1 Definitions of AI

Which of the following statements are true about AI?
Select one or more alternatives:

- [ ] Robotics, 3D printing, and augmented reality are considered applications of AI
- [ ] It is always possible to remove all the bias in machine learning algorithms
- [ ] AI can be defined as any machine or software that exhibits traits associated with a human mind such as learning and problem-solving.
- [ ] AI can be defined as the simulation of human-like intelligence in machines that are programmed to think like humans and mimic their actions
- [ ] Self driving vehicles, targeted advertising, and recommender systems are examples of AI

Maximum marks: 5

2 Search Basics I

Which of the following statements are true?
Select one or more alternatives:

- [ ] In tree search, we store a set of visited nodes
- [ ] In graph search, we store a set of visited nodes
- [ ] The frontier in Depth First Search works as a FIFO (First In First Out) queue
- [ ] In Simulated Annealing, the speed of the cooling schedule and the probability of terminating with a global optimum solution are directly proportional.
- [ ] Local beam search is equivalent to running n random restarts, except that we do it concurrently instead of consecutively

Maximum marks: 5

3 Local Search

In local search, how might we try to avoid getting stuck at local optima?
Select one or more alternatives:

- [ ] Re-running the search algorithm many times
- [ ] Always transition to a better/fitter node
- [ ] Randomly transition between nodes while keeping track of the best one seen so far
- [ ] Sometimes transition to a worse/less fit node
- [ ] Use dynamic programming for path finding

Maximum marks: 5

4 Shortest Path Problems

Which of the following statements are true about Shortest Path Problems?
Select one or more alternatives:

- [ ] Can be used to find the most efficient series of actions while minimizing some value
- [ ] Are only applied to graphs that have costs associated with the nodes
- [ ] Can only be solved using A*
- [ ] Can be used to find a route that minimizes some cost
- [ ] Can only be solved if the graph is acyclic

Maximum marks: 5

5 Heuristic Search I

Which of the following statements are true about A*:
Select one or more alternatives:

- [ ] The way in which we break ties when expanding a node in the frontier has no effect in the performance.
- [ ] A* outperforms DFS because the heuristic adds a bias in the exploration towards the goal
- [ ] It is guaranteed to terminate and it is complete (i.e. it will always find a solution)
- [ ] If we're performing tree-search, A* requires an optimistic heuristic
- [ ] If we're performing graph-search, A* requires an optimistic heuristic

Maximum marks: 5

6 Competitive Search I

Which of the following statements are true about MiniMax?
Select one or more alternatives:

- [ ] MiniMax cannot be used for chess because the search space is too large
- [ ] The order in which we explore the moves can affect the performance
- [ ] It can be used in games with any number of players
- [ ] The order in which we explore the moves has no impact in the final tree
- [ ] It can only be used for deterministic games with perfect information

Maximum marks: 5

7 Competitive Search II

Which of the following statements are true about alpha-beta pruning?
Select one or more alternatives:

- [ ] It always returns the moves that leads to the best outcome in the shortest number of steps.
- [ ] It can suffer from horizon effects only when we limit the depth of the search
- [ ] The order in which we explore the moves has no impact on the final tree
- [ ] Compared to minimax, it increases the searchable depth by orders of magnitude
- [ ] For a given depth, alpha-beta pruning increases the searchable space in comparison to minimax

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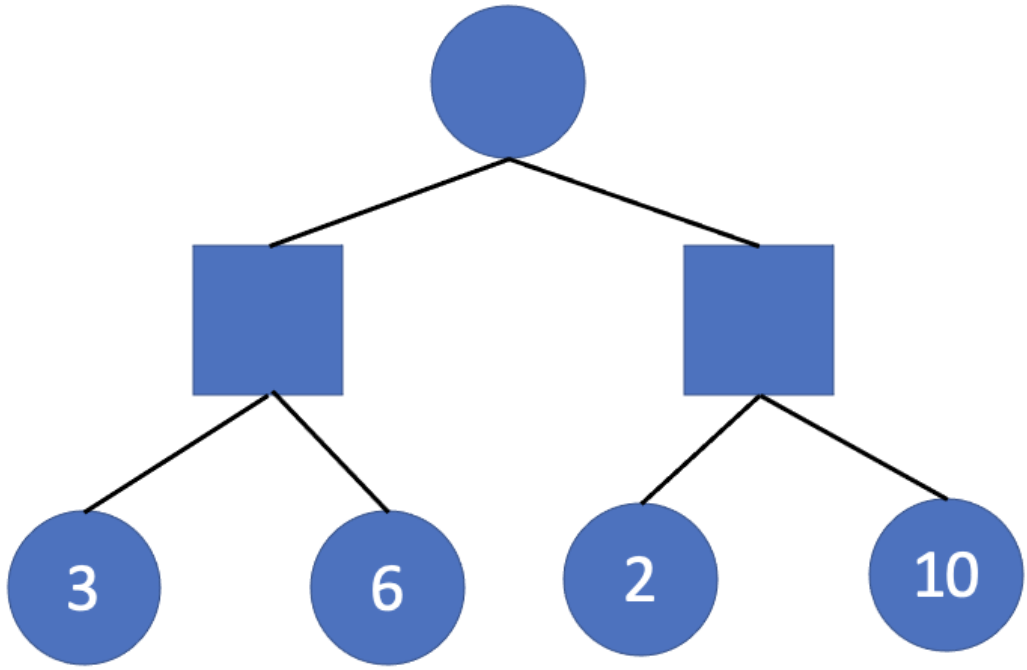
Maximum marks: 5

