

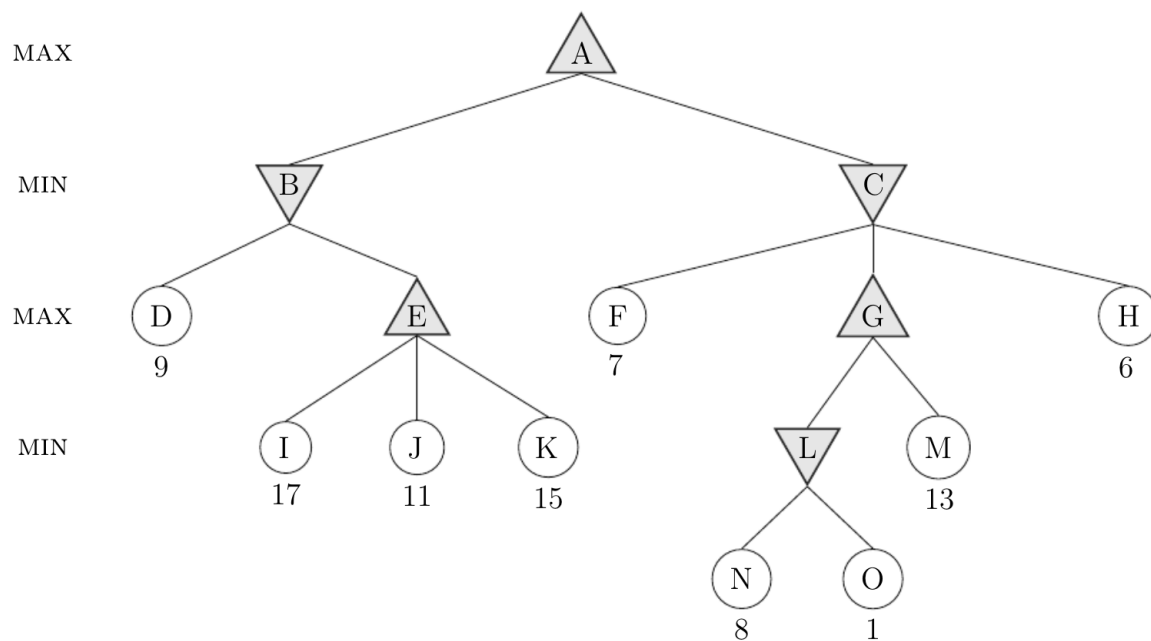
## Foundations of Artificial Intelligence: Homework 2

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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 on it by hand. Write the resulting minimax values next to every node

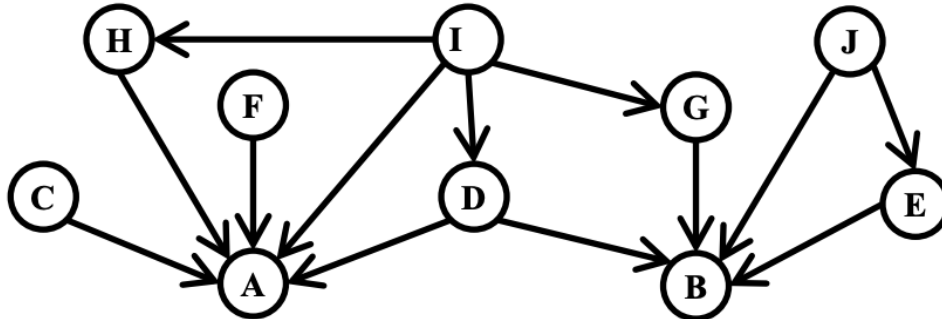
**b)** Do the same, but with **left-to-right alpha-beta** pruning. Write the final values for  $\alpha$  and  $\beta$  next to every node, and indicate which nodes are not examined due to pruning.

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

**Problem 2**

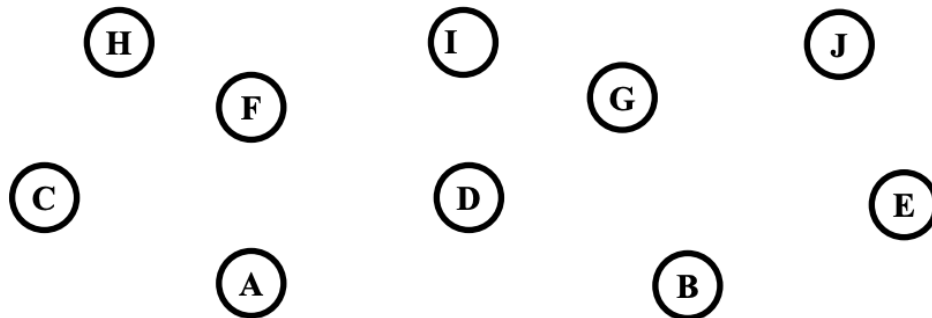
(10 points)

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

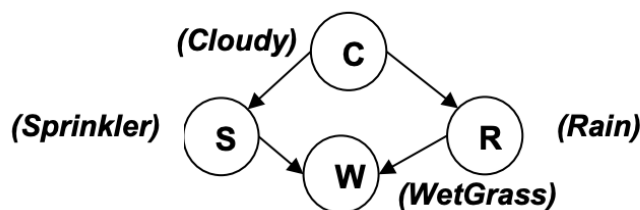


- (b) Draw the Bayesian Network that corresponds to this conditional probability:

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



- (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

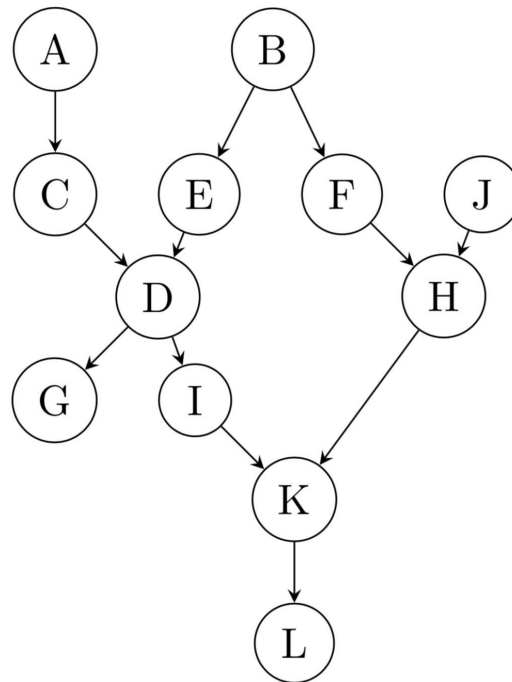
$$P(C = f \wedge R = f \wedge S = t \wedge W = t).$$

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

**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)  $B \perp\!\!\!\perp D \mid A, C$