CS 8750: Artificial Intelligence II

Spring 2015

Programming assignment #3 (12 points)

1. **Problem description**

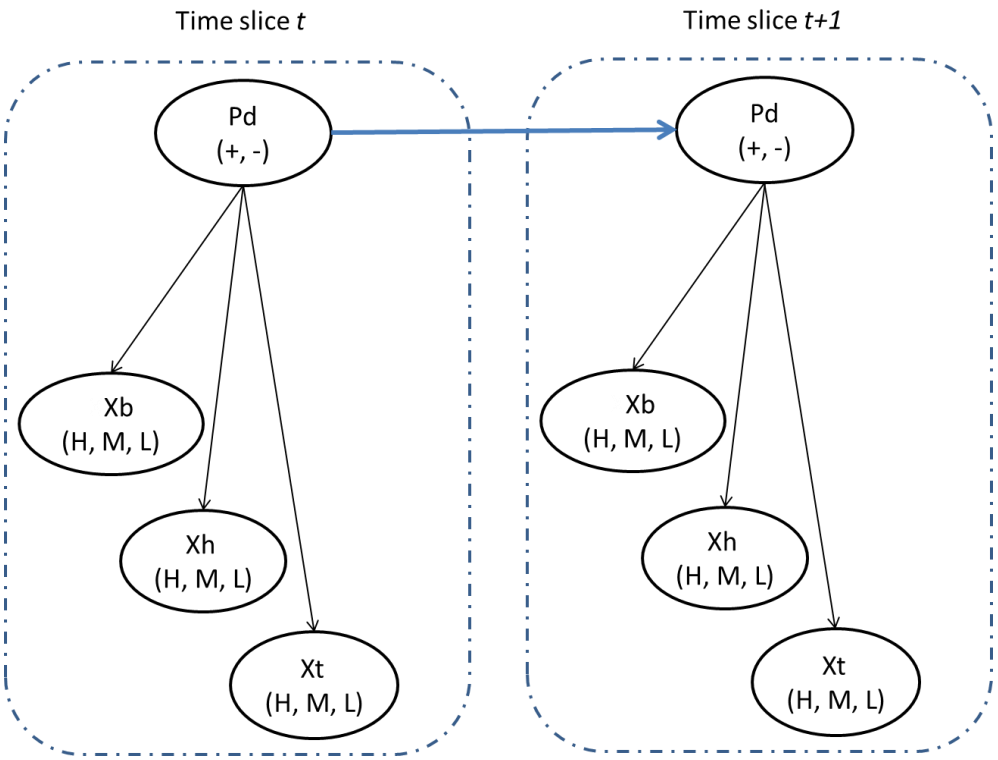
For this assignment, you may form teams with up to 3 members. Only one submission is required for each team.

This assignment focuses on learning with incomplete data and working with temporal models. You are required to implement two temporal Bayesian networks to answer questions of a person had a drink or not, given evidence of breathing rate, heart rate, skin temperature, and optionally ambulation status. You may use any programming language.

The structures and variables of the 2-time-slice temporal Bayesian networks (2TBNs) are as follows. A training dataset, 1001-b, and a test dataset, 1004-b, are provided, in which the 1st column is Xb, 2nd Xh, 3rd Xt, 4th Xa, and 5th Pd. For Xa, stationary is 1, slow is 2, and fast is 3. For Pd, + is 1 and - is 0. Both datasets contain examples with missing values. The test dataset has no value of Pd.

One set of parameters (CPDs) are to be learned from the training dataset for each BN.

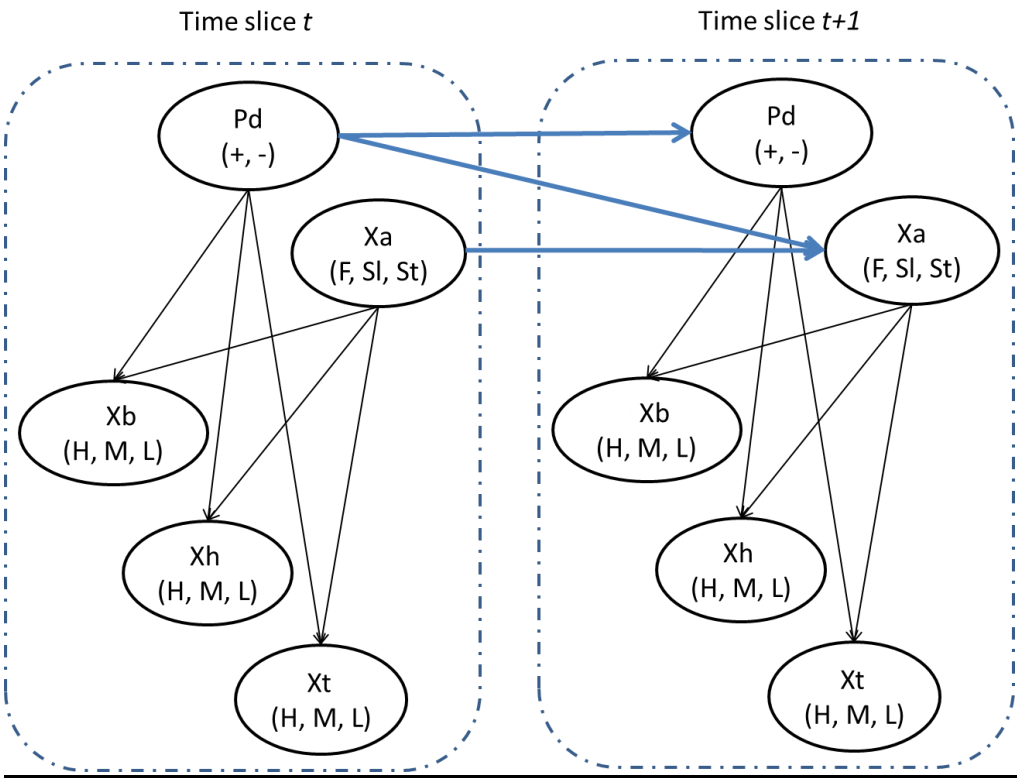
a) BN#1:



- Pd: drink or not. Domain {+, -}
- Xb: breathing rate. Domain {H, M, L}
- Xh: heart rate. Domain {H, M, L}
- Xt: skin temperature. Domain {H, M, L}

The values of Xb, Xh, and Xt in the data files are real number. To discretize the real values of each attribute into H, M, and L, first calculate the mean, m, and std (standard deviation), d. Then, convert a value bigger than m+d to H, less than m-d to L, and the rest to M.

b) <u>BN#2:</u>



- Pd: drink or not. Domain {+, -}
- Xb: breathing rate. Domain {H, M, L}
- Xh: heart rate. Domain {H, M, L}
- Xt: skin temperature. Domain {H, M, L}
- Xa: ambulation status. Domain {Fast, Slow, Stationary}

Use the same method in BN#1 to discretize the real values of Xb, Xh, and Xt into H, M, and L.

2. Submission requirement

Your submission is required to have the following 3 parts:

1) (4 points) For each BN, the formulas of Maximum Likelihood to learn the

parameters from the given training data, your learning program code, and the actual parameters learned (outputs of your program).

2) (4 points) For each BN, the derivations of the formulas to predict Pd from Xb, Xh, Xt, and optionally Xa, your program code that implements the prediction.
3) (4 points) Run each BN on both datasets to predict Pd from Xb, Xh, Xt, and optionally Xa. Report its confusion matrix and prediction accuracy. There should be a total of 4 confusion matrices and 4 accuracy numbers.