8 MiniMax

What is the result (at the root) of applying MiniMax to the following tree?



Select one alternative:

- 6
- 2
- 10
- Cannot be determined
- 3

Maximum marks: 5

9 Planning and Scheduling I

Which of the following statements are true about planing problems?
Select one or more alternatives:

- [ ] Fluents include conjunctions, disjunctions, and conditionals.
- [ ] Planing problems always have one or more solutions
- [ ] PDDL problems can be solved using search algorithms
- [ ] In a PDDL state, negated fluents are omitted.
- [ ] When defining a planing problem, you only need to define: start state, goal, and actions

Maximum marks: 5

10 Planning and Scheduling II

Which of the following statements about scheduling are true?
Select one or more alternatives:

- [ ] The goal is to provide an optimal schedule for the performance of the required actions.
- [ ] Scheduling is about what to do and in what order
- [ ] Minimum slack algorithm is always optimal
- [ ] Resource-free scheduling is a way to estimate a lower-bound of the end time of the tasks.
- [ ] It is not possible to obtain optimal solutions to scheduling problems

Maximum marks: 5

11 Statistical Learning Basics I

Which of the following statements are true about statistical learning?
Select one or more alternatives:

- [ ] P(A,B) and P(A|B) both represent the joint distribution of A and B
- [ ] It is always easy to determine if we have too little data
- [ ] Distributions assign probabilities to a random variable taking particular values
- [ ] A random variable is a variable which can take different values
- [ ] There are many ways to fit data to a distribution

Maximum marks: 5

12 Markov Chains I

Replace with question text
Which of the following statements are true?

- [ ] A Markov chain is a conditional probability distribution that tells us the probability of the state of the system at the next time given the state of the system at the current time
- [ ] Observation matrix and emission matrix are different names for the same matrix
- [ ] A Markov chain has 3 components: the initial state, the transition matrix, the emission matrix.
- [ ] Markov chains cannot be extended to deal with real valued state variables and continuous time
- [ ] In a graphical representation of a Markov chain, variables are represented by nodes, while dependencies are represented by arrows

Maximum marks: 5

13 Markov Models II

In HMM, calculating a prior state distribution given an initial state distribution and a sequence of observations to the present is called

Select one or more alternatives:

- [ ] State prediction
- [ ] None of the other options
- [ ] State estimation
- [ ] Smoothing
- [ ] Most probable path estimation

Maximum marks: 5

14 Hidden Markov Models

Which of the following statements are true?

Select one or more alternatives:

- [ ] State estimation is used to predict the current state of a system given an initial state and a series of observations up until present
- [ ] The most probable sequence of state values given an initial state distribution and a sequence of observations is given by selecting the state with the highest probability at each time slice.
- [ ] Smoothing the probabilities of a HMM is always useful
- [ ] The Viterbi algorithm is used to smooth the probabilities in a HMM
- [ ] The emission matrix gives the probabilities of observing different emissions given the state of the system

Maximum marks: 5

15 Bayesian Networks I

Replace with question text

Which of the following statements are true about Bayesian networks?

- [ ] If a variable B is correlated to a variable A, then a causation relationship is established from A to B
- [ ] A probability distribution is associated with each node, and this probability is conditional on the node's parents.
- [ ] The Bayesian Network representation of a joint distribution is unique
- [ ] Bayesian networks are networks of random variables
- [ ] Conditional independencies cannot be encoded in a Bayesian network

Maximum marks: 5

16 Bayesian Networks II

Which of the following statements are true about Markov Chain Monte Carlo (MCMC) sampling?

