several popular such A.I representation have been members of a family of representations that go under the name of semantic network (They have also been referred to as associative networks).From the view of the predicted calculus a semantic net replace terms with nodes and relations with labeled directed arcs. In the following section, we shall describe the proposal system in details**.**

2. Semantic nets:

A semantic net or net is a structure for representing knowledge as a pattern of interconnected nodes & arcs. The earliest semantic net were designed as intermediate languages for machine translation & most versions are still strongly oriented toward the features of NL. But the more recent versions have grown in power & flexibility to complete with frame systems & logic programming systems as general knowledge representation languages. The simplest networks used in AI are relational graphs. These graphs consist of nodes connected by arcs, each node represents a concept, & each arc represents some relationship between the corresponding concepts.

Semantic nets found a wider application in reasoning of knowledge based system. A semantic consists of two demetary tuples: events denoted by nodes α, & relationship between events, denoted by links. Generally, a linguistic label attached to each link to represent the association between events [2][3]. The earliest semantic networks were designed intermediate languages for machine translation, Semantic net can represent binary predicate (Fig1), as well as unbinary predication, like ternary predicates (Fig. 2)

It is thus clear from (fig 2) that a predicate of arity > 2 can be represented by a number of predicates, each of arity 2, and then the resulting predicated can be represented by a semantic net. For instance, the ternary predicate: Gave (john, the beggar, 20$) which has been represented in (fig 2), as a collection of 4 predicates given by

Agent (john, event)
Beneficiary (the-beggar, event)
Object (20$, event)
Instance-of (give, event)

It obvious that the representation of a high arity predicate in binary form is not unique, &, thus the semantic net of such representation is also not unique.

2.1 Is-a Hierarchy

Another key idea in AI that has sprung from the thinking of things as semantic network is-a hierarchy. Is-a relation are partial orderings on its domains for many domains, this relation has a least upper bound, often a very general concept such as ENTITY, Rarely does have a reatest lower bound, since they tend to have a higher branching factor

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going downward than they do moving up. This is illustrated in Fig (3).[1] [2] [3]

It is usually better to store relationships of the first level and to provide a mechanism for generating the others as they are needed for example
IsA (poodle, dog)
IsA (poodle, dog)
ISA (dog, pet)
ISA (horse, livestock)
Can be replaced by
$\forall \times \forall y \forall z$ is A (x,y) Λ is A (y,z)
is A (x,z)
This ability is called the inheritance of properties.

2.2 Propositional networks

In propositional net certain nodes represent entire propositions. These nodes serve two purposes. They provide points of attachment for intersentential relations; & they define a context that shows the scope of quantifiers & other operators for ex.
"Sue thinks that Bob believes that a dog is eating a bone". The verbs "think" & "believe" take entire propositions as their objects. What Bob believes is the proposition "A dog is eating a bone". What Sue thinks is the more complex propositional "Bob believes that a dog is eating a bone.

3. Neural Network

Neuro computing is a fundamentally new & different approach to information processing, it is the first alternative to programmed computing, which has dominated information processing for the last 45 years [4], that is solving problem involves devising an algorithm &/or a set of rules for solving the problem & then correctly coding these in s/w. In contrast, neuro computing does not require algorithm or rule development & that often significantly reduces the quality of s/w that must be developed. The primary information processing structure of interest in neuro computing is NN [5].

Neural networks is parallel, distributed information Processing structure consisting of process elements interconnected via unidirectional signal channels called connections. Each process element has a signal output connection that branches "fans out" into as many collateral connections as desired, each carries the same signal o/t works in a way similar to how we thinks. The neurons in the human brain encode information [10].

Although a signal neuron can perform certain simple pattern detection functions, the power of a network computing comes from connecting neurons into networks, either by arranging the neurons in a single layer, or multi-layers. The memory of NN lies in the synoptic weight, which can be either presented or adaptive trained by learning mechanism.

