Final (7pm-10pm)

Started: Mar 16 at 7pm

Quiz Instructions

Question 1 — 3 pts

The following LISP function is designed to output the number of atoms in a (possibly nested) list. Match the items into corresponding blanks to make the function work properly.

```
(defun F(x)


(cond
   ([1] 0)       ; returns 0
   ([2] 1)       ; returns 1
   (t
    (+ (F (car x)) (F [3]))  ;else
  )
)
)
```

[1]	(not x)
[2]	(atom x)
[3]	(cdr x)

Question 2

1 pts

As shown in the picture, a driver in Manhattan can only drive along two directions, either drive along a street or along an avenue. Suppose you are at (x_1, y_1), and you want to go to (x_2, y_2), please formulate this as a search problem.

Suppose each state in this problem is a crossroad (U-turn allowed), what is the branching factor of this search problem?

- ○ 1
- ○ 2
- ○ 3
- ◉ 4

Question 3

1 pts

As shown in the previous question, the blue line is an example of the heuristic of L_2 distance.

Is this an admissible heuristic?

- (●) Yes
- ( ) No

Question 4 — 1 pts

As shown in the previous question, the red line is an example of the heuristic of L_1 distance.

Is this an consistent heuristic?

- (●) Yes
- ( ) No

Question 5 — 1 pts

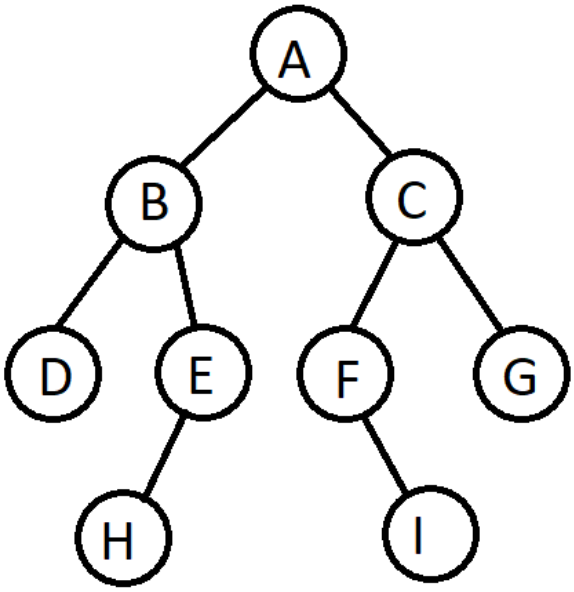
Any consistent heuristic is also admissible.

- (●) True
- ( ) False

Question 6 — 9 pts

You are given a search tree with one node **A** labeled as a start state and another node **F** labeled as a goal state. Number the nodes in the tree according to the order in which they will be **expanded** (not the order in which they are generated). The goal test is applied when the node is expanded. When the order of expansion is arbitrary, assume that nodes are expanded from left to right.

Breadth First Search



A	1
B	2
C	3
D	4
E	5
F	6
G	Not expanded
H	

Not expanded

I

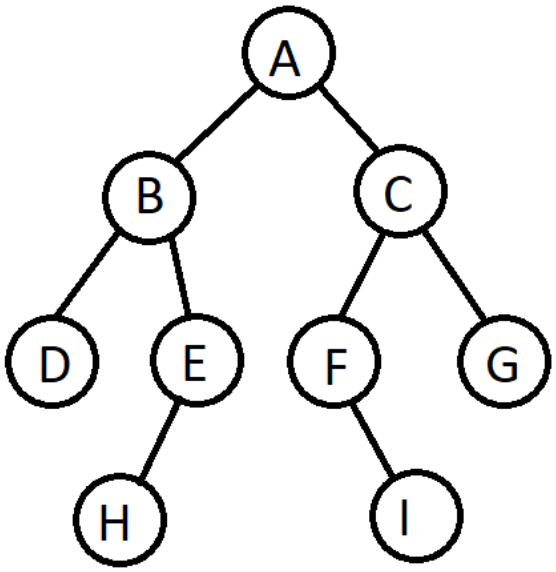
Not expanded

Question 7

12 pts

You are given a search tree with one node **A** labeled as a start state and another node **F** labeled as a goal state. Write the order of node **expansion** (not the order in which they are generated). The goal test is applied when the node is expanded. When the order of expansion is arbitrary, assume that nodes are expanded from left to right.

