

Henzi Kou

CIS 471: Introduction to Artificial Intelligence

Prof. Thanh H. Nguyen

27 November 2019

## Homework 4

### 1. Probability

- i.  $P(X_0 = 1, X_1 = 0, X_2 = 1) = 0.200$
- ii.  $P(X_0 = 0, X_1 = 1) = 0.240$
- iii.  $P(X_2 = 0) = 0.420$
- iv.  $P(X_1 = 0 \mid X_0 = 1) = 0.714$
- v.  $P(X_0 = 1, X_1 = 0 \mid X_2 = 1) = 0.345$
- vi.  $P(X_0 = 1 \mid X_1 = 0, X_2 = 1) = 0.526$

### 2. Bayes Nets and Probability

- i.  $P(g, a, b, s) = P(g)P(a, g)P(b)P(s|a, b) = (0.10)(1.00)(0.40)(1.00) = 0.04$
- ii.  $P(a) = P(a|g)P(g) + P(a|\neg g)P(\neg g) = (1.0)(0.1) + (0.9)(0.1) = 0.19$
- iii. 
$$P(a|s, b) = \frac{P(a, s, b)}{P(a, s, b) + P(\neg a, s, b)} = \frac{P(a)P(b)P(s|a, b)}{P(a)P(b)P(s|a, b) + P(\neg a)P(b)P(s|\neg a, b)}$$
$$= \frac{(0.19)(0.4)(1.0)}{(0.19)(0.4)(1.0) + (0.81)(0.4)(0.8)} \approx 0.2267$$
- iv. 
$$P(g \mid a) = \frac{P(g)P(a \mid g)}{P(g)P(a \mid g) + P(\neg g)P(a \mid \neg g)} = \frac{(0.1)}{(0.1) + (0.09)} = 0.5263$$
- v.  $P(g \mid b) = P(g) = 0.1$

### 3. Bayes Nets: Independence

- i. B
- ii. Both A and B are consistent with the two hypotheses given
- iii. A

### 4. Bayes Nets: D-Separation

- i. False
- ii. False
- iii. True
- iv. True
- v. False

vi. True

**5. Bayes Nets: Variable Elimination**

- i.  $f_1(B = 0) = 0.41$   
 $f_1(B = 1) = 0.59$   
 $f_1(C = 0, D = 0) = 0.2577$   
 $f_1(C = 1, D = 0) = 0.5193$   
 $f_1(C = 0, e = 1) = 0.205$
- ii.  $P(C = 0 \mid e = 1) = 0.608$   
 $P(C = 1 \mid e = 1) = 0.392$

**6. Bayes Nets: Sampling**

- i. A: 0    B: 1    C: None    D: None    E: None  
*Rejected: B*
- ii. A: (A = 1, 0.249)    B: (B = 1, 0.8)    C: (C = 0, 0.052)    D: (D = 0, 0.299)  
E: (E = 1, 0.8)  
*Weight: 0.64*