The basic building blocks of neural network are neuron, so called because it works in a shion vaguely to the neurons found in human brain. Each neuron is a fairly simple device, deriving a single output determines from a number of inputs which are first subjected to a weighting which terminates the influence that the input has on the neuron's output, these weighted values are then added together & subjected to a transfer function which determines the resulting output.
A neural network is constructed by connecting hundreds or even thousands of these neurons together, so that the output of a neuron becomes input of another. The first thing to do is to train the network, training involves adjusting the weightings so each neuron input until the network as a whole generate acceptable results for every entry in the data base. Thus, learning is one of the basic features of intelligence, it represent directed change in the knowledge structure that broves the performance. Each learning law operates in a formation environment. Although information environments tends to be statistical, they are often described in terms of probability density functions.[7][8][9].

4. Semantic Neuro Knowledge Representation [SNKR] Proposed System

Concepts of Artificial Neural Network ANN) are used for knowledge representation, namely semantic representation; such representation included all neural fascinating properties which enables them to exceed the limitations of traditional approach. It is based on the fact, that we "teach" Neural Network to give acceptable answers by examples. The goal is to produce a Network that implements a known or unknown function, when given a sufficient number of Input/Output examples from that function. Such process should be automated by a Learning algorithm. The implementation may be only a good approximation of the function. For binary predicate, ANN can be used to find relation between the events. For example, the semantic network in Fig (3)

can be converted to neural multi layer BackPropagation (BP) Neural Network. To build such BP neural network, an important phase, must be constructed. This phase is training phase.

Is a (x, Variable)
Is a (y, Variable)
Is a (z, Variable)
Is a (n, variable)

In Fig.(6), we have 4-Binary predicates, BP learning method are used for training these 4-Binary predicates. The training set could be constructed as Fig (7). Since we have one relations, one neuron is needed in the output layer, the output of such neuron become 1, when the input layer see a variable. While the no of neuron in the input layer are equal 2, since this is the smallest length which can be used binary coding (00=x , 01=y, 10=z, 11=n). For non-binary predicates, as one shown in fig (2) training set could be constructed as Fig. (8).

From Fig.(2), it clear that the number of neuron in the output layer is four since we have four relations. One important thing to note is that two or more object may share the same relation for example the object go, put, like, … etc. may be instance of the object Event. The activation of any output neuron (make it's output equal to 1) is interpreted as the existence of that relation which represented by this neuron with the input objects.

5. Propositional Semantic Neuron

The proposed system use neuron computing concepts in different way that is: neural networks are used to represent knowledge. Usually Neural networks store there knowledge in confusing manner, like some small real number at each connection in the net, such knowledge are constructed after training phase. In the proposed system (propositional semantic) multiple neural networks are connected together, each net (that is bravely constructed through BP learning method, to represent some proposition) receive input and transmit output to another nets. such that the new constructed neural network can represent the knowledge given in the entire proposition. Traditional methods for Knowledge representation, as explained in section 2, don't use the idea of "teaching Knowledge". Thus they don't have knowledge generality concepts.

Fig. (6) Show how the knowledge stored in one network can serve as a pice of knowledge in new proposition. New constructed neural network generalize knowledge of previous nets. For the same example given in section 2.2 that is:
"Sue thinks that Bob believes that a dog is eating a bone"
We can construct semantic neuron by dividing this sentence into 3 sentences that are:

A) A dog is eating a bone.
B) Bob believes that (A).
C) Sue thinks that (B).

First Build BP Neural Network For (A) as we explain in previous section, then we build BP Neural Network for (B) as in Fig. (10).

Finally we can construct the main neural network, namely C by using A and B a, shown in Fig (8).

6. Conclusions:

This paper proposes knowledge representation system, formed with Artificial Neural Network. This system is able to exhaustively classify an input object to a specific relation.

The performance of the system is better than the conventional method knowledge representation since it represent complex semantic network with simple Artificial Neural Network.

