Study and Analysis of Knowledge Representation methods in Expert System.

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Abstract: During the quarter century since the birth of the branch of computer science known as artificial intelligence (Al), much of the research has focused on developing symbolic models of human inference. In the last decade several related Al research themes have come together to form what is now known as "expert systems research. The knowledge and inference engine are the two fundamental and important components of expert system and without these two components it is impossible to design and develop an expert system . In this paper I study and analyze the knowledge representation methods namely semantic Net and production systems that are mostly used in modern expert systems.
Keywords: *Expert system, Semantic Net, Frames, Knowledge Representation.*

1. Introduction
1.1 Expert system
An expert system is an intelligent computer program that uses knowledge and inference to solve problem that are difficult enough so require significant human expertise for their solution.

1.2 Components of Expert System.
The expert system has the following components:
   a) Knowledgebase: The knowledgebase is the database of the expert system .
   b) Inference Engine: The inference engine acts as the processing element of an expert system.
   c) User Interface: The user interface is the platform on which the user interacts with the expert system.

1.3 Characteristics of Expert System.
1.3.1 High performance : The response at a level of competency equal to or better than an expert .

1.3.2. Adequate response time : Perform in a reasonable time, comparable to or better than HE's time

1.3.3. Good reliability: Must be reliable and not prone to crashes or else it will not be used.

1.3.4 Understandable : Have an explanation capability
a. Sanity check
 b. Accuracy validation of the knowledge
1.3. 5. Flexibility : Important to have an efficient mechanism for adding, changing, and deleting knowledge .

1.4 Advantages of Expert system.
1.4.1. Increased availability: Expertise is available on any suitable computer hardware

1.4.2. Reduced cost : The cost of providing expertise per user is greatly lowered .

1.4.3. Reduced danger : Can be used in environments that might to hazards for a human 4. Permanence The knowledge will last indefinitely .

1.4.5. Multiple expertise: The knowledge of multiple expert can be made available to work simultaneously & continuously on a problem at any time of day or night The level of expertise may exceed that of a single human expert .

1.4.6. Increased reliability : Increase confidence by providing a 2nd opinion When human expertise is tired or under stress she/he will make mistakes.

1.4.7 Intelligent database: Can be used to access a database in an intelligent manner e.g data mining.

1.4.8.Fast response : May response faster and be more available than human expertise .

1.4.9 Explanation : Can explain in detail the reasoning that lead to a conclusion A human may be too tired, unwilling, or unable to do this all the time

2 knowledge representation.

Knowledge-representation is the field of artificial intelligence that focuses on designing computer representations that capture information about the world that can be used to solve complex problems such as diagnosing a medical condition. knowledge and Representation are two distinct entities. They play central but distinguishable roles in intelligent system.

❖ Knowledge is a description of the world. It determines a system's competence by what it knows.

❖ Representation is the way knowledge is encoded. It defines a system's performance in doing something.
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Knowledge is a progression that starts with data which is of limited utility.
1. Data is viewed as collection of disconnected facts Example It is raining
2.By organizing or analyzing the data, we understand what the data means, and this becomes information. It provides answers to "who", "what", "where", and "when". Example:
The temperature dropped 15 degrees and then it start draining.
3.The interpretation   or evaluation of information yield knowledge. It provides answers as "how". Example: If the humidity is very high and the temperature drops substantially, then atmospheres is unlikely to hold the moisture, so it rains.
4.An understanding   of the principles embodied within the knowledge is wisdom. It provides answers as "why".

2.1 Knowledge Representation Methods.
The various Knowledge representation methods are:
❖ Production Rules.
❖ Semantic Net.
❖ Frames.
❖ Logic.
In this paper I am going to analyse the production rules and Semantic Net knowledge representation methods.
❖ **Production Rules or Production System:**
Rules are used to represent relationships. Rule-based knowledge representation employs
IF Condition.

