EECS 391 Introduction to Artificial Intelligence
Fall 2017, Written Assignment 4 (“W4”)

Due: Tue Nov 7 in class

Total Points: 100

Remember: name and case ID, stapled, answers concise, neat, and legible. Submit in class on the due date.

Q1. R&N Q13.16 (10 P.)

It is quite often useful to consider the effect of some specific propositions in the context of some general background evidence (or information) that remains fixed, rather than in the complete absense of information. The following questions ask you to prove more general versions of the product rule and Bayes’ rule, with respect to some background evidence **e**:

a) Prove the conditionalized version of the general product rule:

$$P(X, Y|\mathbf{e}) = P(X|Y, \mathbf{e})P(Y|\mathbf{e}) \tag{1}$$

b) Prove the conditionalized version of Bayes’ rule in Equation (13.13).

Q2. R&N Q14.6 (20 P.)

Q3. R&N Q14.14 (25 P.)

Q4. R&N Q14.1 (25 P.) We have a bag of three biased coins a, b, and c with probabilities of coming up heads of 20%, 60%, and 80% respectively. One coin is drawn randomly from the bag (with equal likelihood of drawing each of the three coins), and then the coin is flipped three times to generate the outcomes X_1, X_2, and X_3.

a) Draw the Bayesian network corresponding to this setup and define the necessary CPTs.

b) Caculate which coin was most likely to have been drawn from the bag if the observed flips come out heads twice and tails once.

Q5. R&N Q14.21 a-c Three soccer teams A, B, and C, play each other once. Each match is between two teams, and can be won, drawn, or lost. Each team has a fixed, unknown degree of quality - an integer ranging from 0 to 3 - and the outcome of a match depends on probabilistically on the difference in quality between the two teams.

a) Construct a relational (or probabilistic) model to describe this domain, and suggest numerical values for all the necessary probability distributions. 5 P.

b) Construct an equivalent Bayesian network to describe this domain. 5 P.

c) Suppose that in the first two matches A beats B and draws with C. Using an exact inference algorithm of your choice, compute the posterior distribution for the outcome of the third. 10 P.