

02-711: Computational Molecular Biology and Genomics

Quiz # 3

February 4, 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.

1 Maximum Likelihood Estimate [15 pts]

Suppose you are a graduate student studying the relationship of Huntington's disease and jerky movement in *Drosophila*. You know that the Huntington's disease will most likely lead to jerky movement in *Drosophila* but does not know the exact probabilities. You decided to build a Bayesian network shown in Figure 1 and learn the parameters from data. You collected the following data (Table 1).

Table 1: Data collected from your experiment

$\langle H[1] = 1, J[1] = 1 \rangle$	$\langle H[2] = 1, J[2] = 1 \rangle$	$\langle H[3] = 0, J[1] = 1 \rangle$
$\langle H[4] = 1, J[1] = 0 \rangle$	$\langle H[5] = 0, J[5] = 0 \rangle$	$\langle H[6] = 0, J[6] = 1 \rangle$
$\langle H[7] = 0, J[7] = 0 \rangle$	$\langle H[8] = 1, J[8] = 1 \rangle$	$\langle H[9] = 1, J[9] = 0 \rangle$
$\langle H[10] = 0, J[10] = 1 \rangle$	$\langle H[11] = 0, J[11] = 0 \rangle$	$\langle H[12] = 0, J[12] = 0 \rangle$
$\langle H[13] = 1, J[13] = 1 \rangle$	$\langle H[14] = 1, J[14] = 0 \rangle$	$\langle H[15] = 0, J[12] = 0 \rangle$

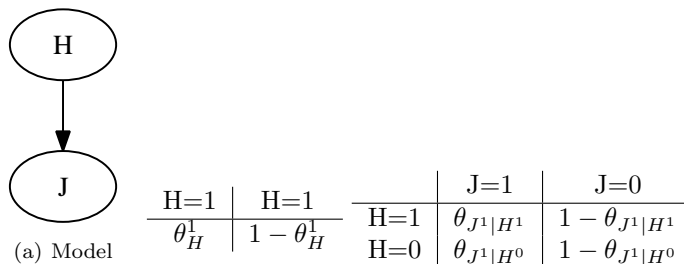


Figure 1: Graphical model representing relationship between Huntington's disease and jerky movements in flies

(a) What are the parameters?

- (b) Write the log likelihood function for the Bayesian network.

$$\log \mathcal{L}(\theta; D) = \log P(D|\theta) =$$

- (c) What is the derivative of the log likelihood function with respect to parameter of Huntington's disease?

$$\frac{\partial}{\partial \theta_{H^1}} \log \mathcal{L}(\theta; D) =$$

- (d) Solve the equation above to find the MLE of θ_{H^1} .

- (e) What is the derivative of the log likelihood function with respect to parameter of jerky movement given the fly has Huntington's disease?

$$\frac{\partial}{\partial \theta_{J^1|H^1}} \log \mathcal{L}(\theta; D) =$$

- (f) Solve the equation above to find the MLE of $\theta_{J^1|H^1}$.