MARIA COLLEGE OF ENGINEERING AND TECHNOLOGY
DEPARTMENT OF INFORMATION TECHNOLOGY
CS61 – Artificial Intelligence

1. Define Artificial Intelligent or AI?

Artificial Intelligence is one of the newest sciences. Artificial Intelligence encompasses a huge variety of subfields, ranging from general purpose areas (learning) to specific tasks (playing chess). Artificial Intelligence systematizes and automates intellectual tasks and is therefore potentially relevant to any sphere of human intellectual activity.

- Artificial Intelligence is the exciting new effort to make computers think. Machines with minds, in the full and literal science.
- Artificial Intelligence is the study of mental facilities through the use of computational models.
- It is the study of the computational that make it possible to understand, reason and act

2. List out the applications of AI?

A few applications of Artificial Intelligence are the following
(i)   Autonomous planning and scheduling
(ii)   Game playing
(iii)   Autonomous control
(iv)   Diagnosis
(v)   Logistics planning
(vi)   Robotics
(vii)   Language understanding and problem solving.

3. Define agents?

An agent is anything that can be viewed as understanding its environments through sensors and acting upon that environment through actuators.

4. Define percept and percept sequence?

The term percept can be used to refer to the agent's perceptual inputs at any given instant.
Percept sequence of an agent is the complete history of everything that agent has.

5. What is rational agent?

A rational agent is one that does the right thing. By right thing, it is meant that this agent speaks correctly fills the table for agent accurately.

6. What are the measures to determine agent's behavior?

This right thing or success must be measured in some way.
The following are the some.
1. Performance Measure

2. Rationality
3. Omniscience, Learning and Autonomy.

7. List out the measures on which rationality depends?

Rationality depends on four things.
- ✓ The performance measure
- ✓ The Agent's prior knowledge of the environment
- ✓ The Agent's action
- ✓ The Agent's percept sequence

8. What is an omniscient agent?

An omniscient agent knows the actual outcome of its actions and can act accordingly. But this is impossible in reality.

9. What is information gathering?

Information gathering is an important part of rationality and is defined as doing actions in order to modify future percepts.

10. What is autonomy?

A rational agent must he autonomous. Autonomous means that it should learn what it can do to compensate for partial and incorrect prior knowledge.

11. Give the acronym for PEAS?

The task environment can be acronymically specified as PEAS. PEAS stands for
- ❖ Performance
- ❖ Environment
- ❖ Actuators
- ❖ Sensors

12. Give the PEAS description for interactive English tutor?

Agent	Performance Measure	Environment	Actuators	Sensors
Interactive English Tutor	Maximize student score on test	Set of students testing agency	Display exercises, suggestions corrections.	Keyboard entry

13. Differentiate between fully observable and partially observable environment?

Fully observable / accessible	Partially observable / inaccessible
If an agent's sensors give it assess to the complete state of environment at each point of time, then that task environment is fully observable.	If an agent's sensors didn't give its assess to the complete state of environment, then that task environment is partially observable.
It depends on performance measure.	It is due to noisy and inaccurate sensors or parts of state are simply missing.

Convenient	In Convenient

14. Differentiate between deterministic and non – deterministic environment.

Deterministics	Stochastics / Nondeterministics
If the next state of the environment is completely determined by the current state and action executed by the agent, then it is deterministic.	If the next state of the environment is not determined by the current state and action executed by the agent, then it is stochastic.
If the environment is fully observable, then it appears to be deterministic.	If the environment is partially observable, then it appears to be stochastic.

15. Differentiate between episodic and sequential environment.

Episodic	Squential
The agent's experiences divided into episodes and each episode consists of the agent perceiving and then performing an action. The next episode doesn't depend on the previous episode.	The current decision could affect all future decisions.
Simpler because the agent doesn't need to think ahead.	Complex because the agents need to think ahead.

16. Differentiate between static and dynamic environment.

Dynamic	Static
If the environment can change, while an agent is deliberately, then it is dynamic.	If the environment cannot change, while an environment is deliberately, then it is static.
Not easy to deal with because the agent is asked continuously what it wants to do. Example : Taxi driving	Easy to deal with because the agent need not keep looking the word. Example : Crossword puzzles.