Back propagation learning method are used to build ANN of the proposed system because it is easy implemented, learning complicated multidimensional-mappings more easily than other learning algorithms.

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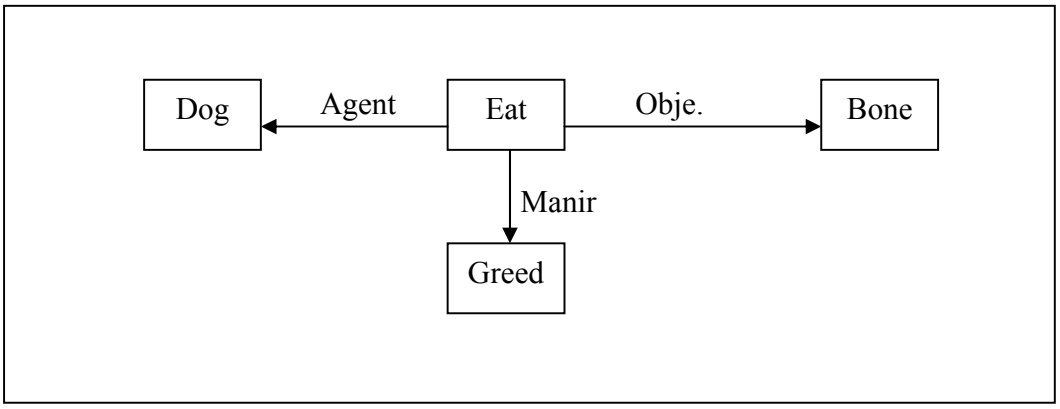

Fig. (1) Semantic net for "A dog is greedily eating a bon"

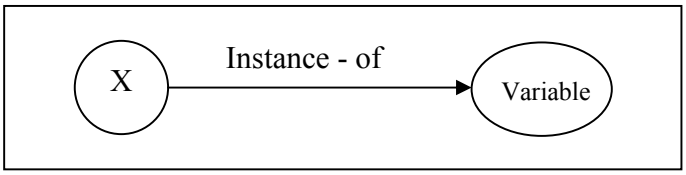

Fig (2): Representation of instance-of (x, variable)

