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Assignment 1
- Artificial Intelligence

Q1. Write short note on.
(i) Hierarchical Planning

Ans: 1) Hierarchical planning is also called as plan decomposition. Generally plans are organized in a hierarchical format.
2) Complex actions can be decomposed into more primitive actions and it can be denoted with the help of links between various states at different levels of the hierarchy. This is called as operator expansion.
3) In terms of major and minor actions, hierarchy of actions can be decided. Minor activities would cover more precise detailed activities to accomplish the major activities.
4) Motivation behind this planning is to reduce the size of search space. For plan ordering we have to try out a large number of possible plans, with plan hierarchies we have limited ways in which we can select and order primitive operations.
5) In hierarchical planning major steps are given more importance. Once the major steps are decided we attempt to solve the minor detailed actions.
6) It is possible that major steps of plan may run into difficulties at a minor step of plan. In such case we need to return to the major step again to produce appropriately ordered sequence to devise the plan.
7) Eg: Actions required for "Travelling to rajasthan" can be given as follows:

- Opening yatra.com (1)
- Finding train (2)
- Buy ticket (3)
- Get taxi (2)
- Reach railway station (3)
- Pay driver (1)
- Check in (1)
- Boarding train (2)
- Reaching Rajasthan (3)

1st level plan :
Buy ticket (3), Reach Railway station (3), Reach Rajasthan (3)

2nd level plan :
Finding train (2), Buy tickets (3), Get taxi (2), Reach railway station (3), Boarding train (2), Reach rajasthan (3)

3rd level plan (Final)
Opening yatra.com (1), finding train (2), Book Ticket (3), take texi (2), Reach Railway station (3), Pay-driver (3), Check in (1), Boarding trains (3), Reach Rajasthan (3)

(iii) Multiagent planning.

1) Many types of planning belong to single user environment wherein agents act alone in a single user environment

2) When the environment consists of multiple agent to, then the way a single agent plan its action get changed.

3) We have a glimpse of environment where multiple agent have to take actions based on current state. The environment could be co-operative or competitive. In both the cases agents action influences each other.

4) Few of the multiagent planning strategies are listed below
   (i) Co-operative
   (ii) multi body planning
   (iii) Co-ordination mechanisms.
   (iv) Competition.

(i) Co-orperation

In co-orperation strategy agents have joint goals and plans. Goals can be divided into subgoals but ultimately combined to achieve ultimate goal.

(ii) Multibody planning.

Multibody planning is the strategy of implementing correct ~~fo~~joint plan.

(iii) Co-ordination mechanisms.

These strategies specifies the co-ordinaton between co-operative agents. Co-ordination mechanisms is used in several co-operating planning.

(iv) Competition:

Competition strategies are used when agents are not co-operating but competing with each other. Every agent wants to achieve the goal first.

Q2. Write a short note on self organizing maps.

Ans: 1) A self organising map (SOM) uses unsupervised learning to build a two dimensional map of a problem space.

2) It uses competitive learning as opposed to error correction learning (which is used in backpropagation with gradient descent)

3) A self organizing map can generate a visual representation of data on a hexagonal or rectangular grid.

4) SOM also represents clustering concepts by grouping similar data together.

5) Applications include meteorology, oceanography, project prioritization and oil and gas exploration.

6) A self organization map is also known as a self organizing feature map (SOM) or a kohonen map.

Kohonen's self organising maps.

1) Kohonen's self organizing networks also known as Kohonen's feature maps or topology preserving maps are used for data clustering.

2) Networks of this type impose a neighbourhood constraint on the output unit such that a certain topological property in the input data is reflected in the output units weights.

Algorithm:

Step 1: Initialize, the weights at some random values
→ set topological neighbourhood parameters. As clustering progresses, the radius of the neighbourhood decreases
Initialize the learning rate α. It should be slowly decreasing function of time.

Step 2: Perform step 3-9 till stopping condition is true.

Step 3: Perform 4-6 for each i/p ~~value of~~ vector x

Step 4: Compute the square of the Euclidean distances
i.e for each $j=1$ to m (there are m no. of output neurons.

$$D(j) = \sum_{i=1}^{n} \sum_{j=1}^{m} (x_i - w_{ij})^2$$

Step 5:
Find the winning unit index J, so that $D(J)$ is minimum.

Step 6: For all units j within a specific neighbourhood of J and for i, calculate new weights

