VETRI VINAYAHA COLLEGE OF ENGINEERING AND TECHNOLOGY
THOTTIAM – 621215
DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
B.E SIXTH SEMESTER

CS6659- ARTIFICIAL INTELLIGENCE
(Regulation 2013)

UNIT I
INTRODUCTION TO Al AND PRODUCTION SYSTEMS

Introduction to AI-Problem formulation, Problem Definition -Production systems, Control strategies, Search strategies. Problem characteristics, Production system characteristics -Specialized production system- Problem solving methods - Problem graphs, Matching, Indexing and Heuristic functions –Hill Climbing-Depth first and Breath first, Constraints satisfaction - Related algorithms, Measure of performance and analysis of search algorithms.

PART - A

1. Define Artificial Intelligence.
The exciting new effort to make computers think machines with minds in the full and literal sense.

2. Define Artificial Intelligence in terms of human performance.

The art of creating machines that perform functions that require intelligence when performed by people.

3. Define Artificial Intelligence in terms of rational acting.

A field of study that seeks to explain and emulate intelligent behaviors in terms of computational processes- Schalkoff. The branch of computer science that is concerned with the automation of intelligent behavior-Luger&Stubblefield.

4. Define Artificial in terms of rational thinking.

The study of mental faculties through the use of computational models-Charniak&McDermott. The study of the computations that make it possible to perceive, reason and act-Winston.

5. What does Turing test mean?
The Turing test proposed by Alan Turing was designed to provide a satisfactory operational definition of intelligence. Turing defined intelligent behavior as the ability to achieve human-level performance in all cognitive tasks, sufficient to fool an interrogator.

6. Define an agent.

An agent is anything that can be viewed as perceiving its environment through sensors and acting upon the environment through effectors.

7. Define rational agent.

A rational agent is one that does the right thing. Here right thing is one that will cause agent to be more successful. That leaves us with the problem of deciding how and when to evaluate the agent's success.

8. Define an Omniscient agent.

An omniscient agent knows the actual outcome of its action and can act accordingly; but omniscience is impossible in reality.

9. What are the factors that a rational agent should depend on at any given time?

The performance measure that defines degree of success. Ever thing that the agent has perceived so far. We will call this complete perceptual history the percept sequence. When the agent knows about the environment. The action that the agent can perform.

10. Define an Ideal rational agent.

For each possible percept sequence, an ideal rational agent should do whatever action is expected to maximize its performance measure on the basis of the evidence provided by the percept sequence & whatever built-in knowledge that the agent has.

11. Define an agent program.

Agent program is a function that implements the agents mapping from percept to actions.

12. Define Architecture.

The action program will run on some sort of computing device which is called as Architecture.

13. List the various type of agent program.

• Simple reflex agent program.

• Agent that keep track of the world.

• Goal based agent program.

• Utility based agent program

14. State the various properties of environment.

Accessible Vs Inaccessible:

If an agent's sensing apparatus give it access to the complete state of the environment then we can say the environment is accessible to he agent.

Deterministic Vs Non deterministic:

If the next state of the environment is completely determined by the current state and the actions selected by the agent, then the environment is deterministic.

Episodic Vs Non episodic:

In this, agent's experience is divided into episodes. Each episodes consists of agents perceiving and then acting. The quality of the action depends on the episode itself because subsequent episode do not depend on what action occur in previous experience.

Discrete Vs Continuous:

If there is a limited no. of distinct clearly defined percepts & action we say that the environment is discrete.

15. What are the phases involved in designing a problem solving agent?

The three phases are: Problem formulation, Search solution, Execution.

16. What are the different types of problem?

Single state problem, Multiple state problem, Contingency problem, Exploration problem.

17. Define problem.
A problem is really a collection of information that the agent will use to decide what to do.

18. List the basic elements that are to be include in problem definition.
Initial state, operator, successor function, state space, path, goal test, path cost.

19. Mention the criteria for the evaluation of search strategy.
There are 4 criteria: Completeness, time complexity, space complexity, optimality.

20. Differentiate blind search & heuristic search.

Blind search has no information about the no. of steps or the path cost from the current state to the goal, they can distinguish a goal state from nongoal state. Heuristic search-knowledge given. Problem specification solution is best.

21. List the various search strategies.

a. BFS

b. Uniform cost search

c. DFS

d. Depth limited search

e. Iterative deepening search

f. Bidirectional search

21. List the various informed search strategy.

• Best first search –greedy search

• A* search

• Memory bounded search-Iterative deepening A*search

• simplified memory bounded A*search

• Iterative improvement search –hill climbing

23. Whether uniform cost search is optimal?

Uniform cost search is optimal & it chooses the best solution depending on the path cost.