Iterative Deepening Search: For example, we first limit the search depth to 1, which means the 1st node expanded is A; then we limit the search depth to 2, again the first node expanded is A, which means the 2nd node in the sequence is also A. You are required to filling the rest of the expansion sequence.



1st

	A
2nd	A
3rd	B
4th	C
5th	A
6th	B
7th	D
8th	E
9th	C
10th	F
11th	None expanded.
12th	None expanded.

Question 8

1 pts

Uniform-cost search with a cost function g(n) = depth(n) is equivalent to breadth first search. Assume the goal test of both algorithms is performed at node expansion.

- (●) True
- ( ) False

Question 9 — 1 pts

If the branching factor is finite and step costs are all identical, breadth first search is an optimal but incomplete search strategy.

- ( ) True
- (●) False

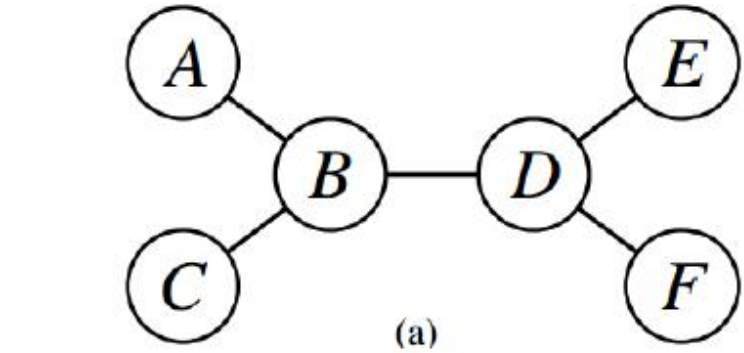
Question 10 — 1 pts

One of the main advantages of hill climbing search is its small space requirements.

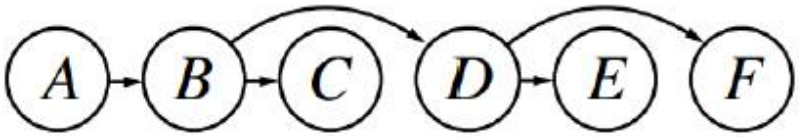
- (●) True
- ( ) False

Question 11 — 1 pts

Consider the tree-structured constraint satisfaction problem. We have already obtained a topological sorting of the tree, shown in picture (b).



(a)



(b)

In what order should we perform value elimination (maintain arc consistency) between each node and its parent?

- (●) From F to A
- ( ) From A to F

Question 12 1 pts

Same as the previous question, after maintaining arc consistency, in what order should we perform value assignment?

- (●) From A to F
- ( ) From F to A

Question 13 1 pts

Suppose we have n nodes in a tree-structured CSP graph, and the domain of each node is at most of size d. What is the time complexity of solving such a CSP problem? Choose the most precise one.

- (●) $O(nd^2)$
- ( ) $O(nd)$
- ( ) $O(d^n)$
- ( ) $O(n^d)$

Question 14

1 pts

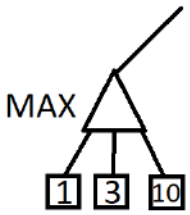
The minimax procedure is guaranteed to compute an optimal move if the other player also plays optimally.

- (●) True
- ( ) False

Question 15

1 pts

Suppose the EXPECT-MINIMAX algorithm encounters such a node shown in the picture. This node has 3 possible child nodes, each has its utility values 1,3,10 respectively. The MAX player has three actions to choose from, each will lead to a distribution over possible successors. According to the EXPECT-MINIMAX algorithm, which action will be chosen?

