MI LAB 7

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PES2UG21CS315

5F

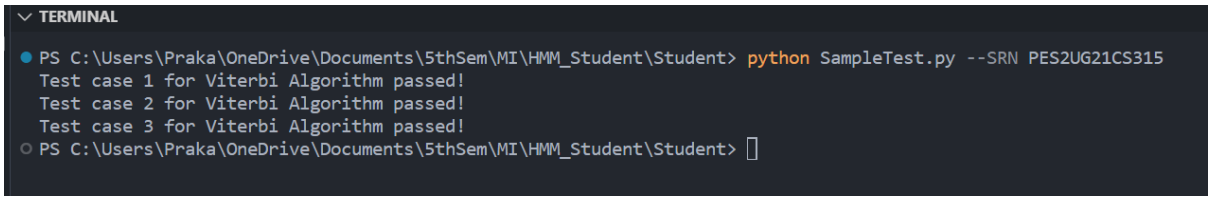
EC CAMPUS

CODE:

```
import torch
class HMM:
    """
    HMM model class
    Args:
        A: State transition matrix
        states: list of states
        emissions: list of observations
        B: Emmision probabilites
    """

    def __init__(self, A, states, emissions, pi, B):
        self.A = A
        self.B = B
        self.states = states
        self.emissions = emissions
        self.pi = pi
        self.N = len(states)
        self.M = len(emissions)
        self.make_states_dict()

    def make_states_dict(self):
        """
        Make dictionary mapping between states and indexes
        """
        self.states_dict = {state: i for i, state in enumerate(self.states)}
        self.emissions_dict = {emission: i for i, emission in
enumerate(self.emissions)}

    def viterbi_algorithm(self, seq):
```

```
        """
        Function implementing the Viterbi algorithm
        Args:
            seq: Observation sequence (list of observations. must be in the
emmissions dict)
        Returns:
            Porbability of the hidden state at time t given an obeservation
sequence
        """

        # Initialize variables
        T = len(seq)  # Length of observation sequence
        delta = torch.zeros((T, self.N))  # Initialize the delta matrix
        psi = torch.zeros((T, self.N), dtype=torch.long)  # Initialize the psi
matrix

        # Find the index for the first observation
        first_obs_index = self.emissions_dict[seq[0]]

        # Initialization Step: Calculate initial probabilities for the first
observation
        pi_tensor = torch.tensor(self.pi)  # Convert pi to a tensor if it's
not already
        delta[0] = pi_tensor * self.B[:, first_obs_index]

        # Recursion Step: Calculate probabilities for subsequent observations
        for t in range(1, T):
            obs_index = self.emissions_dict[seq[t]]

            for j in range(self.N):
                # Calculate delta values and back pointers (psi)
                probabilities = delta[t - 1] * self.A[:, j] * self.B[j,
obs_index]
                delta[t, j], psi[t, j] = torch.max(probabilities, 0)

        # Termination Step: Backtracking to find the most probable sequence
        states_sequence = [0] * T
        _, states_sequence[T - 1] = torch.max(delta[T - 1], 0)

        for t in range(T - 2, -1, -1):
            states_sequence[t] = psi[t + 1, states_sequence[t + 1]]

        # Convert indices to state names
        decoded_states = [self.states[state_index] for state_index in
states_sequence]

        return decoded_states
```

OUTPUT:



THANK YOU 😊