IF Condition (premise or consequent)
THEN **Action**
For example,
IF
the heating element glows
AND
the bread is always dark
THEN the toaster thermostat is broken. When the problem situation matches the IF part of a rule, the action specified by the THEN part of the rule is performed.
Production rules are one of the most popular and widely used knowledge representation languages.
Production rule system consists of three components.
❖ *working memory*
contains the information that the system has gained about the problem thus far.
❖ *rule base*
contains information that applies to all the problems that the system may be asked to solve.
❖ *interpreter*
solves the control problem, i.e., decide which rule to execute on each selection-execute cycle.
Used both for KR and Problem solving system
Advantages of Production System:
Naturalness of expression
Modularity
Restricted syntax
Ability to Represent Uncertain Knowledge
Disadvantages of Production System:
Inefficient
Less expressive

2.2 Semantic Net
It is formalism/mechanism for representing information /Knowledge about objects, people, concepts and specific relationship between them.
The syntax of semantic net is simple. It is a network of labeled nodes and links.
It's a directed graph with nodes corresponding to concepts, facts, objects etc and arcs showing relation or association between two concepts.

The commonly used links in semantic net are of the following types.

Isa: subclass of entity (e.g., child hospital is subclass of hospital).

Inst: particular instance of a class (e.g., India is an instance of country).

Prop: property link (e.g., property of dog is 'bark).

Representation of Knowledge in Semantic Net

Every human, animal and bird is living thing who breathe and eat. All birds can fly. All man and woman are humans who have two legs. Cat is an animal and has a fur. All animals have skin and can move. Giraffe is an animal who is tall and has long legs. Parrot is a bird and is green in color

2.3 Inheritance in Semantic Net

Inheritance mechanism allows knowledge to be stored at the highest possible level of abstraction which reduces the size of knowledge base.

It facilitates inference of information associated with semantic nets.

It is a natural tool for representing taxonomically structured information and ensures that all the members and sub-concepts of a concept share common properties.

It also helps us to maintain the consistency of the knowledge base by adding new concepts and members of existing ones.

Properties attached to a particular object (class) are to be inherited by all subclasses and members of that class.

Isa Facts	Instance Facts	Property Facts
isa(living_thing, nil). isa(human, living_thing). isa(animals, living_thing). isa(birds, living_thing). isa(man, human). isa(woman, human). isa(cat, animal).	inst(john,man). inst(giraffe,animal). inst(parrot, bird)	prop(breathe, living_thing). prop(eat, living_thing). prop(two_legs, human). prop(skin, animal). prop(move, animal). prop(fur, bird). prop(tall, giraffe). prop(long_legs, giraffe). prop(tall, animal). prop(green, parrot)

Queries

- ❖ is john human   instance(john, humans) Y
- ❖ is parrot a living thing instance(parrot, living thing) N
- ❖ is giraffe an animal instance(giraffe, animal)Y
- ❖ does parrot fly property(parrot, fly) Y
- ❖ does john breath property(john , breath) Y
- ❖ has parrot fur property(parrot, fur) N

Advantages of Semantic nets

Easy to visualize.

Formal definitions of semantic networks have been developed.

Disadvantages of Semantic nets

Inheritance (particularly from multiple sources and when exceptions in inheritance are wanted) can cause problems.

Facts placed inappropriately cause problems.

No standards about node and arc values.

2. Conclusion

In this paper, I demonstrate the applicability of semantic Net representation and Production system representation. More specifically, I compare these two modes of discussion representation (i.e., production systems versus semantic Net) and the results show that semantic Net discussion representation leads to a higher level of perceived contextualization and better mutual understanding. Semantic nets have the ability to represent default values for categories. They convey some meaning in a transparent manner. The Semantic nets are simple and easy to understand. They are easy to translate into PROLOG.
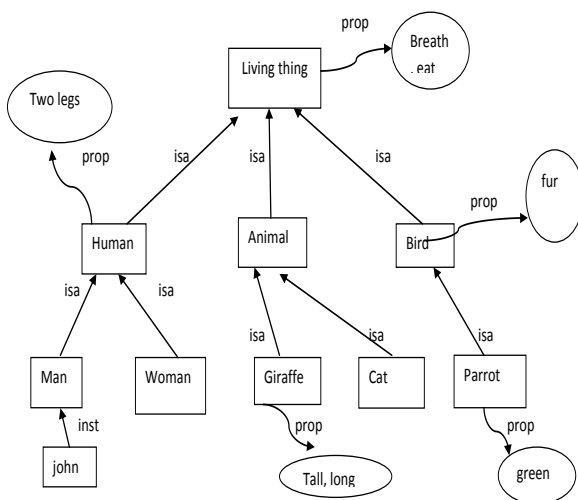

Fig: Semantic Net

Coding of semantic Net into prolog.

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