17. What is discrete and continuous environment?
The discrete/continuous distinction can be applied to the state of environment to the way tune is handled and to the percepts and actions of the agent.
Example :
Discrete environment : Chess game   -   finite number of states
Continuous environment : Taxi driving   -   the speed and location

18. List out the types of agent programs?
Four kinds of agent program exists namely
- Simple reflex agents

- Mode - based reflex agents
- Coat - based agents

19. List out the components of learning agent?
- Learning element
- Performance element
- Critic
- Problem Generator

20. What is a problem solving agent?
Problem solving can be easily done by goal-based agents. These agents can find sequence of actions that achieves its goals when no single will do.

21. Differentiate between informed and uninformed search algorithms?
Informed search strategy uses problem specific knowledge beyond the definition on the problem itself. It can find more efficient solutions than an uniformed strategy Uninformed algorithms are the algorithms that are no information the problem other than its definition.

22. What is searching?

Search is the process of looking for best sequence. A search algorithm takes a problem as input and returns a solution in the form of sequence of action.

23. What are the components of nodes in general tree search algorithm?
A problem can defined by four components namely
- Initial state
- Successor function
- Goal test
- Path cost

24. What is fringe?
Fringe is the collection of nodes that have not yet been expanded. Each element of the fringe is a leaf node that is a node with no successors in the tree.

25. List out the ways to evaluate the performance of algorithms?
An algorithm's performance can be evaluated in four ways.
Completeness :
Ensures whether the algorithm can find a solution when there is one.
Optionality :
Ensures whether the strategy finds the optional solution.
Time complexity :
Determines how long it take to find a solution.
Space complexity :
Determines how much memory is needed to perform a search.

26. What is closed list?
Closed list is a list which stores every expanded node. Open list is a list of unexpanded nodes. If the current node matches a node in the closed list, it is discarded instead a being expanded.

27. What is sensorless problem?

If the agent has no sensors at all, then it would be in several possible states and each action will lead to one of several possible successor states.

28. What is informed search?

Informed search strategy uses, Problem specific knowledge beyond the definition of the problem itself. It can find more efficient solutions than the uninformed strategy.

29. What is the use of heuristic function?

- ✓ A key component of Best – First – search algorithms.
- ✓ It imports some additional knowledge of the problem.
- ✓ It is denoted by h (n)
- ✓ h (n) = estimated cost of the cheapest path from node n to a goal node.
- ✓ If n is a goal node, then h (n) = 0.

30. Narrate the greedy best first search?

- ✓ GBFS expands the node that is closest to the goal.
- ✓ It leads to a solution quickly.
- ✓ It uses f (n) = h (n) to evaluate nodes that are to be expanded
- ✓ For route – finding problems, it uses straight line distance heuristic. Which is denoted as hSLD.

31. List out the advantages of A* search?

- ✓ Optional
- ✓ Complete

32. What is pruning?

Pruning is a method to ignore the portions of the search tree that makes no differences in the final choice.

33. What is a relaxed problem?

A problem with fewer restrictions on the action is called a relaxed problem. The cost of an optimal solutions to a relaxed problem is an admissible heuristic for the original problem.

34. What is local search algorithm?

Local search algorithms are the algorithms that operate using a single current state (single path) and move only to neighbours of that state. They will not retain or remember the paths followed by them.

35. What is pure optimization problem?

Local search algorithm is also useful for finding solutions for pure optimization problem.

The aim of the optimization problem is to find the best state according to an objective function.

36. What is global maximum and minimum?
A landscape has both landscape and elevation. If elevation corresponds to cost, global minimum must be found (lowest valley). If it corresponds to an objective function global minimum must be found (highest peak).

37. What is local maximum?
A peak that is higher than each of its neighboring states. The algorithm will suck with nowhere else to go.