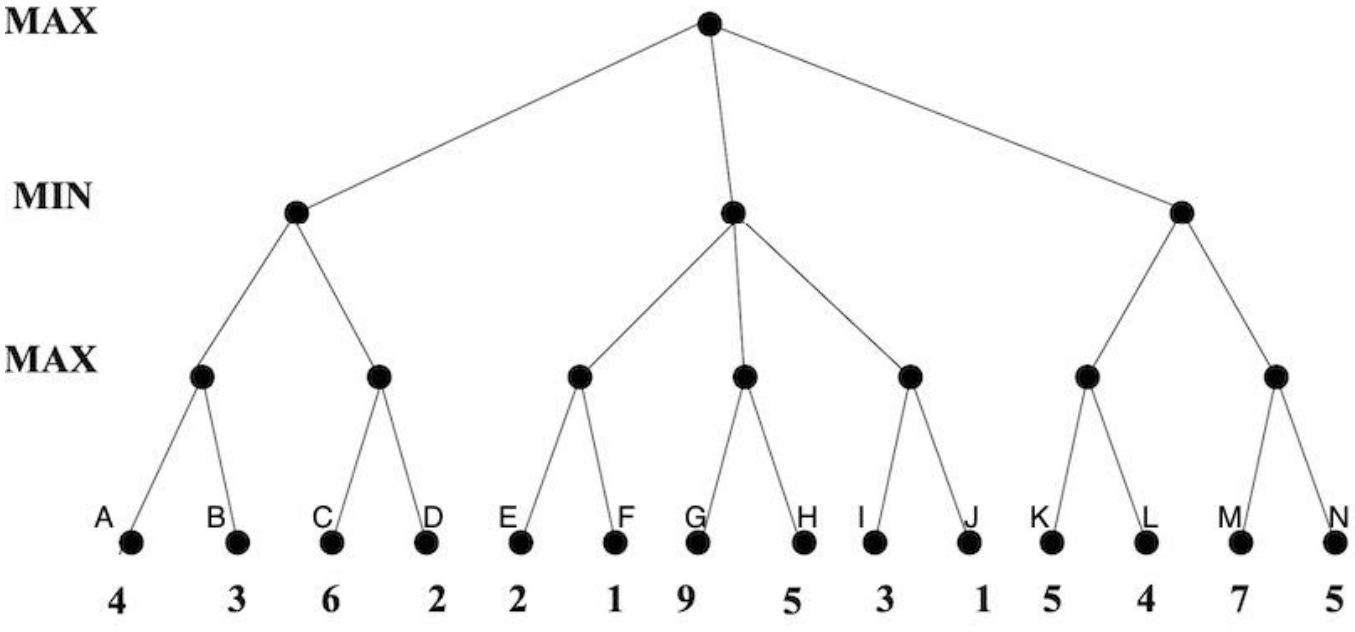


	A1	A2	A3	
1	1/3	0	1/2	
3	1/3	1	0	
10	1/3	0	1/2	

- ○ A1
- ○ A2
- ◉ A3

Question 16

14 pts



Given the above search tree, suppose we are using alpha-beta pruning to help with the search. Indicate each leaf node that will be pruned by Alpha-Beta Pruning.

A	Not Pruned
B	Not Pruned
C	Not Pruned
D	Pruned
E	Not Pruned
F	Not Pruned
G	Pruned
H	Pruned
I	Pruned
J	Pruned
K	Not Pruned
L	Not Pruned
M	Not Pruned
N	Pruned

Question 17

1.5 pts

What is the initial value of alpha in alpha-beta pruning?

- (●) Negative Infinity
- ( ) Positive Infinity
- ( ) 0
- ( ) 1

Question 18

1.5 pts

A computer technician notes that 1/2 of computers fail because of the hard drive, 1/3 because of the microprocessor and 1/6 fails because of both. What is the probability that the microprocessor fails given that the hard drive has failed?

- (●) 1/3
- ( ) 1/2
- ( ) 1/6
- ( ) Non above

Question 19

8 pts

Match the following probability concepts with their definitions or formulae

Probability	Assigns each sentence a d
Conditional independence	$P(a \wedge b \mid c) = P(a \mid c)\, P(b \mid c)$

Independence	P(a ∧b) = P(a) P(b)
Product rule (chain rule)	P(a ∧b∧c) = P(a | b∧c) P(b |
Conditional probability	Degree of belief accorded a
Unconditional probability	Degree of belief accorded t
Bayes' rule	P(a | b) = P(b | a) P(a) / P(b)
Joint probability distribution	Gives probability of all com

Question 20

1.5 pts

$Pr(\alpha) = Pr(\alpha \wedge \beta) + Pr(\alpha \wedge \neg\beta)$ for any events α and β.

