Name ____ Email _______________________

CS540-1 F17 midterm. Circle ONE answer per question.

1. A traffic light repeats the following cycle: green 8 seconds, yellow 4 seconds, and red 4 seconds. A driver saw yellow at a random moment. What is the probability that one second later the light became red?
(A) 1/3 (B) 1/2 (C) 1/4 (D) 3/4 (E) none of the above

C. For three whole seconds in yellow, the color one second later is still yellow. For the duration of the last second in yellow, one second later will be red. Thus 1/4.

2. Let $A \in \{1, 2, 3, 4\}$ and $B \in \{1, 2, 3\}$. To fully specify $P(B \mid A)$ how many numbers are needed?
(A) 7 (B) 8 (C) 9 (D) 12 (E) none of the above

B. For a fixed A, we need two numbers (the third value of B is given by normalization). Thus 4*(3-1)=8.

3. Consider a game board consisting of two bits initially at 00. Each player can simultaneously flip 1 or 2 bits in a move, but needs to pay the other player one dollar for each bit flipped. The player who achieves 11 wins and collects 10 dollars from the other player. What is the game theoretic value of this game for the first player?
(A) 8 (B) 10 (C) -8 (D) -10 (E) none of the above

A. Draw the game tree. It is clear that the first player should immediately flip both bits and force a win, at a cost of 2 dollars but wins 10 dollars. Thus 10-2=8.

4. Consider a search tree where the root is at depth 1, each internal node has k children, and all leaves are at depth D. There is a single goal state at depth $d < D$. How much stack space (in number of states) is sufficient so Depth First Search always succeeds?
(A) d (B) D (C) dk (D) Dk (E) none of the above

D. DK is enough, since DFS needs to push $k - 1$ siblings at each depth, and there are only D levels.

5. What is the advantage of iterative deepening compared to plain Depth First Search?
(A) may find a better goal (B) may need less space (C) may terminate earlier
(D) all of the above (E) none of the above

D. It can find a shallower goal than DFS, doesn't chase down deep (infinite) branches.

6. B is the Boolean whether you have the bird flu or not. H is the Boolean whether you have a headache or not. Let $P(H = 1) = 1/10$, $P(B = 1) = 1/1000$, $P(H = 0 \mid B = 1) = 1/2$. Given that you have the bird flu, what is the probability that you have a headache?
(A) 1/10 (B) 1/1000 (C) 1/2 (D) $\frac{\frac{1}{2} * \frac{1}{1000}}{\frac{1}{10}}$ (E) none of the above

C. This is $P(H = 1 \mid B = 1) = 1 - P(H = 0 \mid B = 1) = 1/2$.

7. In a corpus with n word tokens, the phrase "san francisco" appeared m times. If we estimate probability by frequency (the maximum likelihood estimate), what is the estimated probability $\hat{P}(\text{francisco} \mid \text{san})$?
(A) $\frac{m}{n}$ (B) $\frac{1}{m}$ (C) $\frac{1}{n}$ (D) $\frac{m+1}{n+v}$ where v is the vocabulary size (E) none of the above

E. We don't have enough information. We need to know how many times "san" appears in the corpus.

8. Consider a state space where the states are all positive integers. State i has two neighbors $i-1$ and $i+1$ (except for $i=1$ which only has one neighbor $i=2$). State i has score $\frac{(-1)^i}{i}$. If one runs the hill climbing algorithm, how many initial states can reach the global maximum?
(A) 0 (B) 1 (C) 2 (D) 3 (E) none of the above

D. The scores for states 1,2,3,... are -1, 1/2, -1/3, 1/4, ... The only states that can reach the global maximum 1/2 is 1,2,3.

9. Which of the following is possible?
(A) $P(a \mid b) = P(b)$ (B) $P(a) = P(a, b)$ (C) $P(a) + P(b) = P(a, b)$
(D) all of the above (E) none of the above

D. $P(a \mid b) = P(b)$ can happen in many cases, e.g. when both are independent fair coins. $P(a) = P(a, b)$ if b is an event that is always true. $P(a) + P(b) = P(a, b)$ if both are impossible events.

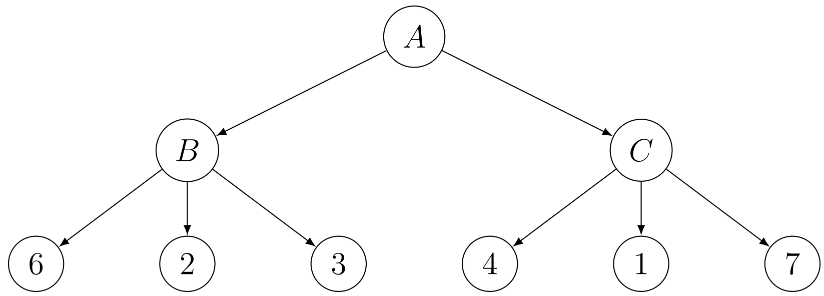
10. If h is an admissible heuristic, which of the following can NEVER be admissible?
(A) $h+1$ (B) $\sqrt{h}$ (C) $2h$ (D) $h-1$ (E) they all can be admissible under some situations

(A/D/E). These either increases or decreases h, but if h is comfortably in between 0 and h*, it still can be admissible for all states except the goal. However, it is correctly pointed out that A and D would not be admissible at the goal node. We will accept any combination of A, D, E.

11. In simulated annealing we move from s to an inferior neighbor t with probability $\exp\left(-\frac{|f(s)-f(t)|}{T}\right)$ where T is the temperature. What is the probability we stay at s instead of moving to t?
(A) $\exp\left(-\frac{|f(t)-f(s)|}{T}\right)$ (B) $\exp\left(\frac{|f(s)-f(t)|}{T}\right)$ (C) $\exp\left(1-\frac{|f(s)-f(t)|}{T}\right)$ (D) $1-\exp\left(-\frac{|f(s)-f(t)|}{T}\right)$ (E) none of the above

D. It is just normalization.

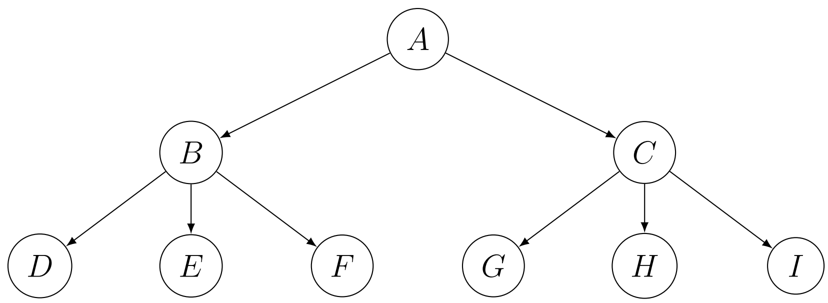
12. Which nodes are pruned by alpha-beta pruning? The max player moves first.



(A) 4,1,7 (B) 1,7 (C) 7 (D) C,4,1,7 (E) none of the above

C. Run alpha-beta. It will prune 7 after seeing 1.

13. Which order of goal check is impossible with Breadth First Search, without specifying the order of successors when putting them in the queue?



(A) H before A (B) B before G (C) I before D
(D) all of the above (E) none of the above

A. For BFS we will always goal-check and expend a parent level before child level. So a grandchild H cannot be goal-checked before the root.