

Assignment 3: Bayes Nets

CSC 384H—Fall 2015

Out: Nov 2nd, 2015

Due: Electronic Submission Tuesday Nov 17th, 7:00pm

Late assignments will not be accepted without medical excuse

Worth 10% of your final.

Be sure to include your name and student number as a comment in all submitted documents.

Handing in this Assignment

What to hand in on paper: No paper submission required.

What to hand in electronically: You must submit all your answers and code electronically. You must submit the following:

1. A file of python code called **bnet.py**. This file will contain your implementation of the factor functions and variable elimination.

To submit these files electronically, use the CDF secure Web site

<https://www.cdf.toronto.edu/students/>

or use the CDF **submit** command. Type **man submit** for more information. The name of the assignment for submit will be “A3”

Since we will test your code electronically, you must

- *make certain that your code runs on CDF using python3 (version 3.4.1 (installed as “python3” on CDF, note that “python” with no “3” invokes the wrong version of python).*
- not add any non-standard python imports from within the python files you submit (the imports that are already in the template files must remain).

Introduction

In this assignment you will implement variable elimination on Bayes Nets.

What is supplied. You will be supplied with python code implementing **Variable**, **Factor**, and **BN** objects. The file `bnet.py` contains the class definitions for these objects. The code supports representing factors as tables of values indexed by various settings of the variables in the factor’s scope.

The template file `bnet.py` also contains function prototypes for the functions you must implement.

Question 1. Implement Variable Elimination

Implement a collection of functions that operate on `Factor` objects and then use these functions to implement `VE` (variable elimination).

multiply_factors Take as input a list of `Factor` objects; create and return a new factor that is equal to the product of the factors in the list. Do not modify any of the input factors.

restrict_factor Take as input a single factor, a variable V and a value d from the domain of that variable; create and return a new factor that is the restriction of the input factor to the assignment $V = d$. Do not modify the input factor.

sum_out_variable Take as input a single factor, and a variable V ; create and return a new factor that is the result of summing V out of the input factor. Do not modify the input factor.

VE Take as input a Bayes Net object (object of class `BN`), a variable that is the query variable Q , and a list of variables E that are the evidence variables (all of which have had some value set as evidence using the variable’s `set_evidence` interface). Compute the probability of every possible assignment

to Q given the evidence specified by the evidence settings of the evidence variables. Return these probabilities as a list where every number corresponds the probability of one of Q 's possible values. Do not modify any factor of the input bayes net.