Due: 04/07/2024 23:59

Foundations of Artificial Intelligence: Homework 2

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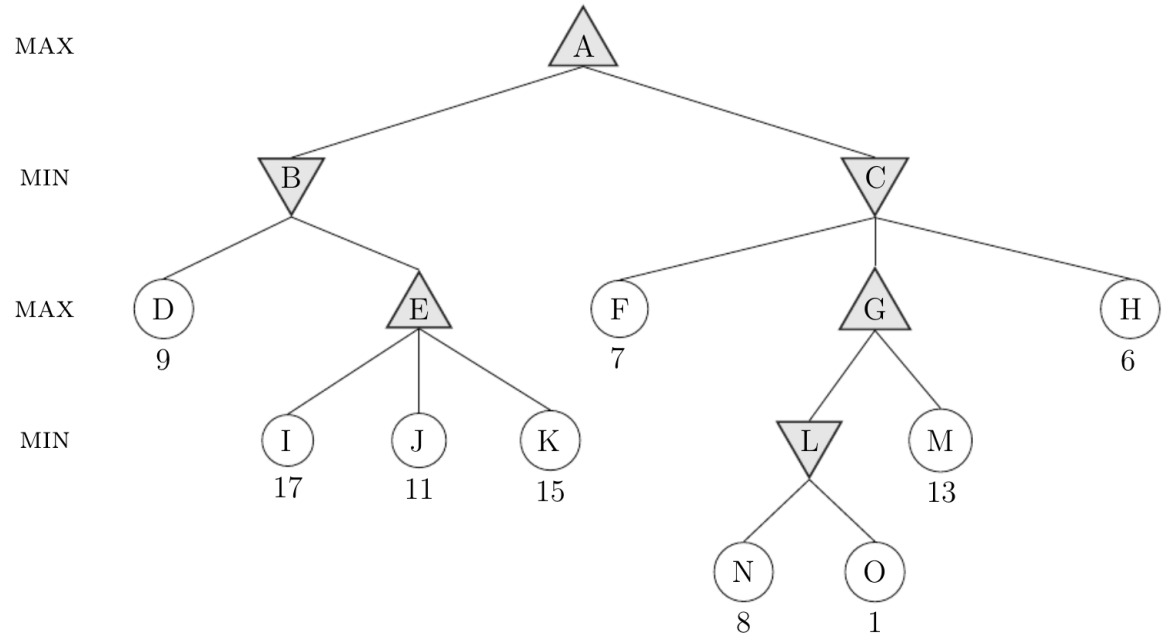
Problem 1 (10 points)

Consider the `MAX-MIN` game tree shown below where the numbers underneath the leaves of the tree are utility values from the first player's point of view (`MAX`).



