CS6320, Spring 2019
Dr. Mithun Balakrishna
Homework 3
Due Sunday, March 10th, 2019 11:59pm

A. Submission Instructions:

- Submit your solutions via eLearning.
- Please submit a single zip file containing **ALL** the relevant homework solution files. The zip filename should follow the pattern "HW#_FirstnameLastname.zip" (Example: HW3_Claire Underwood.zip)
    - **Penalty of 5 points** if not followed
- For all non-programming questions:
    - Please include **ALL** the solutions in a **single** PDF/Doc/PS/Image file
    - The filename should follow the pattern "HW#_FirstnameLastname.FileExtension" (Example: HW3_Claire Underwood.pdf)
    - **Penalty of 5 points** if not followed
- For programming questions:
    - Write the programming solutions in C/C++, Java, or Python. For using any other programming language, please get prior approval from the TA.
    - Include a Readme file with instructions on how to build and run your programming question solution
        - Instructions should be very simple:
            - python bigram.py input_arguments

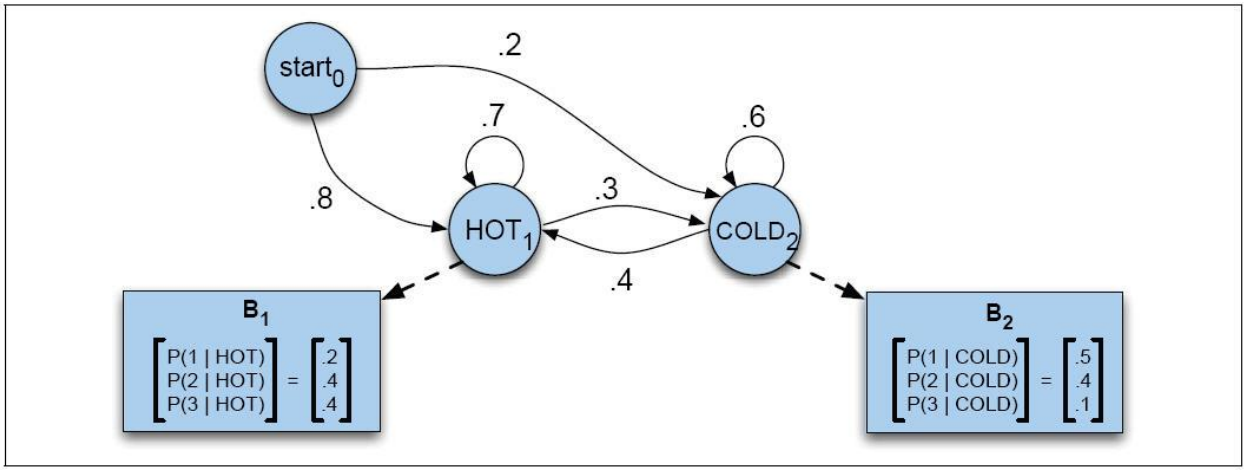
              OR

              python bigram.py (if the input arguments are hard coded)
        - Hard coding the input arguments to your program is fine unless the TA cannot run your code directly. Do **NOT** include instructions such as: "Please modify the path in my main function. Then copy the training data in the same folder."
        - Provide your training data together unless the dataset is too large.
        - **Penalty of 10 points** if not followed
    - Submit ALL your source code files
        - Do not write your solutions in the readme file
        - **Penalty of 10 points** if not followed
- Late Submission Penalty:
    - up to 2 hours late — 10% deduction
    - 2 - 4 hours late — 20% deduction
    - 4 - 12 hours late — 35% deduction
    - 12 - 24 hours late — 50% deduction
    - 24 - 48 hours late — 75% deduction
    - more than 48 hours late — 100% deduction (zero credit)

B. Problems:

1. HMM Decoding: Viterbi Algorithm (75 points):

For the HMM shown below, please perform the following:



a. **(25 points)** Manually build the Viterbi trellis to compute the most likely weather sequences for each of the two observation sequences, *331122313* and *331123312*.

b. **(50 points)** Programmatically implement the Viterbi algorithm to compute the most likely weather sequence and probability for any given observation sequence. Example observation sequences: *331, 122313, 331123312*, etc.

2. Maximum Entropy Modeling (25 points):

Consider the following Maximum Entropy features and weights:

$$f_1(c,x) = \begin{cases} 1 \text{ if } word_i = \text{"race"} \ \& \ c = \text{NN} \\ 0 \text{ otherwise} \end{cases}$$

$$f_2(c,x) = \begin{cases} 1 \text{ if } t_{i-1} = \text{TO } \ c = \text{VB} \\ 0 \text{ otherwise} \end{cases}$$

$$f_3(c,x) = \begin{cases} 1 \text{ if } t_{i-1} = \text{DT } \ c = \text{NN} \\ 0 \text{ otherwise} \end{cases}$$

$$f_4(c,x) = \begin{cases} 1 \text{ if is\_lower\_case}(word_i) = \text{"race"} \ \& \ c = \text{VB} \\ 0 \text{ otherwise} \end{cases}$$

$$f_5(c,x) = \begin{cases} 1 \text{ if } word_i = \text{"race"} \ \& \ c = \text{VB} \\ 0 \text{ otherwise} \end{cases}$$

$$f_6(c,x) = \begin{cases} 1 \text{ if } t_{i-1} = \text{TO} \ \& \ c = \text{NN} \\ 0 \text{ otherwise} \end{cases}$$

		Weights					
		f1	f2	f3	f4	f5	f6
Tags	VB	0	0.75	0	0.10	0.15	0
	NN	0.3	0	0.9	0	0	-0.2

Compute the best tag for the word "race" in the following sentences:

a. Secretariat/NNP is/VBZ expected/VBN to/TO **race**/?? tomorrow/NN

b. the/DT **race**/?? for/IN outer/JJ space/NN