38. What is a ridge?
It results in a sequence of local maximum and is very difficult to navigate.

39. What is CSP?
Constraint satisfaction problem are the problems whose goal test, states conform to a standard, structured and simple representation.
A constraint satisfaction problem is defined by a set of variables X_1, ……… X_n and a set of constraints C_1, C_2, ……… C_m. It is also represented as CSP in short.

   ❖ Each variable Xi has non empty domain D_i of possible values.
   ❖ Each constraint C_i involves some subset of variables and allowable combination of values for the subset.
   ❖

40. What is the use of Constraint graph?
A constraint graph is used to define the structure of a CSP.
Representation :
Nodes   -   Variables of the problem
Arcs   -   Constraits

41. What is called backtracking search?
Depth first search is also known as backtracking search because it chooses values for one variable at a time and backtracks when no legal values for a variable can be assigned.
The backtracking search for a CSP works like DFS in case of incremental successor generation. It also extends the current, assignment to generate a successor instead of copying it.

42. What is the use of degree heuristics?
This heuristics attempts to reduce the branching factor on future choices by selecting the variable that is involved in the largest number of constraints on other unassigned.
Advantages :
   ✓ This heuristics, solves the coloring problem without any false step.
   ✓ It acts as a tie-breaker.
   ✓

43. What is chronological backtracking?

A simple backtracking search, in which the most recent decision is revisited, i.e., if when a search facts, it backs up to the preceding variable any try a different value for it.

44.What is back jumping?

Conflict set is a set of variables that caused the failure. The conflict set for variable X is the set of previously assigned variables that are connected to X by constraints. Back Jumping method backtracks to the most recent variable in the conflict set. This can be implemented by modifying the BACKTRACKING – SEARCH such that it accumulates the conflict set while checking for a legal value to assign.

If no legal value is found, it must return element of the conflict set along with the failure indicator.

Every branch pruned by back jumping is also pruned by forward checking.

45.List out the approaches to solve CSP?

Two primary approaches exist in order to reduce a constraint graph to trees. They are
   ➢ Cutset conditioning based on removing nodes.
   ➢ Tree decomposition based on collapsing nodes together.

46.What is an adversarial search problem?

Adversarial search are the problem that are used when it is necessary to plan ahead. Where other agents are planning against a particular agent or human. These adversarial search problems are often known as games.

47.What is FOL or predicate logic?

First-order logic is a logic which is sufficiently expressive to represent a good deal of our commonsense knowledge. It also either includes or forms the foundation of many other representation languages.

48.List out the advantages of FOL?

   ❖ It has been so important to mathematics, philosophy, and artificial intelligence precisely because those fields can be usefully thought of as dealing with objects and the relations among them.
   ❖ It can also express facts about some or all of the objects in the universe.
   ❖ It enables one to represent general laws rules, such as the statement "Squares neighboring the wumpus are smelly".

49.List out the disadvantages of propositional logic?

It lacks the expressive power to describe an environment with many objects concisely.

50.What is meant by domain of a model?

The domain of a model is the set of objects it contains, these objects are sometimes called domain elements.

51.What is a symbol?

The basis syntactic elements of first-order logic are the symbols that stand for objects, relations, and functions.

52.List out the types of sympols?

The symbols come in three kinds namely?
- (i) Constant symbols standing for objects (Ex : Richard)
- (ii) Predicate symbols standing for relations (Ex : King)
- (iii) Function symbols standing for functions (Ex : Left Leg)

53. What is arity?

Each predicate and function symbol comes with an arity . Arity fixes the number of arguments.

54. Define term?

A term is a logical expression that refers to an object. Constant symbols an therefore terms, but it is not always convenient to have a distinct symbol to name every object.

55. How does an atomic sentence formed?

An atomic sentence is formed from a predicate symbol followed by a parenthesized list of terms; Brother (Richord, John).

56. How to construct complex sentences?

Logical connectives can be used to construct more complex sentences, Just as in propositional calculus. The semantics of sentences formed with logical connectives is identical to that in the propositional case.

