

## EC4209 Artificial Intelligence

### Homework Assignment 2

Due Date:2021-06-01 (Tuesday)

For this homework assignment, you will need to implement four inference tasks on a Hidden Markov Model (HMM) : filtering, prediction, smoothing and computation of the most likely sequence( the viterbi algorithm). The hidden states of the HMM is denoted by  $X(t)$  and the observation (evidence) by  $E(t)$ . For instance, in the weather problem as shown in figure-1 ,  $X(t)$  would be either sunny, rainy, or foggy, and  $E(t)$  is yes or no to indicate if an umbrella was observed. We will use this model with prior probabilities  $P(\text{sunny}) = 0.5$ ,  $P(\text{rainy}) = 0.25$ ,  $P(\text{foggy}) = 0.25$ . The remaining probabilities you need are specified in the figure-1 . You will need to fill in the missing implementations of the following four functions in the included code along with probabilities in the code.

#### **Filtering:**

Given observation sequence  $E(0), E(1), \dots, E(T-1)$ , compute  $P(X(T-1)|E(0), \dots, E(T-1))$ .

#### **Prediction:**

Given observation sequence  $E(0), E(1), \dots, E(T-1)$ , compute  $P(X(T)|E(0), \dots, E(T-1))$ .

#### **Smoothing:**

Given observation sequence  $E(0), E(1), \dots, E(T-1)$ , compute  $P(X(k)|E(0), \dots, E(T-1))$  for  $0 \leq k \leq T-1$ .

#### **Viterbi algorithm:**

Given observation sequence  $E(0), E(1), \dots, E(T-1)$ , compute the most likely sequence of states:  $X(0), X(1), \dots, X(T-1)$

| Today's Weather | Tomorrow's Weather |       |       |       |
|-----------------|--------------------|-------|-------|-------|
|                 |                    | Sunny | Rainy | Foggy |
|                 | Sunny              | 0.8   | 0.05  | 0.15  |
|                 | Rainy              | 0.2   | 0.6   | 0.2   |
| Today's Weather | Foggy              | 0.2   | 0.3   | 0.5   |

| Probability of Umbrella |     |
|-------------------------|-----|
| Sunny                   | 0.1 |
| Rainy                   | 0.8 |
| Foggy                   | 0.3 |

Figure-1

To run your code on the weather data, use: `python hmm.py [weather] [data]`.

For example: `python hmm.py weather weather-test1-1000.txt` (to test weather model on weather-test1-1000.txt)

### **Collaboration policy**

You must code your own solution to the problem without using or looking at other students' code. You should not use any code you find online (except "reasonable", small, 5-line snippets that describe how to solve general programming tasks). You can use any other sources, books, websites to design your algorithm. You should cite any source you use.

### **Submission**

Submit all the python files along with pdf explaining each implementation of your code and output of your algorithm. Only answers in English are acceptable.

### **Data\_Files**

weather-test1-1000.txt

weather-test2-1000.txt

Your submission will be graded on additional test cases in this format.