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16/12/21 ARTIFICIAL INTELLIGENCE 60004190057

ASSIGNMENT 1 TE COMPS A4

Q1 Explain architecture of learning agents with suitable example.

ANS A learning agent is a tool in AI that is capable of learning from its experiences. It starts with some basic knowledge and is then able to act and adapt autonomously, through learning, to improve its own performance. Unlike intelligent agents that act on information provided by a programmer, learning agents are able to perform tasks, analyze performance, and look for new ways to improve on those tasks - all on their own.

A learning agent has the following components:

- Critic
- Learning element
- Performance element
- Problem generator.

1) CRITIC : It is the one who compares sensor's input specifying effect of agent's action on the environment with the performance standards and generate feedback for learning element.

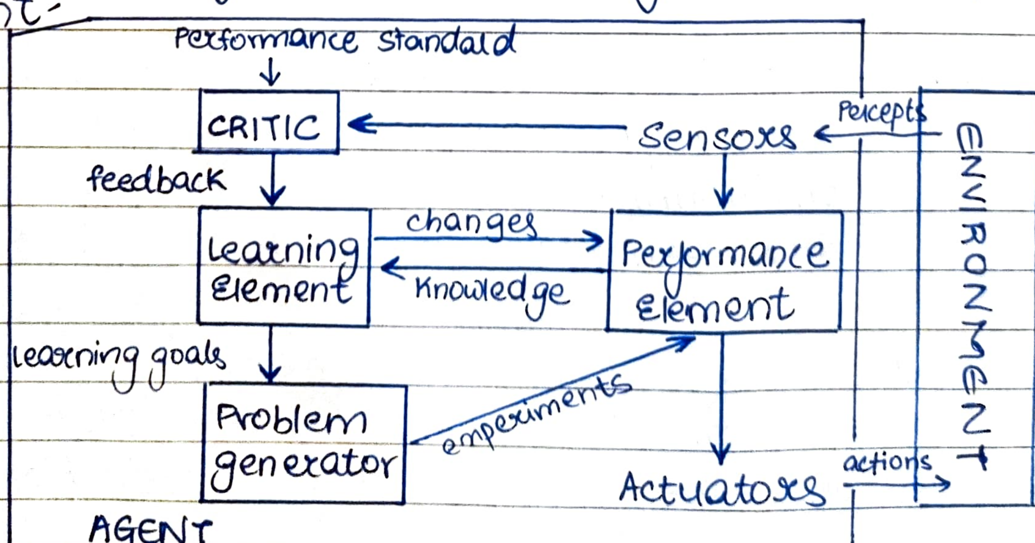
2) LEARNING ELEMENT: This component is responsible to learn from the difference between performance standards and the feedback from critic. According to the

current percept it is supposed to understand the expected behaviour and enhance its standards.

3 PERFORMANCE ELEMENT : Based on the current percept received from sensors and the input obtained by the learning element, performance element is responsible to choose the action to act upon the external environment.

4 PROBLEM GENERATOR : Based on the new goals learnt by learning agent, problem generator suggests new or alternate actions which will lead to new and instructive understanding.

example : when you were in school, you would give mock tests and it would be marked. The test is the critic. The teacher would mark the test and see what could be improved and instructs you how to do better next time, the teacher is the learning element and you are the performance element.



Q2 Explain various agent environments.

ANS An environment is everything in the world which surrounds the agent, but is not a part of an agent itself. An environment can be described as a situation in which an agent is present.

From the point of view of an agent, an environment can have the following various features:

- Fully observable vs Partially observable
- Static vs Dynamic
- Discrete vs Continuous
- Deterministic vs Stochastic
- Single-agent vs multi-agent
- Episodic vs sequential
- Known vs Unknown
- Accessible vs Inaccessible.

1 FULLY OBSERVABLE VS PARTIALLY OBSERVABLE :

- If an agent-sensor can sense or access the complete state of an environment at each point of time then it is a fully observable environment, else it is partially observable.

2 DETERMINISTIC VS STOCHASTIC :

If an agent's current state and selected action can completely determine the next state of the environment, then such environment is called a deterministic environment. A stochastic environment is random in nature and cannot be determined completely by an agent.

3 EPISODIC VS SEQUENTIAL :

In an episodic environment, there is a series of one-shot actions, and only the current percept is required.

In sequential, an agent requires memory of past actions to determine the next best actions.

4 SINGLE-AGENT VS MULTI-AGENT

If only one agent is involved and operating by itself, then such an environment is called single agent environment.

However, if multiple agents are operating then it is called multi-agent environment.

5 STATIC VS DYNAMIC :

If environment can change itself while an agent is deliberating then it is called dynamic environment, else it is static.

example : Taxi driving - dynamic
Crossword puzzle - static

6 DISCRETE VS CONTINUOUS :

If in an environment there are a finite number of percepts and actions that can be performed within it, then such an environment is called discrete else it is continuous.

7 KNOWN VS UNKNOWN :

In Known environment, the results for all actions are known to the agent.

While, in an unknown environment, agent needs to learn how it works in order to perform an action.

8 ACCESSIBLE VS INACCESSIBLE :

If an agent can obtain complete and accurate information about the states environment, then it's called accessible else inaccessible.

Q3 Short Notice

(i) Semantic Networks

ANS → Semantic / Frame network is a knowledge base that represents semantic relations between concepts in a network.

→ In this, network elements are represented with semantic labels that make sense in a given target language.

→ They vary in type and can represent very diverse systems.

→ A contrast to semantic networks occur when networks that are set up in computer machine language are not easily readable by humans.

→ They can be instantiated

For e.g: - Graph database
- concept Map.

