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COM 418E Expert Systems

Question: Knowledge representation schemes.

1. **Logic-based representation**
   It is a systems that define a framework for representing relational knowledge and reasoning about it. Unlike rule systems, logic is a very suitable tool for representing real world models. It can represent very complex relationships among objects, it can represent hierarchies, and it is very extensive. The main problem of reasoning with logic is that inference is usually and NP- complete problem. The reasoning is performed according to strictly defined rules of inference;
   a) **Propositional logic:** the syntax of propositional knowledge defines the allowed sentence.
   b) First order predicate logic:
   c) Modal logic: Modal logic extends propositional logic of possibilities and necessity.
   d) **Non-monotonic logic**: Non-monotonic logic is a result of synthesis of cognitive sciences and traditional logic representations.
2. **Procedural representation**
   Knowledge is represented as a set of instructions for solving problem. The representation of certain concepts in computer by procedure or programs in some appropriate language, rather than by static data items such as numbers or lists.
3. **Network representation**
   Knowledge is expressed as a graph in which the nodes represented objects or concepts in the problem domain and the arcs represent relations or associations between them. Examples semantic network, conceptual graphs. The nodes of this graph then represent entities and class entities. These classes then may hierarchically ordered to represent the knowledge.

This lead to the basic relations between the nodes, that is: the subclass, entity of.

4. **Structural representation**
   It extends networks by allowing each node to be a complex data structure consisting of names slots with attached value, this values may be simple numeric or symbolic data, pointer to other complex data structures or even procedure for performing a particular task. Example frames, objects.
5. **Frames**
   Frames have been the first attempt to mimic human reasoning and knowledge hierarchy representation. They were first proposed by Minsky and found tremendous applications in early expert systems. Frames are grouping of slots that represent semantically close knowledge. The principle of frames has been further enhanced and refined in Object Oriented Programming Paradigm and Multi-Agent Systems.
6. **Rules**
   Rules represent a very human friendly knowledge representation. They are composed of simple if-then clauses that are activated usually according to a custom heuristic function.