24. Write the time & space complexity associated with depth limited search.

Time complexity =O (bd) , b-branching factor, d-depth of tree
Space complexity=O(bl)

25. Define iterative deepening search.

Iterative deepening is a strategy that sidesteps the issue of choosing the best depth limit by trying all possible depth limits: first depth 0, then depth 1,then depth 2& so on.

26. Define CSP

A constraint satisfaction problem is a special kind of problem satisfies some additional structural properties beyond the basic requirements for problem in general. In a CSP; the states are defined by the values of a set of variables and the goal test specifies a set of constraint that the value must obey.

27. Give the drawback of DFS.

The drawback of DFS is that it can get stuck going down the wrong path. Many problems have very deep or even infinite search tree. So dfs will never be able to recover from an unlucky choice at one of the nodes near the top of the tree.SoDFS should be avoided for search trees with large or infinite maximum depths.

28. What is called as bidirectional search?
The idea behind bidirectional search is to simultaneously search both forward from the initial state & backward from the goal & stop when the two searches meet in the middle.

29. Explain depth limited search.

Depth limited avoids the pitfalls of DFS by imposing a cut off of the maximum depth of a path. This cutoff can be implemented by special depth limited search algorithm or by using the general search algorithm with operators that keep track of the depth.

30. List some drawbacks of hill climbing process.

Local maxima: A local maxima as opposed to a goal maximum is a peak that is lower that the highest peak in the state space. Once a local maxima is reached the algorithm will halt even though the solution may be far from satisfactory.

Plateaux: A plateaux is an area of the state space where the evaluation fn is essentially flat. The search will conduct a random walk.

PART- B

1) Explain the following uninformed search strategies with
examples. i. (i)Breadth First search
ii. (ii)Depth First search
iii. (iii)Depth limited search
iv. (iv)Uniform cost search

2) Explain in detail about the heuristic function.

3) What are constraint satisfaction problem? How can you formulate them
as search problem?

4) Explain in detail Model based reflex agent.

5) Explain in detail Goal based reflex agent.

6) Explain in detail Utility based reflex agent.

7) Explain in detail Learning agent.

8) Explain in detail Problem solving agent.

9) Write in detail about any two informed search strategies.

UNIT II
REPRESENTATION OF KNOWLEDGE

Game playing - Knowledge representation, Knowledge representation using Predicate logic,
Introduction to predicate calculus, Resolution, Use of predicate calculus, Knowledge representation using
other logic-Structured representation of knowledge.

PART-A
1. What is the use of QUEUING_FN?
QUEUING_FN inserts asset of elements into the queue. Different varieties of queuing fn
produce different varieties of the search algorithm.

2. Mention the criteria for the evaluation of search strategy.
There are 4 criteria: Completeness, time complexity, space complexity, optimality.

3. Differentiate blind search& heuristic search.
Blind search has no information about the no. of steps or the path cost from the current state to
the goal, they can distinguish a goal state from nongoal state.
Heuristic search-knowledge given. Problem specification solution is best.

3.List the various search strategies.
a. BFS
b. Uniform cost search

c. DFS

d. Depth limited search

e. Iterative deepening

f. Bidirectional search

4. List the various informed search strategy.

Best first search –greedy search ,A* search,Memory bounded search-Iterative deepening A*search -simplified memory bounded A*search Iterative improvement search –hill climbing - simulated annealing

5.Differentiate BFS & DFS.

BFS means breath wise search. Space complexity is more. Do not give optimal solution Queuing fn is same as that of queue operator

DFS means depth wise search.Space complexity is less Gives optimal solution Queuing fn is some what different from queue operator.

6. Whether uniform cost search is optimal?

Uniform cost search is optimal & it chooses the best solution depending on the path cost.

7.Write the time & space complexity associated with depth limited search.

Time complexity =O (bd) ,

b-branching

factor, d-depth

of tree

Space complexity=o (bl)

8.Define iterative deepening search.

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Depth limited avoids the pitfalls of DFS by imposing a cut off of the maximum depth of a path. This cutoff can be implemented by special depth limited search algorithm or by using the general search algorithm with operators that keep track of the depth.

13. Give the procedure of IDA* search.

Minimize f(n)=g(n)+h(n) combines the advantage of uniform cost search + greedy search A* is complete, optimal.It's space complexity is still prohibitive. Iterative improvement algorithms keep only a single state in memory, but can get stuck on local maxima. In this alg each iteration is a dfs just as in regular iterative deepening. The depth first search is modified to use an f-cost limit rather than a depth limit. Thus each iteration expands all nodes inside the contour for the current f-cost.