- (●) True
- ( ) False

Question 21

1.5 pts

$Pr(\alpha \vee \neg\beta) = Pr(\alpha) + Pr(\neg\beta)$ for any events α and β.

- ( ) True
- (●) False

Question 22

1.5 pts

If $\alpha \models \beta$, then $Pr(\alpha) \leq Pr(\beta)$

- (●) True
- ( ) False

Question 23

1.5 pts

The sentence $\exists x Person(x) \wedge Rich(x) \wedge (\forall y (Person(y) \wedge Rich(y)) \Rightarrow x = y)$ says

- ( ) At least one person is rich
- (●) There is exactly one person who is rich
- ( ) All the people are rich
- ( ) No person is rich
- ( ) None of the others

Question 24

1.5 pts

$(X \vee Y) \wedge (\neg X \vee \neg Y)$ is a disjunctive normal form (X, Y are variables).

- ( ) True
- (●) False

Question 25

1.5 pts

$A \vee B \vee \neg C$ is a Horn clause (A, B and C are variables).

- ○ True
- ◉ False

Question 26 — 1.5 pts

$\Delta \models \alpha$ if and only if $\Delta \wedge \neg\alpha$ is not valid.

- ○ True
- ◉ False

Question 27 — 1.5 pts

A sentence α is valid if and only if $\neg\alpha$ is unsatisfiable.

- ◉ True
- ○ False

Question 28 — 1.5 pts

Consider the knowledge base $\Delta = \{A \Rightarrow B, \neg C \Rightarrow \neg B, A \Rightarrow \neg C\}$. Which of the following sentences is entailed by Δ: (and means $\wedge$, or means $\vee$, not means $\neg$)

- ○ A and C
- ○ A or B
- ◉ not A
- ○ not A and B

- ○ None of the others

Question 29 — 1.5 pts

The following two sentences:

$\exists t\ time(t) \wedge (\forall x\ person(x) \implies fooled(x, t))$

$\forall x\ person(x) \implies (\exists t\ time(t) \wedge fooled(x, t))$

are:

- ○ Equivalent.
- ◉ The first implies the second.
- ○ The second implies the first.
- ○ None of the others.

Question 30 — 1.5 pts

$\forall x \exists y Likes(x, y)$ is equivalent to $\exists x \forall y Likes(x, y)$

- ○ True
- ◉ False

Question 31 — 1.5 pts

The CNF of $\neg(\forall x\ \exists y\ (P(x) \Rightarrow Q(x, y)))$ is: (A is the Skolemization constant)

A. $P(F(A)) \vee \neg Q(F(A), y)$.

B. $P(F(A)) \wedge \neg Q(F(A), y)$.

C. $P(A) \vee \neg Q(A, y)$.

D. $P(A) \wedge \neg Q(A, y)$.

- ○ A
- ○ B
- ○ C
- ○ D
- ◉ None of the others

Question 32

1.5 pts

Any sentence in first-order logic can be expressed without using the universal $\forall$ quantifier.

- ◉ True
- ○ False

Question 33

1.5 pts

Given two propositional sentences Δ and α, if we have $\Delta \models \alpha$, then Δ must have at least a single model (satisfied by at least one world).

- ○ True
- ◉ False

Question 34

1.5 pts

A unifier exists for $P(F(B), F(G(w)), w)$ and $P(F(y), F(y), B)$.

- ○ True
- ◉ False

Question 35

1.5 pts

If α can be derived from a knowledge base Δ using some inference rules, then α can be derived from Δ' using the same inference rules, where Δ' is a larger knowledge base that includes every sentence in Δ.

- ◉ True
- ○ False

Question 36

1.5 pts

A sibling is another child of one's parent (not necessarily all parents). Which of the following sentences reflects this fact:

A. $\forall x, y \; Sibling(x, y) \Leftrightarrow (x \neq y \wedge \forall p \; Parent(p, x) \wedge Parent(p, y))$.

B. $\exists x, y \; Sibling(x, y) \Leftrightarrow (x \neq y \wedge \exists p \; Parent(p, x) \wedge Parent(p, y))$.

C. $\forall x, y \; Sibling(x, y) \Leftrightarrow (x \neq y \wedge \exists p \; Parent(p, x) \wedge Parent(p, y))$.

D. $\forall x, y \; Sibling(x, y) \Leftrightarrow (\exists p \; Parent(p, x) \wedge Parent(p, y))$.

- ○ A
- ○ B
- ◉ C

- ○ D
- ○ None of the others

Question 37 — 1.5 pts

Which of the following is equivalent to the sentence $\forall x \exists y \neg Friends(x, y)$?

