COMS 4701: Artificial Intelligence

Homework 5 Sample Solutions

Problem 1

1. No independences. Information can flow "up" from any variable to 'Disease' or 'BirthAsphyxia', and then flow "down" to any other variable.

2. ('LVHreport', 'LVH'), ('GruntingReport', 'Grunting'), ('RUQO2', 'HypoxiaInO2'), ('CO2Report', 'CO2'), ('XrayReport', 'ChestXray')

3. 'Sick', 'Grunting', 'GruntingReport'. To access any other variables, information must flow upward from 'Age' to the common cause 'Disease' and then downward.

4. 'Grunting' or 'GruntingReport'. Observing either would activate a common effect and remove the associated collider.

Problem 2

1.

$$\begin{aligned}\Pr(S \mid ba) &\propto \sum_d \Pr(ba)\Pr(d \mid ba)\Pr(S \mid d) \propto \sum_d \Pr(d \mid ba)\Pr(S \mid d) \\ &= 0.2(0.4, 0.6) + 0.3(0.3, 0.7) + 0.25(0.2, 0.8) + 0.15(0.3, 0.7) + 0.05(0.7, 0.3) + 0.05(0.7, 0.3) \\ &= (0.335, 0.665)\end{aligned}$$

2.

$$\begin{aligned}\Pr(G \mid d, s) &\propto \sum_{lp} \Pr(d)\Pr(s \mid d)\Pr(lp \mid d)\Pr(G \mid s, lp) \propto \sum_{lp} \Pr(lp \mid d)\Pr(G \mid s, lp) \\ &= 0.6(0.2, 0.8) + 0.1(0.4, 0.6) + 0.3(0.8, 0.2) \\ &= (0.4, 0.6)\end{aligned}$$

3.

$$\begin{aligned}\Pr(GR \mid d, s) &\propto \sum_g \Pr(g \mid d, s)\Pr(GR \mid g) \\ &= 0.4(0.8, 0.2) + 0.6(0.1, 0.9) \\ &= (0.38, 0.62)\end{aligned}$$