14. What is the advantage of memory bounded search techniques?

We can reduce space requirements of A* with memory bounded alg such as IDA* & SMA*.

15. List some properties of SMA* search.

• It will utilize whatever memory is made available to it.
• It avoids repeated states as for as its memory allow.
• It is complete if the available memory is sufficient to store the shallowest path.
• It is optimal if enough memory is available to store the shallowest optimal solution path.

PART B

1) Give the Syntax and Semantics of a first order logic in detail with an eg.

2) Give Syntax and Semantics of a first order logic for a family domain.

3) Give the Syntax and Semantics of a first order logic for Numbers, Sets, Lists domain.

4) Elaborate upon the process of knowledge engineering with electronic circuit's domain.

5) Explain about unification with an algorithm in a first order logic.

6) Explain in detail the concept of theorem proverbs.

7) Explain forward chaining and backward chaining in detail for a first order definite clauses. (UNI QUES)

8) Explain how categories and objects are presented in any four sets.

9) Elaborate upon the ontology for situation calculus.

10) Elaborate upon the ontology for event calculus.

11) Explain predicate logic (UNI QUES)

12) Write notes on proposition logic (UNI QUES)

13) Explain the resolution procedure with an example (UNI QUES)

14) Illustrate the use of predicate logic to represent the knowledge with suitable example (UNI QUES)

15) With an example explain the logics for non monotonic reasoning (UNI QUES)

16) How facts are represented using prepositional logic? give an example (UNI QUES)

UNIT III
KNOWLEDGE INFERENCE

Knowledge representation -Production based system, Frame based system. Inference – Backward chaining, Forward chaining, Rule value approach, Fuzzy reasoning - Certainty factors, Bayesian Theory-Bayesian Network-Dempster - Shafer theory.

PART-A

1.Define a knowledge Base.

Knowledge base is the central component of knowledge base agent and it is described as a set of representations of facts about the world.

2.Define a Sentence.

Each individual representation of facts is called a sentence. The sentences are expressed in a language called as knowledge representation language.

3. Define an inference procedure

An inference procedure reports whether or not a sentence is entiled by knowledge base provided a knowledge base and a sentence .An inference procedure 'i' can be described by the sentences that it can derive. If i can derive from knowledge base, we can write. KB --Alpha is derived from KB or i derives alpha from KB.

4.What are the three levels in describing knowledge

based agent? Logical level
Implementation level
Knowledge level or epistemological level

5.Define Syntax

Syntax is the arrangement of words. Syntax of a knowledge describes the possible configurations that can constitute sentences. Syntax of the language describes how to make sentences.

6.Define Semantics

The semantics of the language defines the truth of each sentence with respect to each possible world. With this semantics, when a particular configuration exists with in an agent, the agent believes the corresponding sentence.

7.Define Logic

Logic is one which consist of
1. A formal system for describing states of affairs, consisting of a) Syntax b)Semantics.
2. Proof Theory – a set of rules for deducing the entailment of a set sentences.

8.What is entailment?

The relation between sentence is called entailment.The formal definition of entailment is this: if and only if in every model in which is true, is also true or if is true then must also be true. Informally the truth of is contained in the truth of

9.What is truth Preserving?

An inference algorithm that derives only entailed sentences is called sound or truth preserving .

10.Define a Proof

A sequence of application of inference rules is called a proof. Finding proof is exactly finding solution to search problems. If the successor function is defined to generate all possible applications of inference rules then the search algorithms can be applied to find proofs.

11.Define a Complete inference procedure

An inference procedure is complete if it can derive all true conditions from a set of premises.

12.Define Interpretation

Interpretation specifies exactly which objects, relations and functions are referred to by the constant predicate, and function symbols.

13.Define Validity of a sentence
A sentence is valid or necessarily true if and only if it is true under all possible interpretation in all possible world.

14.Define Satistiability of a sentence
A sentence is satisfiable if and only if there is some interpretation in some world for which it is true.

15.Define true sentence
A sentence is true under a particular interpretation if the state of affairs it represents is the case.

16.What are the basic Components of propositonal logic?
i. Logical Constants (True, False)

17.Define Modus Ponen's rule in Propositional logic?
The standard patterns of inference that can be applied to derive chains of conclusions that lead to the desired goal is said to be Modus Ponen's rule.