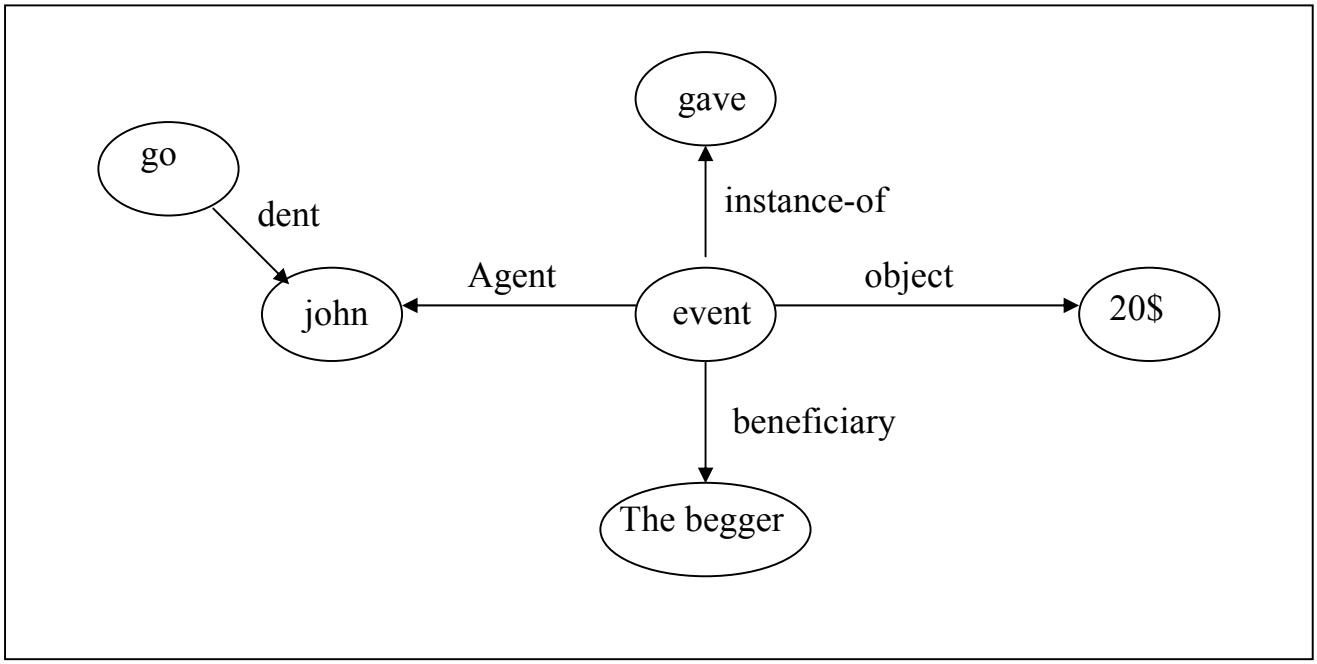

Fig (3): Representation of Gave (john, the beggar, 20$)