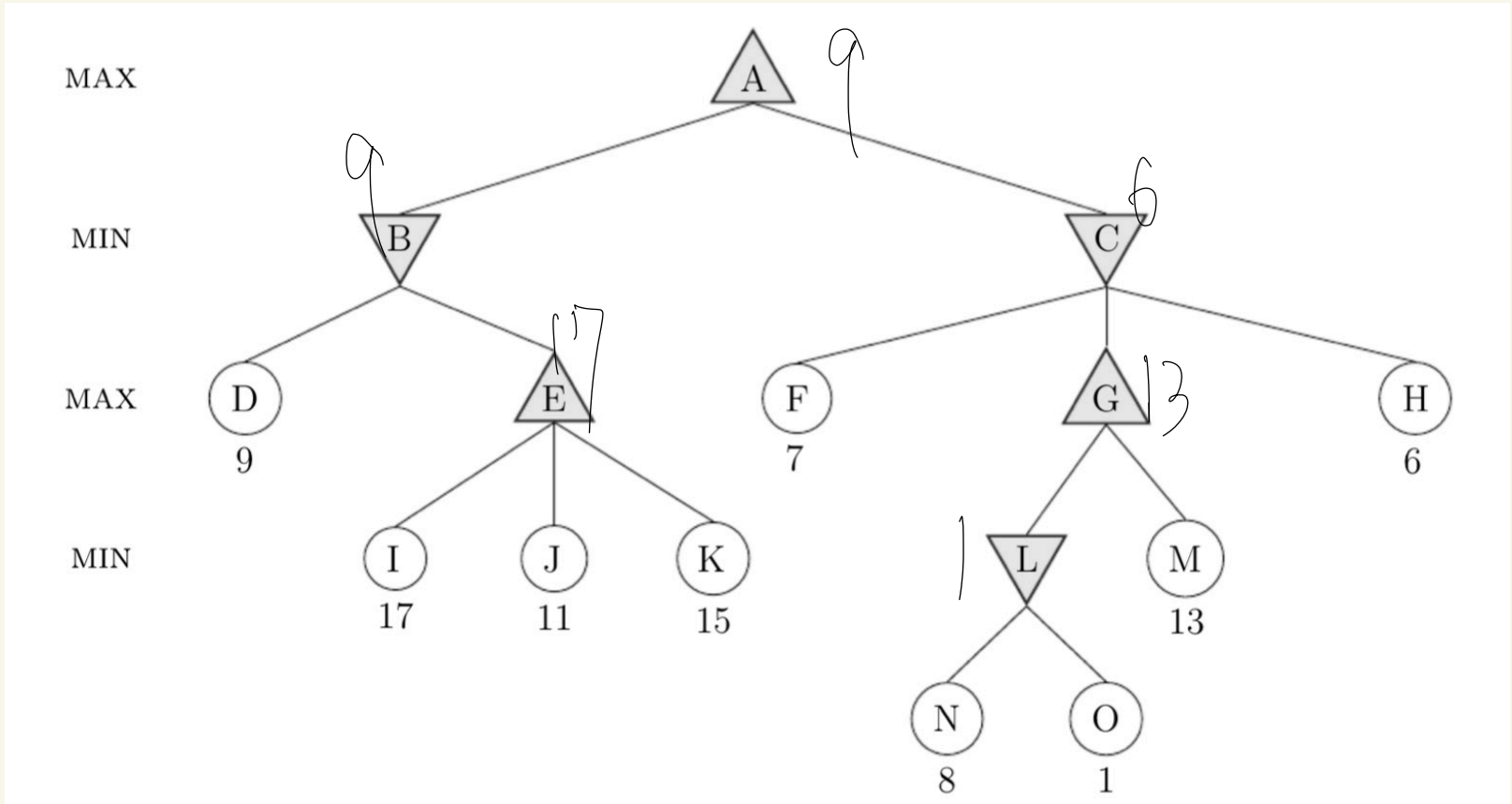
a) Draw a copy of the tree on paper and perform the **minimax** algorithm algorithm on it by hand. Write the resulting minimax values next to every node

b) Do the same, but with **left-to-right alpha-beta** pruning. Write the final values for α and β next to every node, and indicate which nodes are not examined due to pruning.

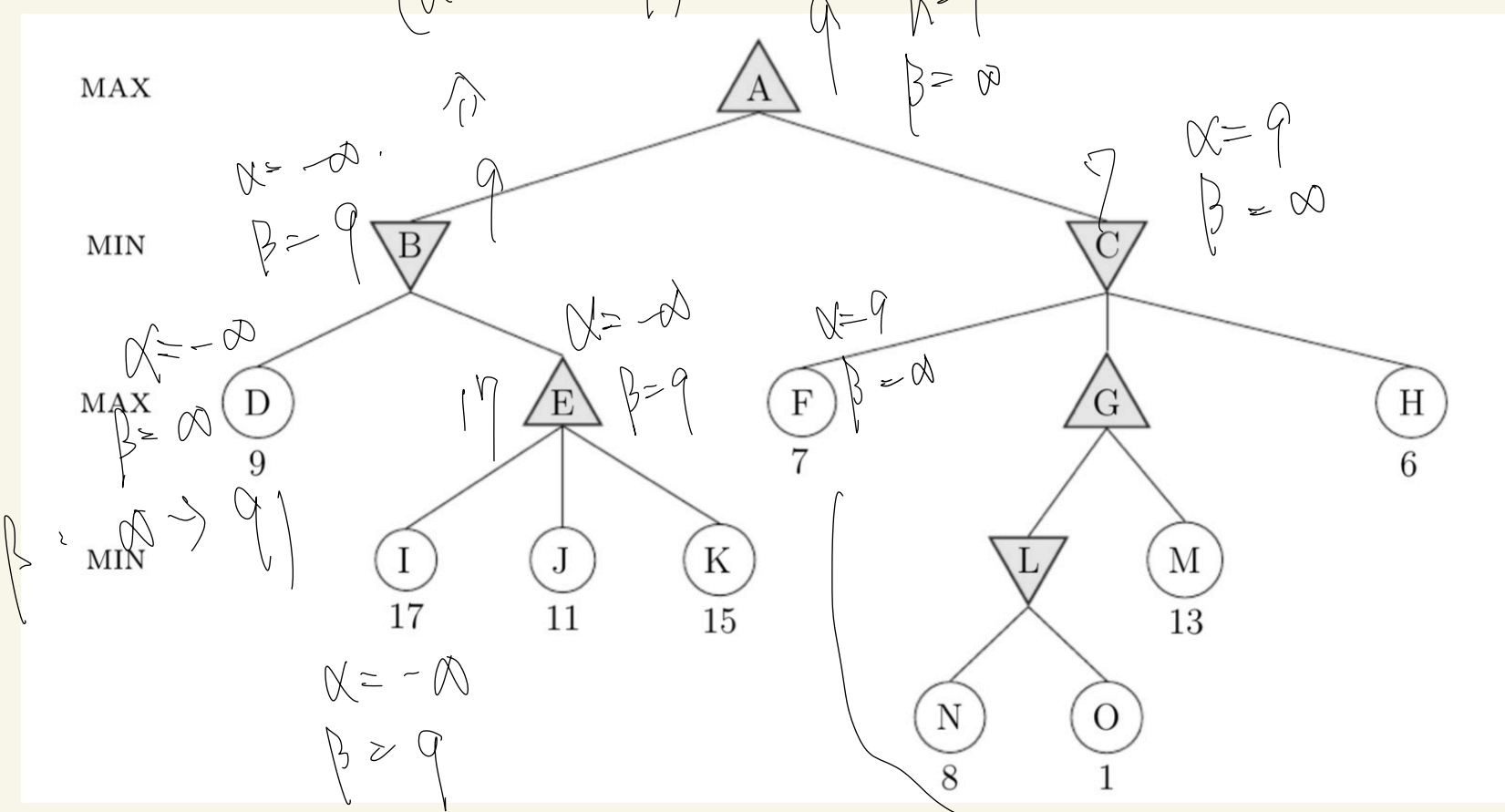
c) Do the same, but with **right-to-left alpha-beta** pruning. Write the final values for α and β next to every node, and indicate which nodes are not examined due to pruning.