PART-B

1)   Explain Planning with state space search with an example
2)   Explain partial order planning with example
3)   Explain Graph Plan algorithm with the example
4)   What is STRIPS explain in detail with the example
5)   How we plan and act in non deterministic domains
6)   What is conditional planning
7)   How we schedule with resource constraints
8)   How we plan with propositional logic
9)   Explain partial order planning with unbound variables
10)   Give an example for partial order planning
11)   what is Backward state space search
12)   Explain Heuristics for state space search
13)   Explain Forward state space search
14)   For Air cargo transport explain STRIPS
15)   For Blocks World explain STRIPS
16)   Compare STRIPS and ADL language

UNIT IV
PLANNING AND MACHINE LEARNING
Basic plan generation systems - Strips -Advanced plan generation systems – K strips -Strategic explanations -Why, Why not and how explanations. Learning- Machine learning, adaptive Learning.

PART-A

1. Why does uncertainty arise ?

Agents almost never have access to the whole truth about their environment. Agents cannot find a categorical answer. Uncertainty can also arise because of incompleteness, incorrectness in agents understanding of properties of environment.

2. State the reason why first order, logic fails to cope with that the mind like medical diagnosis.
Three reasons

a.laziness: o it is hard to lift complete set of antecedents of consequence, needed to ensure and exceptionless rule.

b. Theoritical Ignorance: o medical science has no complete theory for the domain.

c. Practical ignorance: even if we know all the rules, we may be uncertain about a particular item needed.

3. Define the term utility?
The term utility is used in the sense of "the quality of being useful .", utility of a state is relative to the agents, whose preferences the utility function is supposed to represent.

4.What is the need for probability theory in uncertainty ?
Probability provides the way of summarizing the uncertainty that comes from our laziness and ignorance . Probability statements do not have quite the same kind of semantics known as evidences.

5.what is the need for utility theory in uncertainty?
Utility theory says that every state has a degree of usefulness, or utility to in agent, and that the agent will prefer states with higher utility.The use utility theory to represent and reason with preferences.

6. What is called as principle of maximum expected utility ?
The basic idea is that an agent is rational if and only if it chooses the action that yields the highest expected utility, averaged over all the possible outcomes of the action. This is known as MEU.

7. What Is Called As Decision Theory ?
Preferences As Expressed by Utilities Are Combined with Probabilities in the General Theory of Rational Decisions Called Decision Theory.
Decision Theory = Probability Theory + Utility Theory.

8. Define Prior Probability.
p(a) for the Unconditional or Prior Probability Is That the Proposition A is True. It is important to remember that p(a) can only be used when there is no other information.

9. Define conditional probability.
Once the agents has obtained some evidence concerning the previously unknown propositions making up the domain conditional or posterior probabilities with the notation p(A/B) is used. This is important that p(A/B) can only be used when all be is known.

10. Define probability distribution.
Eg. P(weather) = (0.7,0.2,0.08,0.02). This type of notations simplifies many equations.

11.What is an atomic event?

An atomic event is an assignment of particular values to all variables, in other words,
the complete specifications of the state of domain.

12.Define joint probability distribution
This completely specifies an agent's probability assignments to all propositions in the domain.
The joint probability distribution p(x1,x2,--------xn) assigns probabilities to all possible atomic
events; where X1,X2------Xn 10 =variables.

13.Give the Baye's rule equation
W.K.T P(A ^ B) = P(A/B) P(B) ------------------------- 1
        P(A ^ B) = P(B/A) P(A) ------------------------- 2
DIVIDING BY P(A) ; WE GET
P(B/A) = P(A/B) P(B) -------------------- P(A)

14.What is meant by belief network?
A belief network is a graph in which the following holds A set of random variables. A set of
directive links or arrows connects pairs of nodes. The conditional probability table for each
node The graph has no directed cycles.

15. What are the ways in which one can understand the semantics of a belief network?
There are two ways to see the network as a representation of the joint probability distribution
to view it as an encoding of collection of conditional independence statements.

16.What is the basic task of a probabilistic inference?
The basic task is to reason in terms of prior probabilities of conjunctions, but for the most
part, we will use conditional probabilities as a vehicle for probabilistic inference.

17. What are called as Poly trees?
The algorithm that works only on singly connected networks known as Poly trees. Here at most
one undirected path between any two nodes is present.

18.Define casual support
E+X is the casual support for X- the evidence variables "above" X that are connected to X
through its parent.

19.Define evidential support
E-X is the evidential support for X- the evidence variables "below" X that are connected to
X through its children.

