02-711: Computational Molecular Biology and Genomics
Quiz # 2

January 28, 2009

Name:

You have 15 minutes to complete the quiz. The quiz is closed book. You may use a calculator to do numerical computations. If there are any questions, clarifications, or errors, feel free to talk to the instructor or TA. Please make sure you write your name on the quiz.

One day, you attended a seminar given by Professor Su-In Lee about Drosophila. In her talk, you learned there were some interesting relationships between Alzheimer's (Yes/No) and Huntington's disease (Yes/No) with the eye color (Red/Blue), wing shape (Curly/Flat), and bristle type (Tufted/Non-Tufted) and you decided to model a Bayesian network from the information you learned. Below are some of the facts you learned from the talk.

1. If a fly has Alzheimer's but not Huntington's disease, the chance of seeing a blue-eyed flies is 0.2. Chance of seeing a red-eyed fly among the ones with Huntington's but not Alzheimer's diseases is 0.75. There are 30% chance of seeing blue-eyed among healthy flies and 60% chance of seeing blue-eyed flies among flies with both diseases.
2. Among all the flies with Alzheimer's disease, 85% of them have curly wing while only 45% of the flies with no Alzheimer's disease have curly wing.
3. 20% of the blue-eyed and curly-winged flies have tufted bristle; 50% of the red-eyed and curly-winged flies have tufted bristle; 70% of the blue-eyed and flat-winged flies have tufted bristle; and 10% of the red-eyed and flat-winged flies have tufted bristle.
4. 60% of flies have Alzheimer's disease.
5. 30% of flies have Huntington's disease.

Suppose H:Huntington's disease, A:Alzheimer's disease, C:Eye Color, S:Wing Shape, and B:Bristle type, you came up with a Bayesian network shown in Figure 1 given the above information.

1 Joint Probabilistic Distribution [10 pts]

(a) Draw the CPDs for each variable in the Bayesian network (Figure 1).

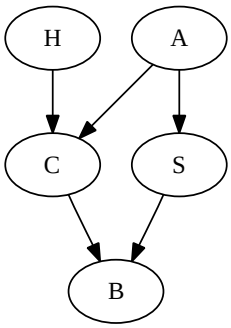

Figure 1: Bayesian network for the fly problem

(b) Write out the joint probability distribution of the Bayesian network. (e.g. $P(H, A, C, S, B)$).

(c) Compute $P(H = \text{Yes}, A = \text{Yes}, C = \text{Red}, S = \text{Curly}, B = \text{Yes})$.

(d) Compute $P(H = \text{No}, A = \text{Yes}, C = \text{Red}, S = \text{Curly}, B = \text{Yes})$.

(e) Compute $P(H = \text{Yes}|A = \text{Yes}, C = \text{Red}, S = \text{Curly}, B = \text{Yes})$.

2 Independence Assumption [5 pts]

Given the Bayesian network in Figure 1, list all the independence assumptions. (Hint: There's at least 3 independence assumptions).