57. What is the use of quantifiers? Mention its types?

Quantifiers are used to express properties of entire collections of objects, instead of enumerating the objects by name if a logic that allows objects is found.

Types :

FOL contains two standard quantifiers, called
- (i) Universal and (ii) Existential
- (ii)

58. What is meant by ground term?

A term with no variables is called a ground term.

59. What is knowledge engineering?

Knowledge engineering is the general process of knowledge base construction. A knowledge engineer is someone who investigates a particular domain, learns what concept are important in that domain, and creates a formal representation of the objects and relations in the domain.

60. List out the steps involved in knowledge engineering?

Knowledge engineering projects vary widely in content, scope, and difficulty, but all such projects include the following steps :
- (i) Identify the task
- (ii) Assemble the relevant knowledge
- (iii) Decide on a vocabulary of predicates, functions, and constants
- (iv) Encode general knowledge about the domain
- (v) Pose queries to the inference procedure and get answers
- (vi) Debug the knowledge base

61. What is unification algorithm?

The process of finding substitutions that make different logical expressions look identical is called unification. It is a key component of all first – order inference algorithms.

The UNIFY algorithm takes two sentences and returns a unifier for them if one exists : UNIF (p,q) = θ where SUBST (θ,p) = SUBST (θ,q)

62. What is forward chaining?

A Forward – chaining algorithm start with the atomic sentence in the knowledge base and apply Modus Ponens in the forward direction, adding new atomic sentences, until no further inferences can be made.

63. What is conjunct ordering problem?

Conjunct ordering problem is the problem of find an ordering to solve the conjuncts of the rule premise so that the total cost is minimized.

64. What is incremental forward chaining?

In incremental forward chaining algorithm, at iteration t, a rule is checked only if its premise includes a conjunct Pi that unifies with a fact pi' newly inferred at iteration t – 1

65. List out the advantages of incremental forward chaining?
   (i)   It is more efficient
   (ii)   With suitable indexing, it is easy to identify the entire rules that can be triggered by any given fact.
   (iii)   Inferences cascade through the set of rules until the fixed point is reached, and then the process begins again for the next new fact.

66. What is backward chaining?

Backward Chaining algorithms work backward from the goal, chaining through rules to find known facts that support.

67. What is logic programming?

Logic programming is a technology that comes fairly close to representing that systems should be constructed by expressing knowledge in a formal language and that problems should be solved by running inference processes on that knowledge.

68. What is prolog?

Prolog is the most widely used logic programming language. Its users number in the hundreds of thousands.

69. List out the applications of prolog?
   (i)   Used as a rapid – prototyping language
   (ii)   Used for sympol manipulation tasks such as writing compilers and parsing natural language.
   (iii)   Many expert systems have written in prolog for legal, medical, financial, and other domains.
   (iv)

70. List out the efficient implementation of logic programs?

The execution of a prolog program can happen in two modes namely.
   (i)   Interpreted mode
   (ii)   Complied mode

71. What is the use of constraint logic programming?
Constraint logic programming (CLP) allows variables to be, constrained rather than bound. A solution to a constraint logic program is the most specific set of constraints on the query variables that can be derived from the knowledge base.

72. What are the elements of learning agent?
A learning agent can be thought of as containing the following elements namely
   ✓ Performance element : decides what actions to take
   ✓ Learning element : modifies the performance element so that it makes better decisions.

73. List out the issues affecting the design of learning element?
The design of a learning element is affected by three major issues :
   ✓ Which components of the performance element are to be learned?
   ✓ What feedback is available to learn these components?
   ✓ What representation is used for the components?
   ✓ Availability of prior knowledge.

74. List out the categories of learning problem?
Two categories of learning exist based on hypothesis space. They are
   ✓ Realizable learning problem : if the hypothesis space contains the true function.
   ✓ Unrealizable learning problem : if the hypothesis space contains the true function.

75. Define classification?
Classification is called as learning a discrete-valued function. Boolean classification is concentrated more where each example is classified as true (positive) or false (negative).