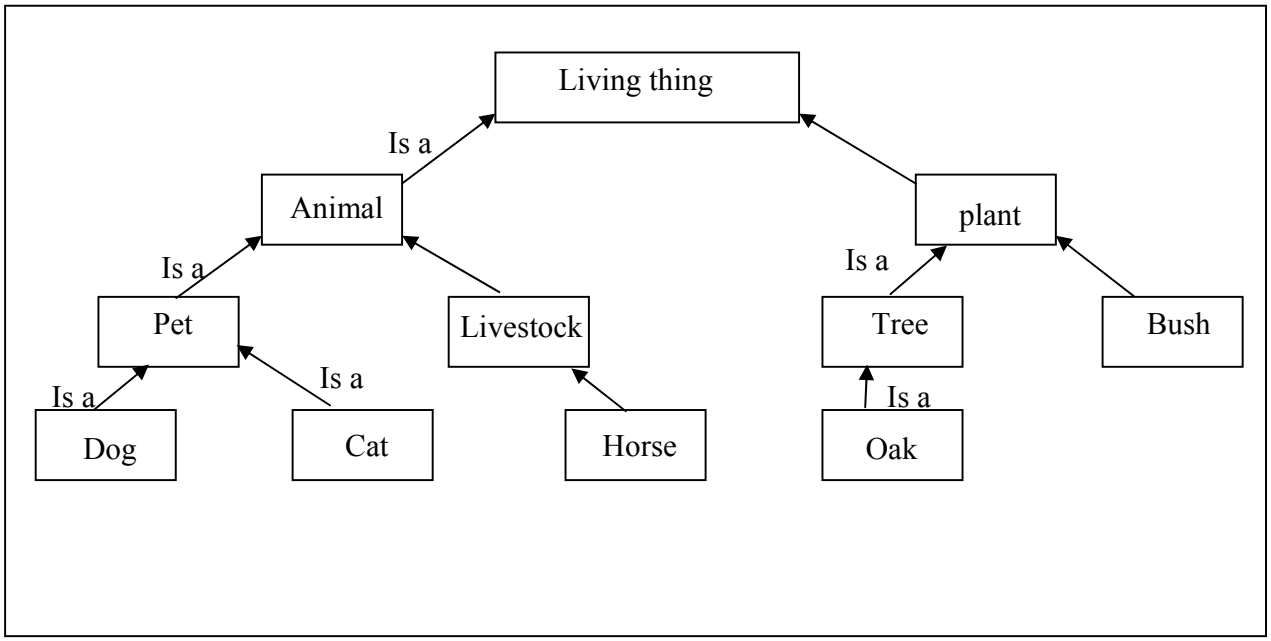

Fig (4): Is a Hierarchy

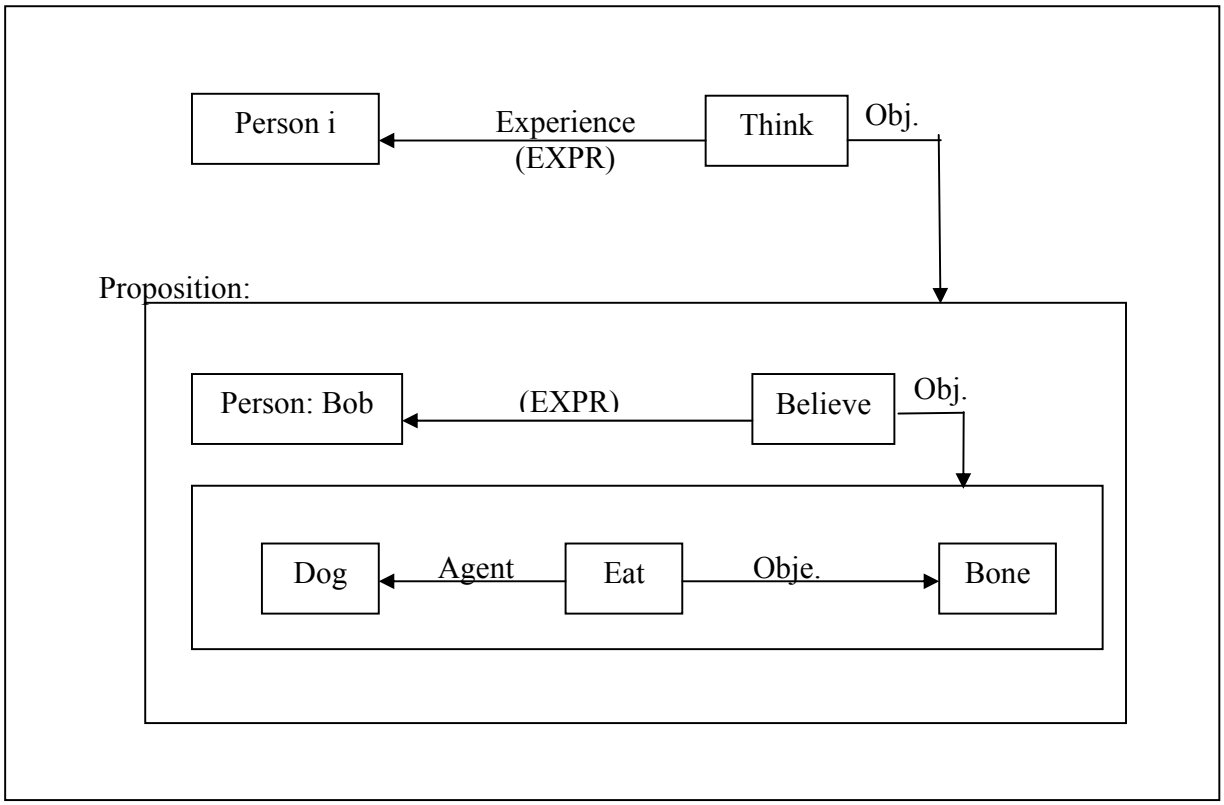

Fig.(5) Propositional network of "Sue thinks Bob believes that a dog is eating a bone"