$$w_{ij} = w_{ij}(old) + \alpha [x_i - w_{ij}(old)]$$

Step 7: Update the learning rate α using formula

$$\alpha(t+1) = 0.5\alpha(t)$$

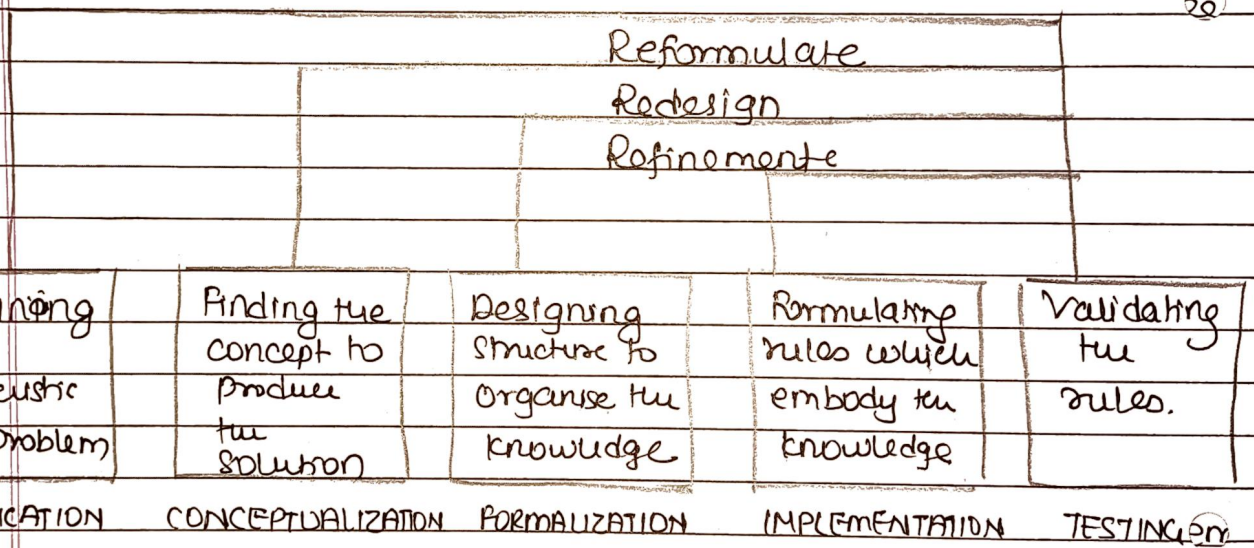
Step 8: Reduce Radius of topological neighbourhood at specified time intervals.

Step 9: Test for stopping condition.

Q3. Explain phases in building Expert Systems with ES architecture in detail.

Ans: There are 5 phases while developing an expert system.

(i) Identification.
(ii) Conceptualization
(iii) Formalization
(iv) Implementation
(v) Testing (validation, verification and maintainence)



1) Identification:

(a) Before developing an expert system, it is important to describe, with as much precision as possible. The problem ~~with~~ which the system is intended to solve.

(b) The exact nature of the problem and start the precise goals which indicate exactly how the expert system is expected to contribute to the solution, these are must be determined.

2) Conceptualization:

(a) Once it has been identified for the problem an expert system has to solve, the next stage involves analyzing the problem further to ensure that it specifies as well as generalizes are understood.

(b) The conceptualization stage involves a circular procedure of iteration and reiteration between the knowledge engineer and the domain expert.

(c) When both agree that the key concepts and the relationships among them have been adequately conceptualized, this stage is complete.

3) Formalization.

(a) During the identification and formalization stages, the focus is entirely on understanding the problem.

(b) During the formalization stage, the problem is connected to its proposed solution, an expert system is supplied by analyzing the relationships depicted in the conceptualization stage.

(c) The knowledge, engineer begins to select the techniques which are appropriate for developing the particular expert system.

(d) During formalization, it is important that the knowledge engineer, be familiar with the following.

i) The various techniques of knowledge representation and intelligent search techniques used in expert systems.

(ii) Expert system tools which can give greatly expidite the development process.

(iii) Other expert system which may solve similar problems and thus may be adaptive to problem at hand.

e) The formalization process is often the most interactive stage of expert system development as well as the most time consuming.

f) The knowledge engineer must develop a set of rules and ask the domain expert if those rules adequetly represent the expert's knowledge.

g) This process is also interactive: the rule review is repeated and the rules are refined continually until the results are satisfactory.

4) Implementation.

a) During the implementation stage the formalised concepts are programmed into the computer which has been chosen ~~for~~ for system development, using the predetermined techniques and tools to implement a prototype works.

b) The knowledge engineer may be able to determine if techniques chosen to implement the expert system there the appropriate ones.

c) Once the prototype system has been refined sufficiently to allow it to be executed the expert system is ready to be tested thoroughly to ensure the it expertise correctly.

5) Testing.

a) Testing provides an opportunity to identify the weakness in the structure and implementation of the system and to make the appropriate corrections.

(b) Depending on type of problems encountered the testing procedure may indicate that the system was implemented incorrectly or perhaps that the rules were implemented correctly but were ~~able~~ poorly or incompletely formulated.

Q4. Explain AI application in detail.

(ii) ~~Natural Processing~~

(i) Natural Language Processing

Ans: 1) Natural Language Processing (NLP) refers to AI method of communicating with an intelligent systems using a natural language such as English.

2) Processing of natural language is required when you want an intelligent system like robot to perform as per your instructions when you want to hear decision from a dialouge based clinical expert system etc.

3) The field of NLP involves making computers to perform useful tasks with the natural langues humans use.

The input and output of an NLP system can be
- speech
- written text.

4) Components of NLP
There are two components of NLP.

- Natural Language Understanding (NLU)

i) Understanding involves the following tasks
- Mapping the given input in natural language into useful representations.
- Analyzing different aspects of the language.

- Natural Language Generation (NLG)

(i) It is the process of producing meaningful phrases and sentences in the form of natural language from some internal representation.

(ii) It involves:
- Text Planning
- Sentance Planning
- Text realization.

(iii) The NLU is harder than NLG.

Steps in NLP

(i) Lexical analysis:
It involves identifying and analyzing the structure of words.

(ii) Syntactic Analysis (Parsing):
It involves analysis of words in the sentance for grammar and arranging words in a manner that shows the relationship among the words.

(ii) ~~Syntactic Analysis~~

(iii) Semantic analysis:
It draws the exact meaning or the dictionary meaning from the text.

(iv) Discourse Integration:
The meaning of any sentence depends upon the meaning of the sentence fi just before it. In addition it also brings about the meaning of immediately succeding sentences.

(v) Pragmatic analysis:
During this, what was said is re-interpreted on what it actually means.