CECS 451
Assignment 5
Total: 40 Points

General Instruction

- Submit uncompressed file(s) in the Dropbox folder via Canvas (Not email).
- Use `Python 3`, any other programming language is not acceptable.
- You can import modules in the following list of libraries (please check the full list *here*). If you want to use any other library, please consult with the instructor.

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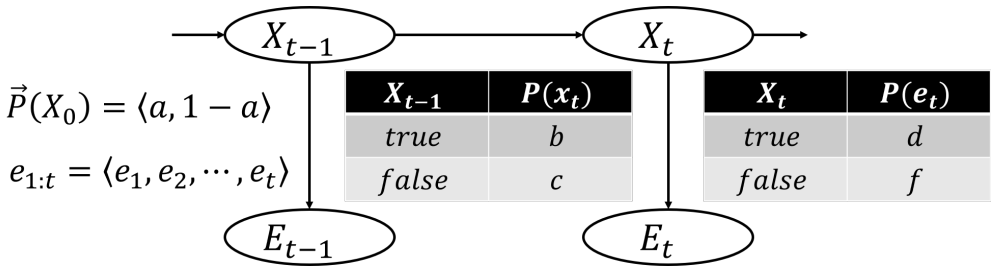
1. (40 points) Implement a `Python` program to perform filtering in a Hidden Markov Model (HMM) with the following specifications:
   (a) Assume that the hidden state variable and the evidence variable are binary.
   (b) The program should compute $\vec{P}(X_t|\vec{e}_{1:t})$ given $\vec{e}_{1:t}$.
   (c) The program accepts a text file as input, containing multiple lines.
   (d) Each line specifies values for independent variables $a, b, c, d, f, e_1, e_2, \cdots, e_t$ in Figure 1 in that order. For example,
   `0.5,0.7,0.3,0.9,0.2,t,t`
   means $a = 0.5, b = 0.7, c = 0.3, d = 0.9, f = 0.2, e_1 = t, e_2 = t$.



X_{t-1}	$P(x_t)$
true	*b*
false	*c*

X_t	$P(e_t)$
true	*d*
false	*f*

Figure 1: HMM of binary variables.

   (e) The program outputs the probability $\vec{P}(X_t|\vec{e}_{1:t})$. For example,
   `0.5,0.7,0.3,0.9,0.2,t,t--><0.8834,0.1166>`
   `0.5,0.7,0.3,0.9,0.2,t,t,f--><0.1907,0.8093>`
   The output should not contain white spaces within a line, and the probabilities should be formatted to four decimal places using `"{:.4f}".format()`
   (f) The program should be executable on Python 3 using the command:
   `> python hmm.py cpt.txt`
   The program should use `sys.argv` to handle input file names, allowing for different file names without hardcoding.

(g) Grading:

- The output format must match the example provided.
- No credit will be given if the program is not executable.
- The input file for grading will contain more lines.