→ They are used in NLP applications.
For e.g: semantic Parsing, Word sense disambiguity.

(ii) Semantic Web

ANS → The term 'semantic web' was coined by "Tim Berners lee"

→ It is a mesh of data that are associated in such a way that they can easily be processed by machines instead of humans.

→ It can be conceived as an extension version of world wide web and it represents and effective means of data representation in the form of globally linked database

→ The key goal is to trigger the evolution of existing web to enable users to search, discover, share and join information with less effort

Q4 Write short notes on :-

1 Resource description framework [RDF] :-

→ It is a standard for describing web resources and data interchange, developed and standardized with W3C.

→ It is the exact, most powerful and expressive standard designed by now.

→ RDF enables effective data integration from multiple resources, detatching data from its schema.

→ This allows multiple schemas to be applied, interlinked, queried as one and modified without changing the data instances.

→ It is built around the existing web standards XML and URL

(ii) Web Ontology language [OWL]

ANS → The W3C OWL is a semantic web language designed to represent rich and complex knowledge about things, group of things and relation between things

→ It is a computational logic based language such that knowledge expressed in OWL can be exploited by computer programs

→ Eg: To verify the consistency of knowledge or to make implicit knowledge explicit

→ OWL documents [ontologies] can be published in world wide web and may refer to or be referred from other OWL ontologies.

Q5 Dempster - Shafer theory

ANS → Dempster- Shafer Theory [DST] is an evidence theory which was released because of the following reasons :-

i) Bayesian theory is only concerned about single evidences.

ii) Bayesian probability cannot describe ignorance.

→ It is used to solve problems where there may be a chance that a ~~differenct~~ evidence will lead to some different result.

→ The uncertainity in this model is given by :-

i) Consider all possible outcomes.

ii) Belief will lead to believe in some ~~possible~~ possibility by bringing out some evidence.

iii) Plausibility will make evidence compatible with possible outcomes

→ CHARACTERISTICS :-

i) Ignorance is reduced by adding more evidence.

ii) Combination rule is used to combine various type of possibilities.

iii) Interval reduces and diagnose hierarchies can be represented using DST.

For e.g. : If $P = \{a, b, c\}$ then power set is given as : $\{\emptyset\} \{a\}, \{b\}, \{c\}, \{a, b\}, \{b, c\}, \{a, c\}, \{a, b, c\}$
$= 2^3$ elements.

- MASS FUNCTION $m(K)$: Interpretation of $m(\{K \text{ or } B\})$ i.e. there is evidence $\{K/B\}$ which cannot be divided among more specific beliefs for K & B.

- Belief in K : It is the sum of masses of element which are subsets of K.

E.g.: $K = \{a, b, c\}$
$\therefore$ Belief $(K) = m(a) + m(b) + m(c) + m(a,b) + m(b,c) + m(a,c) + m(a,b,c)$

- Plausibility in K : It is the sum of masses that intersects with K

Q6

$$R^T = \begin{array}{c|cccc} & y_1 & y_2 & y_3 & y_4 \\ \hline x_1 & 1 & 0.2 & 0.3 & 0 \\ x_2 & 0.2 & 0.4 & 0.4 & 0.2 \\ x_3 & 0.3 & 0.5 & 0.6 & 0.9 \\ x_4 & 0 & 0.6 & 0.9 & 1 \end{array}$$

$$S = \begin{array}{c|cc} & z_1 & z_2 \\ \hline y_1 & 1 & 0.5 \\ y_2 & 1 & 0.5 \\ y_3 & 0.5 & 1 \\ y_4 & 0.5 & 1 \end{array}$$

Max - Min computation :

$T = R^T \cdot S$

$$T = \begin{array}{c|cc} & z_1 & z_2 \\ \hline y_1 & 1 & 0.5 \\ y_2 & 0.4 & 0.4 \\ y_3 & 0.5 & 0.9 \\ y_4 & 0.6 & 1 \end{array}$$

$(x_1 z_1) = \max(\min(1,1),\ \min(0.2, 1), \min(0.3, 0.5), \min(0, 0.5))$

$= \max(1, 0.2, 0.3, 0)$

$= 1$

$(x_1 z_2) = \max(\min(1, 0.5), \min(0.2, 0.5), \min(0.3, 1), \min(0, 1))$

$= \max(0.5, 0.2, 0.3, 0)$

$= 0.5$

Similarly, for all pairs we get:

$(x_2; z_1) = 0.4$
$(x_2, z_2) = 0.4$

$(x_3, z_1) = 0.5$
$(x_3, z_2) = 0.9$

$(x_4, z_1) = 0.6$
$(x_4, z_2) = 1$

Max - product computation:

$$W = R^T \cdot S = \begin{array}{c} \\ x_1 \\ x_2 \\ x_3 \\ x_4 \end{array} \begin{array}{c} \begin{array}{cc} z_1 & z_2 \end{array} \\ \begin{bmatrix} 1 & 0.5 \\ 0.4 & 0.4 \\ 0.5 & 0.9 \\ 0.6 & 1 \end{bmatrix} \end{array}$$

$(x_1, z_1) = \max(1\times1, 0.2\times1, 0.3\times0.5, 0\times0.5)$
$= \max(1, 0.2, 0.15, 0)$
$= 1$

$(x_4, z_2) = \max(1\times0.5, 0.2\times0.3, 0.3\times1, 0\times1)$
$= \max(0.5, 0.1, 0.3, 0)$
$= 0.5$

similarly for other pairs!

$(x_2, z_1) = 0.4$
$(x_2, z_2) = 0.4$

$(x_3, z_1) = 0.5$
$(x_3, z_2) = 0.9$

$(x_4, z_1) = 0.6$
$(x_4, z_2) = 1$