CS-171, Intro to A.I., Fall Quarter, 2018—Quiz # 2—20 minutes

NAME: _____ UCI NetID: _____

YOUR ID: _____ ID TO RIGHT: _____ ROW: _____ SEAT: _____

1. (10 pts total) Probability. Use the definition of conditional probability to show that P(a | b ∧ a) = 1. **Show your work!**

P(a | b ∧ a) = P(a ∧ b ∧ a) / P(b ∧ a) = P(b ∧ a) / P(b ∧ a) = 1 **R&N Ex. 13.1, p. 506**

2. (10 pts total) Bayes'Rule. Write down the expression that results from applying Bayes' Rule to P(H | D).

P(H | D) = P(D | H) P(H) / P(D)

3. (10 pts total) P(H ∧ D) [1]. Write down the expression for P(H ∧ D) in terms of P(H), P(D), and P(H ∨ D).

P(H ∧ D) = P(H) + P(D) − P(H ∨ D) **Class HW Ch. 13, 1b-d**

4. (10 pts total) P(H ∧ D) [2]. Write down the expression for P(H ∧ D) in terms of P(D) and P(H | D).

P(H ∧ D) = P(H | D) P(D)

5. (30 pts total, 10 pts each) Consider the following joint distribution (R&N Fig. 13.3; t = *toothache*, d = *dental pick catches*, c = *cavity*). An arithmetic expression contains only numbers, parentheses, and +, –, *, and /.
Write an arithmetic expression for each of the following expressions.

	t		¬t	
	d	¬d	d	¬d
c	0.108	0.012	0.072	0.008
¬c	0.016	0.064	0.144	0.576

5.a. (10 pts) P(t ∧ ¬d ∧ c) = 0.012

5.b. (10 pts) P(¬t ∨ ¬c) = 0.072 + 0.008 + 0.144 + 0.576 + 0.016 + 0.064

5.c. (10 pts) P(c | t ∧ d) = 0.108 / (0.108 + 0.016)

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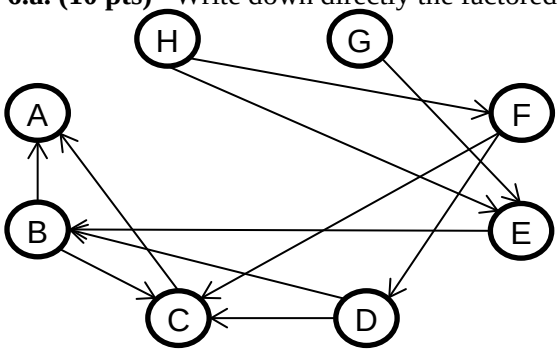
6. (30 pts total, 10 pts each) BAYESIAN NETWORKS.

6.a. (10 pts) Write down directly the factored conditional probability expression corresponding to this network:

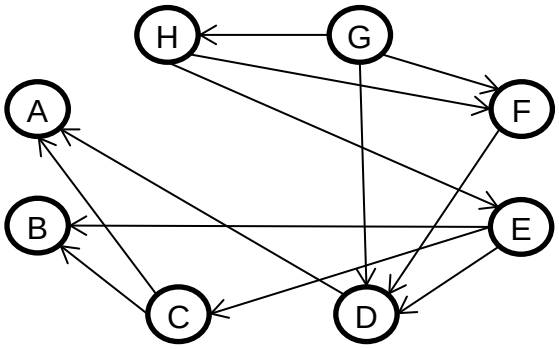


See Section 14.1-4.

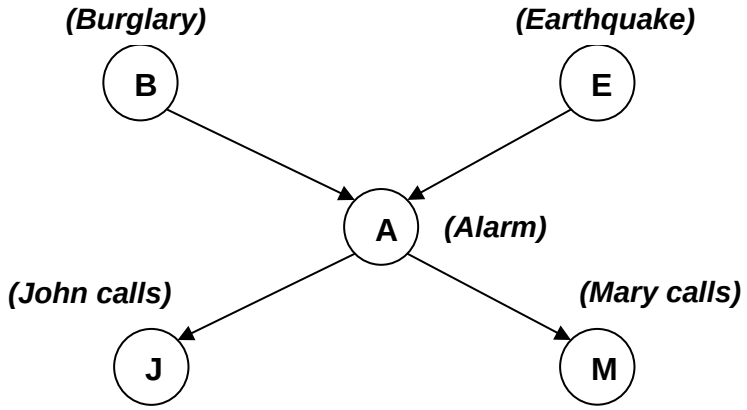
P(A | B, C) P(B | D, E) P(C | B, D, F) P(D | F) P(E | G, H) P(F | H) P(G) P(H)

6.b. (10 pts) Draw the Bayesian Network corresponding to this factored conditional probability expression:

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



6.c. (10 pts) Shown below is the Bayesian network corresponding to the Burglar Alarm problem, i.e., P(J,M,A,B,E) = P(J | A) P(M | A) P(A | B, E) P(B) P(E). This is Fig. 14.2 in your R&N textbook.



P(B)
.001

P(E)
.002

B	E	P(A)
t	t	.95
t	f	.94
f	t	.29
f	f	.001

A	P(J)
t	.90
f	.05

A	P(M)
t	.70
f	.01

Write down an expression that will evaluate to P(J=f ∧ M=t ∧ A=t ∧ B=t ∧ E=f). **Express your answer as a series of numbers (numerical probabilities) separated by multiplication symbols.** You do not need to carry out the multiplication to produce a single number (probability). **SHOW YOUR WORK, first as the symbolic conditional probabilities from the graphs, then as the corresponding numeric probabilities from the tables above.**

P(J=f ∧ M=t ∧ A=t ∧ B=t ∧ E=f)

[put symbolic here] = P(J=f | A=t) * P(M=t | A=t) * P(A=t | B=t ∧ E=f) * P(B=t) * P(E=f)

[put numeric here] = .10 * .70 * .94 * .001 * .998

Note:
P(E=f) = [1 – P(E=t)] = [1 – .002)] = .998
P(J=f | A=t) = [1 – P(J=t | A=t)] = .10