Q1

(a)



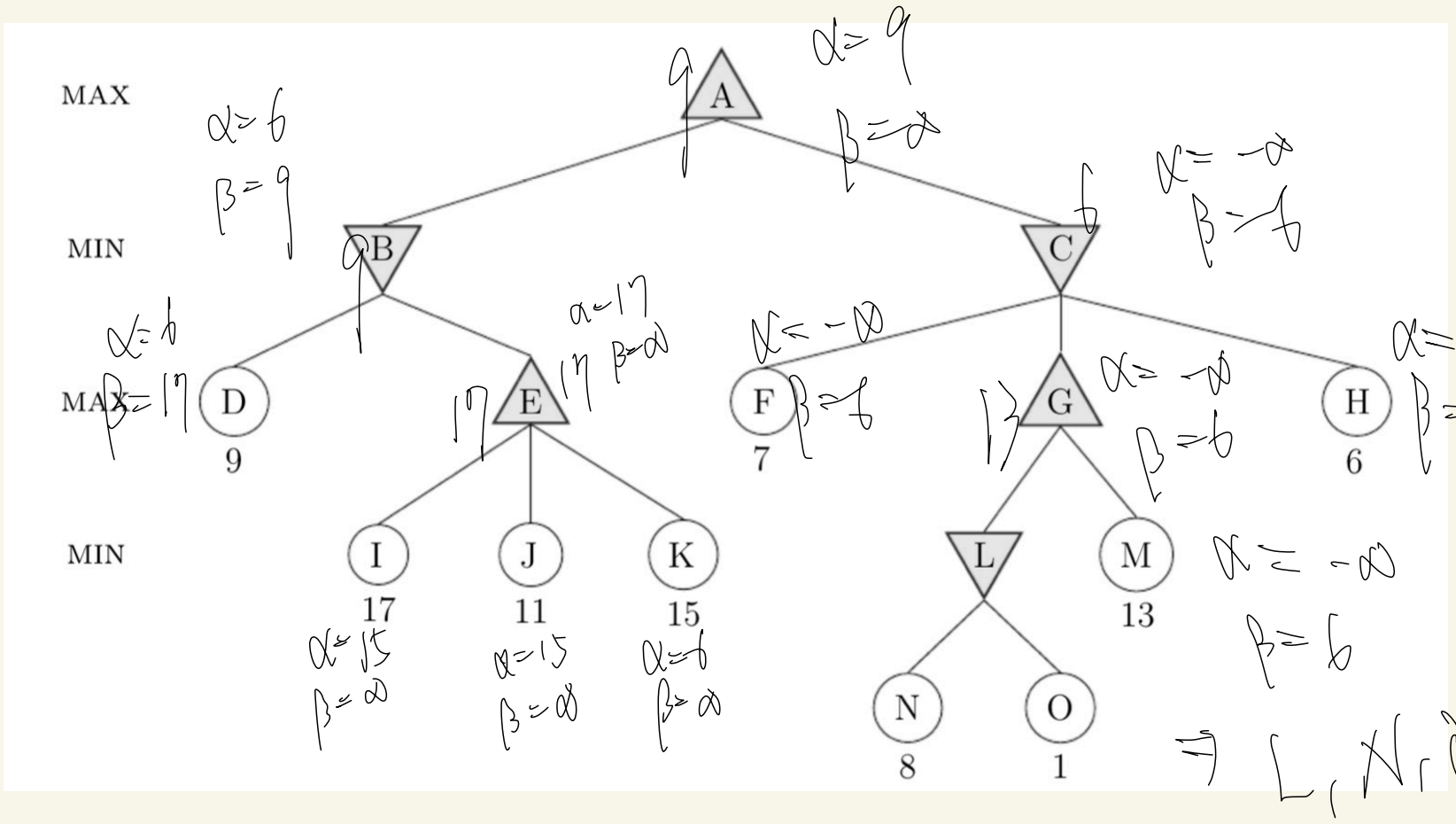
(b)



