HOMEWORK ASSIGNMENT #6B

DUE: April 13, 2015
CSCI573: Probabilistic Reasoning, Prof. Nevatia
Spring Semester, 2015

This is the second part of assignment #6. Due date for this part is extended till April 13; due date for #6A remains April 8. This part consists of one problem only.

Consider a modified Hidden Markov Model where the state transition is a function of not just the previous state but of two previous states (except for the state at t= 1). Thus, we are given $P(\mathbf{X}^{(t+1)} | \mathbf{X}^{(t)}, \mathbf{X}^{(t-1)})$. Let the observation model still be a function of the current state only, i.e. we are given $P(\mathbf{O}^{(t)} | \mathbf{X}^{(t)})$. These two distributions, along with the initial distribution, $P(\mathbf{X}^{(0)})$ provide a complete parameterization for this model.

a) Show a clique-tree for this network that could be used to make inferences in the rolled-out network would like (as in Figure 15.1, but without the messages that are passed). You only need to show nodes up to some time period, say up to t =4.

b) Derive *recursive* equations for filtering for this model, *i.e.* equations for computing $\boldsymbol{\sigma}^{(t)}(\boldsymbol{X}^{(t)} | O^{(1:t)})$ in terms of beliefs at earlier time slices. It is reasonable to expect that these equations will be similar to equations (15.1) and (15.2) but a function of two earlier belief states. You may derive these equations using the clique-tree derived in part (a) above or directly by simplifying the probability distribution, following a procedure similar to that used to derive equations (15.1) and (15.2).