76. Define regression?
Regression is called learning a continuous function.

77. List out the problems with trivial tree.
The problems with this trivial tree are
   ✓ It just memorizes the observations.
   ✓ It does not extract any pattern from the examples, so it is not expected to be able to extrapolate to examples it has not seen.

78. What is over fitting?
The problem of finding meaningless "regularity" in the data, whenever there is a large set of possible hypotheses is called over fitting occurs ever when the target function is not at all random. It badly affects every kind.

79. What is decision pruning?

A simple technique called decision tree pruning can deal with the problem of over fitting. Pruning works by preventing recursive splitting on attributes that are not clearly relevant, even when the data at that node in the tree are not uniformly classified.

80. How to detect irrelevant attributes?

An irrelevant attributes can be found by calculating the information gain. If the information gain is close to zero, then the attribute is irrelevant. Another method is to use statistical significance test.

81. What are the possibilities of missing data?

The values might have gone unrecorded
They might be too expensive to obtain.

82. List out the problems that occur due to missing data?

Given a complete decision tree, how should one classify an object that is missing one of the test attributes?
How should one modify the information gain formula when some examples have unknown values for the attribute?

83. Define hypothesis space?

The hypothesis space H is the set of all hypothesis $\{H_1, \ldots, H_n\}$ that the learning.

84. What is EBL?

Explanation based learning (EBL) extracts general rules from single examples by explaining the examples and generalizing the explanation. It provide a deductive method turning first-principles knowledge into useful, efficient, special – purpose expertise.
Hence, the entailment constraints satisfied by EBL are the following :
Hypothesis ^Descriptions = classifications
Background = Hypothesis.

85. List out the steps in EBL?

Given an example, construct a proof that the goal predicate applies to the example using the available background knowledge.
In parallel, construct a generalized proof tree for the variabilized goal using the same inference steps as in the original proof.
Construct a new rule whose left-hand side consists of the leaves of the proof tree and whose right – hand side is the original proof.
Drop any conditions that are true regardless of the values of the variables in the goal.

86. List out the advantages and disadvantages of EBL?

Advantages :
   ✓ Because EBL uses Equation 4,2,3, it was initially thought to be better way to learn from examples.
   ✓ EBL is now viewed as a method for converting first-principles theories into useful special-purpose knowledge.

Disadvantages :

- ✓ The agent does not actually learn anything factually new from the example
- ✓ It requires more computation.

87. What is memorization?

The technique of memorization has long been used in computer science to speedup programs by saving the results of computation. The basic idea of memo functions is to accumulate a database of input/output pairs. When the function is called, it first checks the database to see whether it can avoid solving the problem from scratch.

88. What are functional dependencies?

Sentences that express a strict from of relevance are called functional dependencies i.e. given nationality, language is determined. They are also called as determinations.

89. What is data and hypothesis?

Data : Data are evidence of some or all of the random variables describing the domain.
Hypothesis : The Hypotheses are probabilistic theories of how the domain works, including logical theories as a special case.

90. What is the idea behind Bayesian learning?

Bayesian learning calculates the probability of each hypotheses, given the data and makes predictions by using all the hypotheses, Weighted by their probabilities. In this way learning is reduced to probabilistic inference.

91. What is Native Bayes model? Mention the reason for its name?

Native Bayes models the most common Bayesian network model used in machine. In this model, the "class" variables C is the root and the "attribute" variables Xi are the leaves.
Reason for the name Native
It assumes that the attributes are conditionally independent of each other given the class.

92. What are the advantages of native bayes learning?

- ✓ The method learns fairly well.
- ✓ It does surprisingly well in a wide range of applications.
- ✓ Native Bayes learning scales well to very large problems.
- ✓ No search is required to find, the maximum-likelihood native Bayes hypothesis.

93. What are hidden or latent variables?

Variables which are not observable in the data that are variable for learning are called hidden variables. They are also called latent variables.

94. What is unsupervised clustering?

Unsupervised clustering is the problem of selecting multiple categories in a collection of objects. The problem is unsupervised because the category labels are not given.

95. What are the types of instance based learning?

Instance based learning comes in two flavors namely.