$V_I = 17 > \beta = 9$ → J, K not examined

$V_F = 7 < \alpha = 9$ → G, H, L, M, N, O not examined

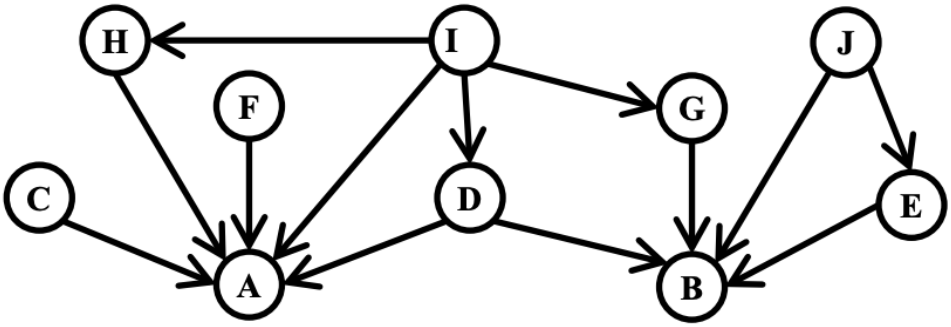
(c)



→ L, N, O not examined

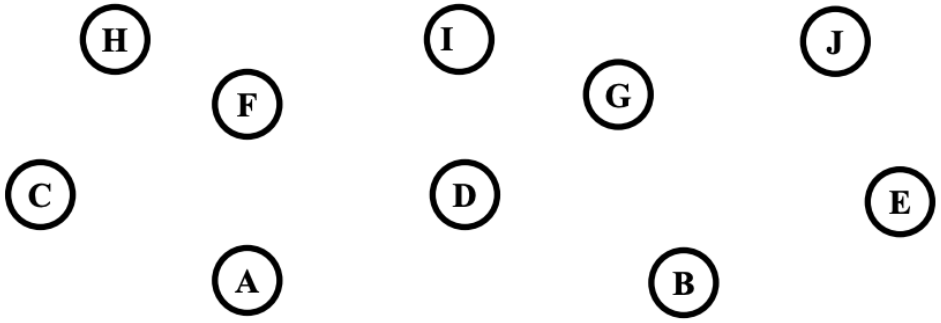
Problem 2 (10 points)

(a) Write down the factored joint probability distribution according to the following Bayesian Network.

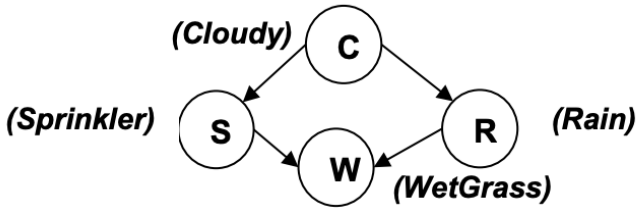


(b) Draw the Bayesian Network that corresponds to this conditional probability:

$$P(A|C,D,F,H)P(B|D,E,J)P(C|H)P(D|G,J)P(E)P(F|G,I)P(G|I,J)P(H)P(I)P(J)$$



(c) Below is the Bayesian network for the WetGrass problem.