A. $\exists x \forall y \neg Friends(x, y)$

B. $\neg \exists x \forall y Friends(x, y)$

C. $\neg \forall x \exists y Friends(x, y)$

D. $\neg \exists x \neg \forall y \neg Friends(x, y)$

- ○ A
- ◉ B
- ○ C
- ○ D

Question 38 — 1.5 pts

$\alpha \models \beta$ if and only if $\neg(\alpha \implies \beta)$ is not valid.

- ○ True
- ◉ False

Question 39 — 1.5 pts

The result of dropping quantifiers from $\forall x \exists y Friends(x, y)$ during the process of converting to Conjunctive Normal Form (CNF), gives (A is the Skolemization constant, F

is the Skolemization function)

- ○ Friends(x,y)
- ○ Friends(F(x), y)
- ○ Friends(x, F(y))
- ○ Friends(x, A)
- ◉ None of the others

Question 40

1.5 pts

Consider a Bayesian network with structure $(X \leftarrow Z \rightarrow Y)$ (X and Y are children of Z). Then $Pr(x, y, z)$ is equal to:

- ○ Pr(x) Pr(y) Pr(z).
- ◉ Pr(x|z) Pr(y|z) Pr(z).
- ○ Pr(x|z) Pr(y|z).
- ○ Pr(x) Pr(y) Pr(z|xy).
- ○ None of the others.

Question 41

1.5 pts

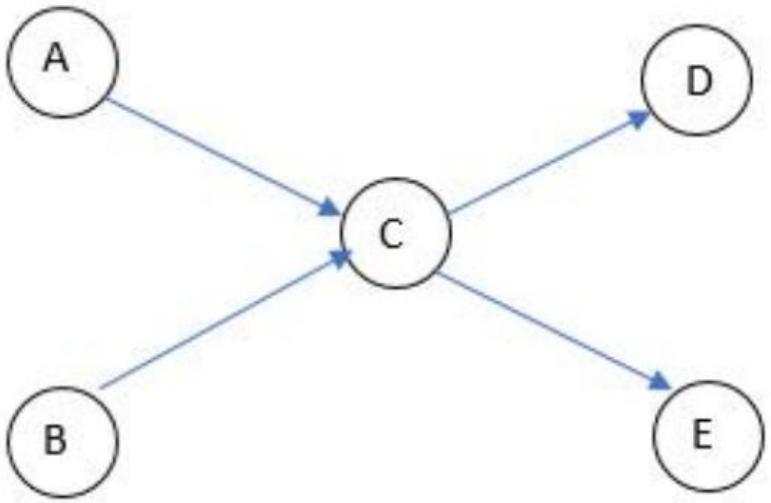
If a student scores an A+ on CS111 (X), then that student must be exceptional (E) and, hence, will most probably score an A on CS161 (Y). If we want to represent this scenario using a Bayesian network, which of the following causal structures should we use? '<-' and '->' indicate arrows in Bayesian networks.

- ○ None of the others.
- ○ X <- E, Y <- E
- ○ X <- E, Y -> E

- (●) X -> E, Y <- E
- ( ) X -> E, Y -> E

Question 42

1.5 pts



Given the above the Bayesian network, state whether the following arguments are true or false

A and B are conditionally dependent if C or D or E have been given

- ( ) True
- (●) False

Question 43

1.5 pts

Following the same Bayesian network, state whether the following arguments are true or false

E is conditionally independent of A, B and D if C is not given

- ( ) True

◉ False

Question 44 1.5 pts

Following the same Bayesian network, state whether the following arguments are true or false

D is conditionally independent of A, B and E if C is given

◉ True

○ False

Question 45 1.5 pts

Following the same Bayesian network, state whether the following arguments are true or false

D and E are dependent if C is not given

◉ True

○ False

Quiz saved at 8:06pm Submit Quiz