Select one or more alternatives:

- [ ] A burn period improves the performance of the algorithm but it's not always necessary
- [ ] It is easy to decide a priori a good burn period
- [ ] Gibbs Sampler and Metropolis/Metropolis Hastings differ on the way they use the samples to generate the desired distributions
- [ ] MCMC aims to estimate the probability distributions of a set of unknown variables given a set of known variables
- [ ] Gibbs Sampler, Metropolis/Metropolis Hastings, and Metropolis within Gibbs are examples of MCMC sampling algorithms

Maximum marks: 5

17 Deep Neural Networks I

Which of the following statements are true?
Select one or more alternatives:

- [ ] Learning a discrete-valued function is called regression
- [ ] When a model overfits the data, the mean error on the training dataset increases
- [ ] Gradient descent is an optimization algorithm that can be used to minimize the loss function
- [ ] Basic ANNs are a series of one or more feature transformations followed by either linear regression (for regression tasks) or logistic regression (for classification tasks).
- [ ] Gradient descent must be used for training ANNs

Maximum marks: 5

18 Image Analysis with Convolutional Networks I

From the following, which ones are **not** a method for data augmentation?
Select one or more alternatives:

- [ ] Randomly rotating a few training images
- [ ] Warping images to have significant distortion
- [ ] Adding Gaussian noise and blur to training images
- [ ] Mirroring images over horizontal or vertical axes
- [ ] Overlapping a training image over another training image

Maximum marks: 5

19 Image Analysis with Convolutional Networks II

For the following input image, choose the resultant image partition once processed with the given filter kernel:

5	6	3
1	1	2
4	4	5

Image

2	1
1	1

Kernel

Select one or more alternatives

- [ ]

18	13
18	11

- [ ]

18	11
18	13

- [ ]

18	18
11	13

- [ ]

18	11
13	18

- [ ]

18	18
13	11

Maximum marks: 5

20 CNN

Which of the following are NOT hyper-parameters?
Select one or more alternatives:

- [ ] Learning rate
- [ ] Regularization parameters
- [ ] Number of epochs
- [ ] Batch size
- [ ] Weights in a neural network

Maximum marks: 5

21 Re-Exam A*

RE-EXAM/OLD STUDENTS ONLY!

Table 1 gives the edge values for a shortest path problem. Using these and the A* algorithm, find the shortest path from the start node to the goal node. Provide a valid heuristic and show all working (all steps/turns).

Table 1: Edges

	Start	A	B	C	D	E	Goal
Start	0	2	0	2	0	0	0
A	0	0	2	0	0	0	0
B	0	0	0	3	7	0	0
C	0	0	0	0	6	0	4
D	0	0	0	0	0	3	0
E	0	0	0	0	0	0	4
Goal	0	0	0	0	0	0	0

Fill in your answer here

Maximum marks: 20

22 RE-EXAM Scheduling

RE-EXAM/OLD STUDENTS ONLY!

Provide a complete resource constrained schedule for the actions found in the table below. Include the status of the resources at the relevant points in time.

Index	Action	Duration	Uses	Consumes	After
1	Start	0		0 nails	NA
2	Action 1	50		-1 nail	1
3	Action 2	45	Saw	-1 nail	1
4	Action 3	40	Saw	0 nails	1
5	Action 4	5		0 nails	2,4,3
6	Action 5	5	Hammer	1 nail	4,3,2
7	Action 6	25	Saw	0 nails	4
8	Action 7	20	Saw,Hammer	1 nail	6,2,3
9	Finish	0		0 nails	5,7,8

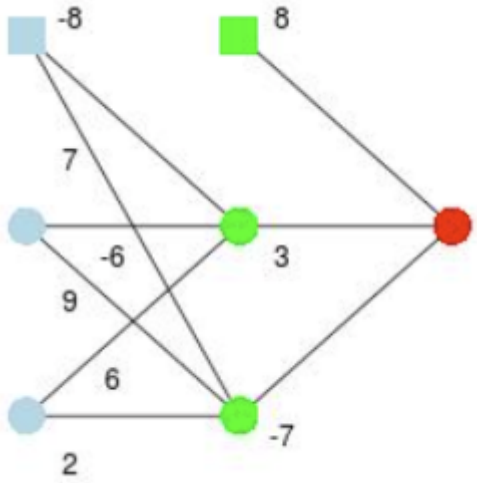
Fill in your answer here

Maximum marks: 20

23 RE-EXAM ANNs

RE-EXAM/OLD STUDENTS ONLY!

Examine the neural network given in the diagram below. In this diagram, square nodes represent biases, blue nodes the input layer, green nodes a hidden layer, and red nodes the output layer. The first round blue input node is associated with feature X1, and the second with feature X2 (counting downwards). Assuming that all activation functions are rectifiers (i.e. the hidden nodes are ReLU units), and the output is a basic linear regression function, calculate the output of this network if it was given an input of X1 = -5 and X2 = -7.



Fill in your answer here

Maximum marks: 10