20.What is called as multiple connected graph?
A multiple connected graph is one in which two nodes are connected by more than one path.

PART-B

1) How to deal with uncertainty (dec 05)
2) What is Baye's rule ? explain how Baye's rule can be applied to tackle uncertain knowledge
   (june 07)
3) Explain probabilistic reasoning (june 07)
4) Explain HMM
5) What is a Bayesian network
6) How to get the exact inference form Bayesian network

7) How to get the approximate inference form Bayesian network

8) What are all the temporal model

9) How to determine uncertain acting under uncertainty

10) In temporal model explain filtering and prediction

11) Explain Smoothing with needed algorithm

12) How to handle uncertainty

13) How to construct Bayesian network

14) What are all the exact inference in Dynamic Bayesian Network

15) What are all the approximate inference in DBN

16) How to represent knowledge in an uncertain domain

UNIT V
EXPERT SYSTEMS

Expert systems - Architecture of expert systems, Roles of expert systems - Knowledge Acquisition –
Meta knowledge, Heuristics. Typical expert systems - MYCIN, DART, XOON, Expert systems shells.

PART-A

1. Define planning.

Planning can be viewed as a type of problem solving in which the agent uses beliefs about
actions and their consequences to search for a solution.

2. What are the features of an ideal planner?

The planner should be able to represent the states, goals and actions.
The planner should be able to add new actions at any time.
The planner should be able to use Divide and Conquer method for solving very big problems.

3. What are the components that are needed for representing an action?

The components that are needed for representing an action are: Action description. Precondition.
Effect.

4. What are the components that are needed for representing a plan?

The components that are needed for representing a plan are: A set of plans steps. A set of
ordering constraints.

5. What are the different types of planning?

The different types of planning are as follows: Situation space planning.
Progressive planning.
Regressive planning.
Partial order planning.
 Fully instantiated planning.

**6.What are the ways in which incomplete and incorrect information's can be handled in
planning?**

They can be handled with the help of two planning agents namely,
Conditional planning agent.
Replanning agent.

7.Define a solution.

A solution is defined as a plan that an agent can execute and that guarantees the achievement of
goal.

8. Define a complete plan.

A complete plan is one in which every precondition of every step is achieved by some other step.

9. Define a consistent plan.
A consistent plan is one in which there are no contradictions in the ordering or binding constraints.

10. Define conditional planning.
Conditional planning is a way in which the incompleteness of information is incorporated in terms of adding a conditional step, which involves if – then rules.

11. Give the classification of learning process.
The learning process can be classified as:
Process which is based on coupling new information to previously acquired knowledge
Learning by analyzing differences.
Learning by managing models.
Learning by correcting mistakes.
Learning by explaining experience.

12.Process which is based on digging useful regularity out of data, usually called as Data base mining:
• Learning by recording cases.
• Learning by building identification trees.
• Learning by training neural networks.

13. What is Induction heuristics?
descriptions from positive and negative examples.

14.What are the different types of induction heuristics?
There are two different types of induction heuristics.
They are: Require-link heuristics.
Forbid-link heuristics.

15.What are the principles that are followed by any learning procedure?
   • The wait and see principle.
   • The no altering principle.
   • Martin's law.

16. State the no altering principle.
The law states that, "When an object or situation known to be an example, fails to match a general model, create a special case exception model".

17. State Martin's law.
The law states that, "You cannot learn anything unless you almost know it already".

18. Define Similarity nets.
Similarity net is an approach for arranging models. Similarity net is a representation in which nodes denotes models, links connect similar models and links are tied to different descriptions.

19. Define Reification.
The process of treating something abstract and difficult to talk about as though it were concrete and easy to talk about is called as reification.

20. What is reified link?

The elevation of a link to the status of a describable node is a kind of reification. When a link is so elevated then it is said to be a reified link.

PART B

1) Explain the various forms of learning.
2) How is the learning process in a decision tree?
3) Explain the various methods of logical formulation in logical learning?
4) How are explanation based learning done?

5) Elaborate upon inductive logic programming.
6) Write in detail the EM algorithm.
7) Give an overview of a neural network.
8) Explain multilayer feed forward neural networks with an algorithm
9) Explain the nonparametric learning methods.
10) How learning is done on a complete data using statistical methods?
11) Explain the relevance based learning (May 10)
12) Describe the decision tree learning algorithm (May 2010)
13) Discuss active reinforcement leaning (May 10)
14) Discuss passive reinforcement learning (May 10)
15) How to further proceed to decision making (Dec 05)
16) Describe multilayer feed forward network (June 09)