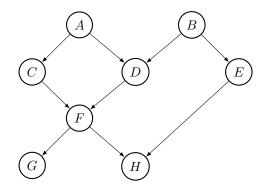
## $\operatorname{CS}$ 161: Fundamentals of Artificial Intelligence

Winter 2021– Assignment 6

## Questions



					B	E	$\Pr(E B)$
A	$\Pr(A)$	B	$\Pr(B)$	_	1	1	.1
1 0	.2	1	.7		1	0	.9
0	.8	0	.3		0	1	.9
	•		'		0	0	.1

A	B	D	$\Pr(D AB)$
1	1	1	.5
1	1	0	.5
1	0	1	.6
1	0	0	.4
0	1	1	.1
0	1	0	.9
0	0	1	.8
0	0	0	.2

Figure 1: A Bayesian network with some of its Conditional Probability Table (CPT)s.

## 1. Consider the Bayesian network in Figure 1:

- (a) List the Markovian assumptions (also known as topological semantics) encoded in the Bayesian network structure.
- **(b)** Provide the Markov blanket for variable *D*.
- (c) Express Pr(A, B, C, D, E, F, G, H) as a multiplication of conditional and marginal probabilities, using the chain rule for Bayesian networks.
- (d) Derive Pr(E, F, G, H) from the result of Pr(A, B, C, D, E, F, G, H) computed above. Express it using factors.
- (e) Multiply the factors (tables) of Pr(D|AB) and Pr(E|B). Show the new factor.
- (f) Sum out D from the factor computed above. Show the new factor.
- (g) Express  $Pr(a, \neg b, c, d, \neg e, f, \neg g, h)$  in terms of the parameters in the Conditional Probability Table(CPT)s in Figure 1 (here a denotes A = 1 and  $\neg a$  denotes A = 0). Use placeholder symbols for the parameters that are not shown in the CPTs.
- **(h)** Compute  $Pr(\neg a, b)$ .
- (i) Compute  $Pr(\neg e \mid a)$ .

## 2. Consider the following sentences:

- i. John likes all kinds of food.
- ii. Apples are food.
- iii. Chicken is food.
- iv. Anything anyone eats and isn't made sick by is food.
- v. If you are made sick by something, you are not well.
- vi. Bill eats peanuts and is well.
- vii. Sue eats everything Bill eats.

Translate the above sentences(i to vii) into formulas in first-order logic [use different variables each time when quantifying].

For first-order syntax, feel free to use the following text file notation: | (for disjunction), & (for conjunction), - (for negation), => (for implication), <=> (for equivalence), E (for existential quantification, e.g., E x, y, Loves(x, y)), and A (for universal quantification, e.g., A x, y, Loves(x, y)).