

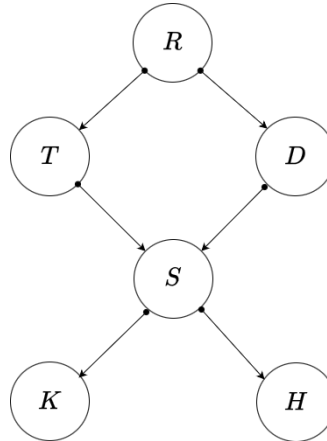
CS461 Quiz Three

CS461 Section #:	
Name:	
NetID:	

0. True / False Questions.

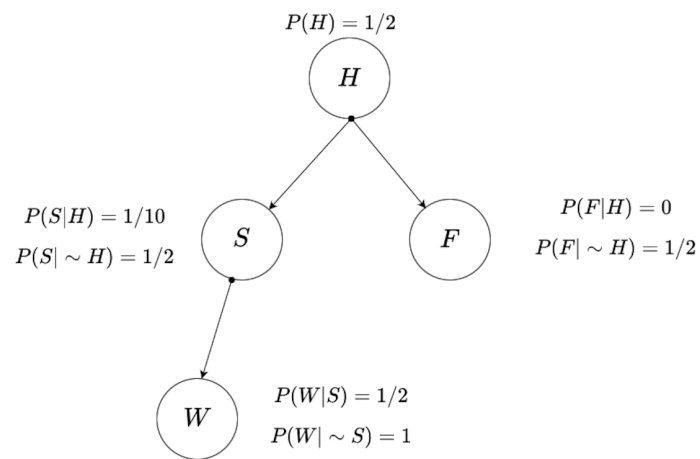
- In a Bayesian network, a direct edge from A to B indicates a causal and effect relationship between A and B. (True / False)
- A joint density has a unique Bayesian network representation. (True / False)
- Given a Bayesian network (structure and conditional probability tables), we can quantify any probability of interest within the defined model. (True / False)
- When A and B are conditionally independent given C, we can say A and B do not have a direct causal and effect relationship. (True / False)
- In EM algorithm, the parameters updated at each iteration are guaranteed to monotonically increase the log-likelihood of the observed data. (True / False)
- By using GMM and EM algorithm, we can solve a clustering problem. (True / False)
- K-means guarantees monotonically increase the log-likelihood of the observed data. (True / False)
- Gibbs sampling generates i.i.d (independent identically distributed) data samples. (True / False).

1. Choose all true statements.



- ① $T \perp\!\!\!\perp D$
- ② $T \perp\!\!\!\perp D | R$
- ③ $T \perp\!\!\!\perp D | R, S$
- ④ $T \perp\!\!\!\perp D | K$
- ⑤ $R \perp\!\!\!\perp S$
- ⑥ $R \perp\!\!\!\perp S | T$
- ⑦ $R \perp\!\!\!\perp S | D$
- ⑧ $R \perp\!\!\!\perp S | T, D$
- ⑨ $K \perp\!\!\!\perp H | S$

2. Given the following Bayesian network what is $P(S+ | H+, W+)$?



** hint: use the fact that H and W are the Markov Blanket of S .

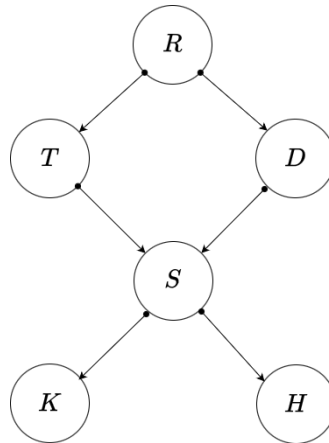
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0. True / False Questions.

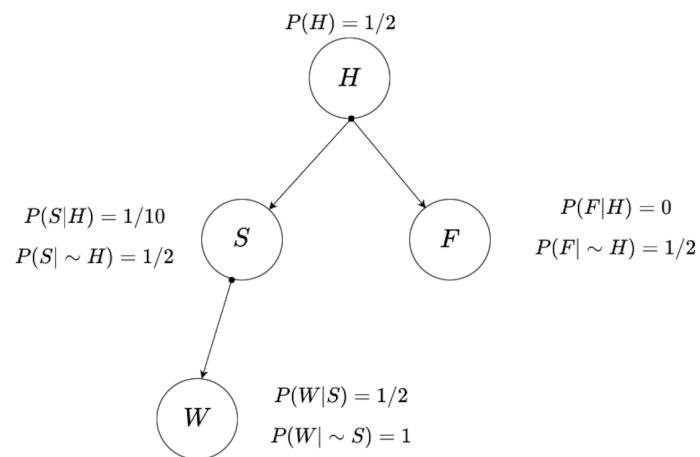
- In a Bayesian network, a direct edge from A to B indicates a causal and effect relationship between A and B. (True / **False**)
- A joint density has a unique Bayesian network representation. (True / **False**)
- Given a Bayesian network (structure and conditional probability tables), we can quantify any probability of interest within the defined model. (**True** / False)
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- Gibbs sampling generates i.i.d (independent identically distributed) data samples. (True / **False**).

1. Choose all true statements.



- ① $T \perp\!\!\!\perp D$ (no)
- ② $T \perp\!\!\!\perp D | R$ (yes)
- ③ $T \perp\!\!\!\perp D | R, S$ (no)
- ④ $T \perp\!\!\!\perp D | K$ (no)
- ⑤ $R \perp\!\!\!\perp S$ (no)
- ⑥ $R \perp\!\!\!\perp S | T$ (no)
- ⑦ $R \perp\!\!\!\perp S | D$ (no)
- ⑧ $R \perp\!\!\!\perp S | T, D$ (yes)
- ⑨ $K \perp\!\!\!\perp H | S$ (yes)

2. Given the following Bayesian network what is $P(S+ | H+, W+)$?



** hint: use the fact that H and W are the Markov Blanket of S .

$$\begin{aligned}
 P(S|H+, W+) &= \alpha P[S|H+] \cdot P[W+ | S] \\
 &= \alpha \begin{bmatrix} 1/10 \\ 9/10 \end{bmatrix} \cdot \begin{bmatrix} 1/2 \\ 1 \end{bmatrix} = \alpha \cdot \begin{bmatrix} 1/20 \\ 9/10 \end{bmatrix}
 \end{aligned}$$

$$\alpha \cdot 19/20 = 1$$

$$\alpha = 20/19$$

$$P(S|H+, W+) = \begin{bmatrix} 1/19 \\ 19/19 \end{bmatrix}$$