HW07: More Bayes' Net *

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1 D-Separation

(a) AV and SL are **not independent**.

(b) AA and FP are **independent**.

(c) U and BB are **independent**.

(d) SL and BB are **not independent**.

1. Assuming no evidence is given, nothing changes. **Not independent**.

2. SL is a sink that connects AA and FP. **Not independent**.

3. AA would actually "block" the dependence. **Independent**.

4. FP actually "blocks" the dependence. **Independent**.

2 Variable Elimination

The joint distribution is represented by $P(a, b, c, d, e, f) = P(A)P(B|A)P(C|A)P(D|B)P(E|B)P(F|C)$. One way to think of our factored representation is as

$$P(a, b, c, d, e, f) = \alpha P(A) \sum_{b \in B} P(B|A) \sum_{c \in C} P(C|A) \sum_{d \in D, e \in E} P(D|B)P(E|B) \sum_{f \in F} P(F|C) \tag{1}$$

Note that each of these factorized summations ends up being 1, *i.e.*, $\sum_{f \in F} P(F|C) = 1$ if we know all of f. So summing out the variables that we don't care about trivially gives us:

$$P(C|D =\sim d, f = f) = \alpha P(C|A)P(\sim d|B)P(f|C) \tag{2}$$

Substituting in the values with pointwise product and normalizing the result gives us the final term of our exact-inference variable elimination: $P(C|F = f, D =\sim d) = 0.6943$.

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3 Sampling

1. Of the $N = 20$ samples generated, there are 10 for which is is true that $S = s$. Of these there are 3 for which it is true that $A = a$, and 7 for which it is true that $A =\sim a$.

Having generated and rejected these samples, we must now normalize these counts. Normalizing them gives us $P(A = a|S = s) = \frac{3}{7+3} = 0.3$.

2. The number of rejected samples, straightforwardly, is the number of samples for which it is *not* true that $S = s$. In other words, it is quite literally: $P(S =\sim s)$.