DA311 Machine Learning Lab
Assignment 10

Date: October 31st, 2023

Q1. A Markov Model is given with 5 states $\{S_1, S_2, S_3, S_4, S_5\}$; initial state probabilities $\pi_i = 0.2$ where $1 \le i \le 5$; and the following transition probabilities:

	S_1	S_2	S_3	S_4	S_5
S_1	0.6	0.2	0.0	0.1	0.1
S_2	0.0	0.3	0.5	0.2	0.0
S_3	0.2	0.0	0.4	0.3	0.1
S_4	0.1	0.1	0.2	0.2	0.4
S_5	0.3	0.2	0.0	0.3	0.2

There is a sequence of states starting at $t=0$ and ending at $t=4$. Write a code to estimate the probability of seeing state S_2 at $t=4$.

a) Without using Dynamic programming

b) Using Dynamic Programming

Q2. Define a Hidden Markov Model, λ with three states $\{S_1, S_2, S_3\}$; observations $\{a, b, c\}$; initial state probabilities $\pi_1 = 0.25, \pi_2 = 0.75, \pi_3 = 0$; and the following transition and observation probabilities:

	S_1	S_2	S_3	a	b	c
S_1	0	0.5	0.5	0.5	0.5	0
S_2	1	0	0	0.3	0.3	0.4
S_3	0	1	0	0.25	0	0.75

a) Write code to estimate $P(O)$, where $O = a, c, a, a, b$ using the following two approaches:

1. Without using Dynamic programming

2. Using Forward algorithm

b) Use the Viterbi algorithm to estimate the best state path, $Q = q_0, q_1, q_2$ that generated the sequence $O = a, c, a$.