P(C)
.5

C	P(S)
t	.1
f	.5

C	P(R)
t	.8
f	.2

S	R	P(W)
t	*t*	.99
t	*f*	.90
f	*t*	.90
f	*f*	.00

Write down an expression that will evaluate to

$$P(C = f \wedge R = f \wedge S = t \wedge W = t).$$

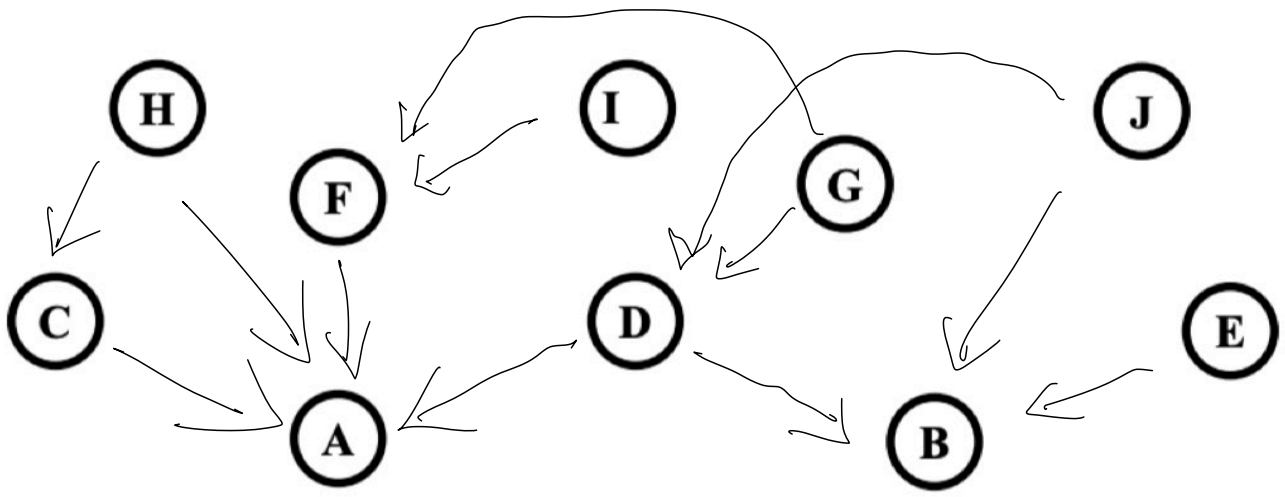
You do not need to carry out the multiplication to produce a single number (probability).

Q2

(a) $P(A|C,H,F,I,D)P(B|D,G,J,E)P(C)P(D|I)P(E|J)P(F)P(G|I)P(H|I)P(I|J)P(J)$

(b)

$P(A|C,D,F,H)P(B|D,E,J)P(C|H)P(D|G,J)P(E)P(F|G,I)P(G|I,J)P(H)P(I)P(J)$



(c) $P(W=t|S=t \wedge R=f)P(S=t|C=f)P(R=f|C=f)P(C=f)$

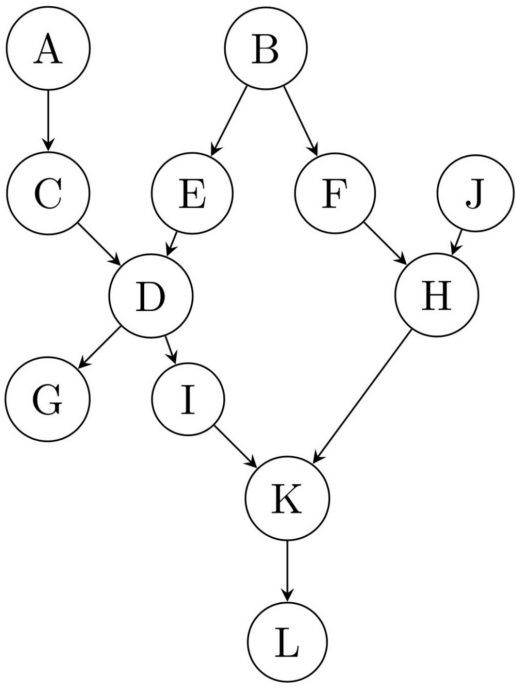
Q3

(a) A, C, G, D, J

(b)

Problem 3 (10 points)

According to the following Bayesian Network,



(a) List all the variables that are d-separated from F given E.

(b) List all the variables that are d-separated from F given E and K.

Problem 4 (10 points)

Draw a Bayes net with four states $\{A, B, C, D\}$, that follows all of the independence constraints below.

(a) $A \perp\!\!\!\perp B$

(b) $A \not\perp\!\!\!\perp D \mid B$

(c) $A \perp\!\!\!\perp D \mid C$

(d) $A \not\perp\!\!\!\perp C$

(e) $B \not\perp\!\!\!\perp C$

(f) $A \not\perp\!\!\!\perp B \mid D$

(g) $B \perp\!\!\!\perp D \mid A, C$