✓ Parametric learning
✓ Nonparametric learning

96. What is parametric learning method?

It is a kind of statistical learning that has focused primarily on fitting the parameters of a restricted family of probability models to an unrestricted data set.

97. Mention the advantages and disadvantages of parametric learning?

Advantages :
✓ Simple
✓ Effective

Disadvantages :

✓ It assumes a particular restricted family of models often oversimplifying what's happening in the real world, from where the data come.
✓ It cannot give hope to learn a complex and detailed model.

98. List out the families of non-parametric learning method?

Two simple families of nonparametric instance-based learning methods exist namely Nearest neighbor model and Kernel model.

99. Define neural networks?

Neural networks are complex non linear functions with many parameters. Their parameters can be learned from noisy data and they have been used for thousands of applications.
Normal networks are also called as connectionism, parallel distributed processing, and neural computation.

100. List out the abstract properties of neural networks?

The following are the abstract properties of neural networks.
✓ They have the ability to perform distributed computation.
✓ They have the ability to tolerate noisy inputs.
✓ They have the ability to learn.

101. What are the categories of neural networks structures? There are two main categories of neural networks structures namely.

✓ Acyclic or feed-forward networks
✓ Cyclic or recurrent networks.

102. List out the advantages of neural networks?

✓ The neural networks learns well, because the data were generated from
✓ neural networks are capable of far more complex learning task of course.
✓ There are literally tens of thousands of published applications of neural networks

103. What is recurrent network?

A recurrent network feed its outputs back into its own inputs. This means that the activation levels of the network from a dynamical system that may reach a stable state or exhibit oscillations or even chaotic behavior.

104. List out the features of recurrent networks?

Recurrent networks can support short – term memory.

It is also more difficult to understand.

105. Define reinforcement?

Reinforcement is a feedback from which the agent comes to know that something good has happened when it wins and that something bad has happened when it loses. This is also called as reward.

Examples : In chess game, the reinforcement is received only at the of the game.

105. List out the types of reinforcement learning?

The following are the types of reinforcement learning

- ✓ Passive reinforcement learning
- ✓ Active reinforcement learning

106. What is reinforcement learning?

In this learning, the agent's policy is fixed and the task is to learn the utilities of states. It could also involve learning a model if the environment.

107. What is active reinforcement learning?

In this learning, in addition to passive reinforcement learning, the agent must also learn what to do. The principal issue exploration is.

108. What is ADP?

An adaptive dynamic programming (or ADP) agent works by learning the transition model of the environment and solving the corresponding Markov decision process using a dynamic programming method.

109. List out the advantages and disadvantages of ADP?

Advantages :

- ✓ It can converge quite quickly
- ✓ The process of learning the model itself is easy.
- ✓ It provides a standard against which other reinforcement learning algorithms can be measured.

Disadvantages :

It is intractable for large state spaces.

110. What is TD learning?

The basic idea of all temporal-difference methods is, first to define the conditions that hold locally when the utility estimates are correct, and then, to write an update equation that moves the estimates toward this ideal "equilibrium" equation.

111. List out the advantages and disadvantages of TD?

Aadvantages :

- ✓ It is much simpler
- ✓ It requires much less computation per observation.

Disadvantages :

- ✓ It does not learn quite as fast as the ADP agent
- ✓ It shows much higher variability.

112. Differentiate between ADP and TD?

ADP Approach	TD Approach
ADP adjusts the state to agree with all of the successors that might occur, weighted by their probabilities.	TD adjusts a state to agree with its observed successor.
ADP makes as many adjustments as it needs to restore consistency between the utility estimates U and the environment model T.	TD makes a single adjustments per observed transition.

113. What is Q – learning?

An alternative TD method called Q – learning can be used that learns an action-value representation instead of learning utilities. The notation   Q (a, s) can be used to denote the value of doing action a in state s. Q-values are directly related to utility values as follows :

U (s) = max Q (a, s)

114. List out the applications of reinforcement learning?

Application to game playing

Application to robot control.

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