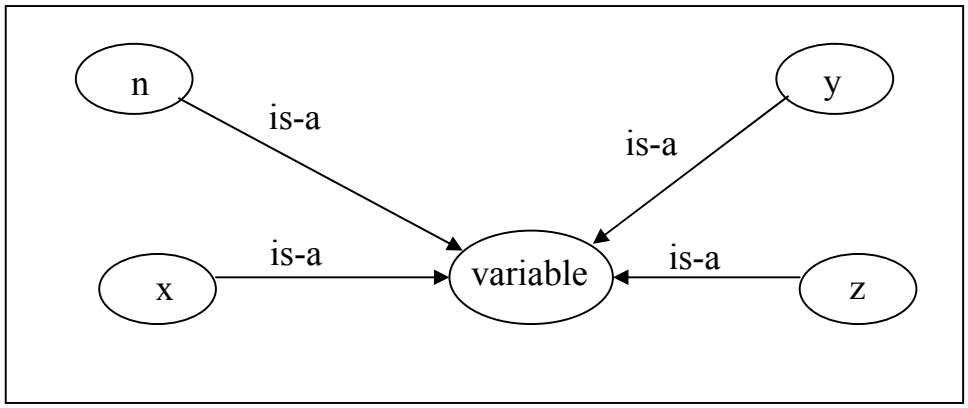

Fig (6) semantic net for 4 binary predicate

Input	Desired output
X	1
Y	1
Z	1
N	1
Other input	0

Fig (7), Training set for Fig. (6)

Input	Desired output			
	Agent	Instance-of	Object	Beneficence
John	1	0	0	0
The beggar	0	0	0	1
Gave	0	1	0	0
20$	0	0	1	0

Fig. (8). Training set for Fig. (2)

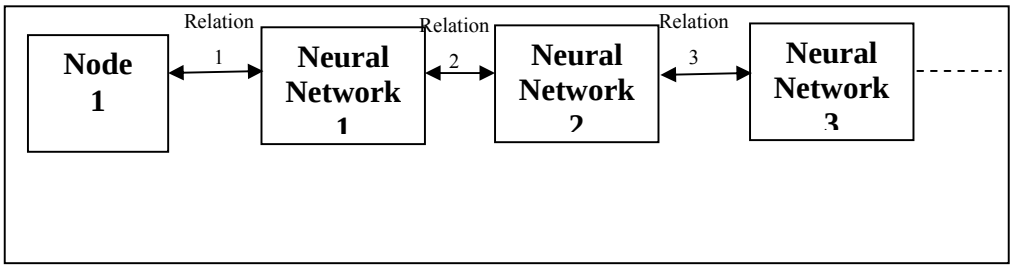

Fig. (9) Propositional Semantic Neuron

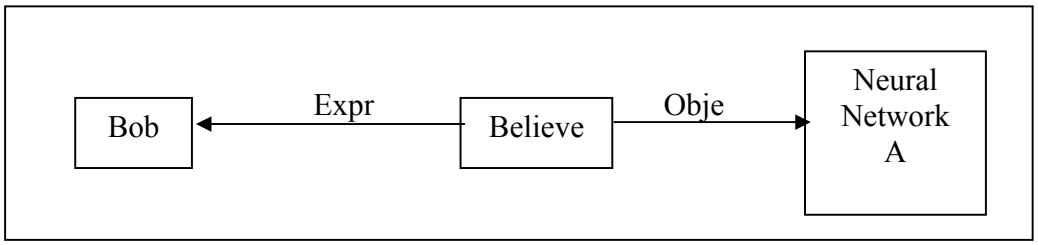

Fig. (10)BP Neural Network for (B) Propositional Semantic Neuron

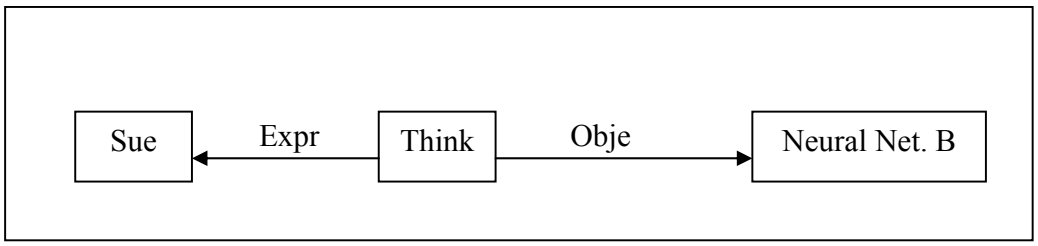

Fig.(11)BP Neural Network for (C)