CS4786/5786: Machine Learning for Data Science, Spring 2015
4/21/2015: Lecture 22 handout: More intuition on Bayesian Networks

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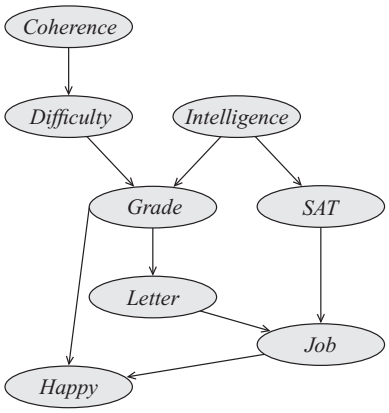
Announcements

1. [wiki diffs demo?]
2. Competition 1 grading will emphasize the contents of the writeup, not raw accuracy per se on either challenge. But in terms of expected accuracy: if you hit around 80% accuracy on challenge 1 in ways that demonstrate your understanding of the course content, we will be happy.
3. The guest lecture by Lars Backstrom, Director of Newsfeed Ranking and Infrastructure at Facebook, is scheduled for 5-6pm on Sunday the 26th, tentative location G01 Gates Hall. His preference is that the talk not be recorded; we will, however, do our best to take notes. The Sunday lecture replaces the usual lecture on Tuesday the 28th.

Today's goals (1) Running example for more intuition in general Bayes Nets; (2) Variable elimination on leaves and roots: why trees like Hidden Markov Models (HMMs) are nice; (3) Preparation for more HMM material in next lecture

I. Running example: Figure 9.8 of Daphne Koller and Nir Friedman's 2009 book *Probabilistic Graphical Models: Principles and Techniques* . Ignore the shading.



We'll henceforth use C, D, I, etc. to stand for the variables *Coherence*, *Difficulty*, *Intelligence*, etc.

(1) $$P(C,D,I,G,S,L,J,H) = P(C)P(I)P(D|C)P(G|D,I)P(S|I)P(L|G)P(J|L,S)P(H|G,J)$$

II. Clicker question Which of the following are true?

(A) G is independent of S

(B) G is conditionally independent of S given I

(C) S is conditionally independent of L given J

(D) more than one is true

III. Clicker question Which of the following are true?

(A) The value of $P(D = d|C = c)$ is given directly by the Bayes Net and its conditional prob. tables

(B) The value of $P(D = d)$ is given directly by the Bayes Net and its conditional prob. tables

(C) The value of $P(D = d)$ needs to be computed by summing values in the conditional prob. tables

(D) The statement (B) is false but (A) and (C) are true

(E) The statement (C) is false but (A) and (B) are true

IV. Clicker question What happens if you try to marginalize out (eliminate the variable) H, which is a leaf, from equation 1?

(A) It disappears entirely

(B) It shows up as a subscript of an m term

(C) It shows up as an argument in some conditional or marginal probability

V. Clicker question What happens if you try to marginalize out (eliminate the variable) C, which is parentless and has only one child, from equation 1?

(A) It disappears entirely

(B) It shows up as a subscript of an m term

(C) It shows up as an argument in some conditional or marginal probability

VI. Clicker question What happens if you try to marginalize out (eliminate the variable) I, which is parentless and has multiple children, from equation 1?

(A) It disappears entirely

(B) It shows up as a subscript of an m term

(C) It shows up as an argument in some conditional or marginal probability

VII. Small HMM