## Homework 5

**Nov 09, 2022**

In this homework assignment you are going to implement the forward algorithm in the forward-backward algorithm and write a unit test for your function.

**Task 1 - Forward model**

The formula is $P(X_{t+1}|e_{1:t+1}) = \alpha P(e_{t+1}|X_{t+1})\sum_{X_t} P(X_{t+1}|x_t)P(x_t|e_{1:t})$

You are supposed to complete the **forward** function in the *forward.py* file. In this function you calculate the probability distribution of the belief states ($X_t$) given the evidence ($e_t$) and the probability distribution of the belief states ($X_{t-1}$).

There are four input parameters of the function **forward**.

1. (1) xT_1Distribution - A dictionary representing the distribution of the random variable. The keys of dictionary are the possible values of random variable $X_{t-1}$ and the values of the dictionary are the corresponding probability $P(x_{t-1}|e_{1:t-1})$.
2. (2) eT - a scalar representing $e_t$.
3. (3) transitionFunction - transitionTable - A dictionary whose keys are belief states ($X_{t-1}$) and values are dictionaries whose keys are the next belief states ($X_t$) and values are the probabilities of transitioning from $X_{t-1}$ to $X_t$ ($P(X_t|x_{t-1})$).
4. (4) sensorTable - A dictionary whose keys are belief states (X) and values are dictionaries whose keys are observations (e) and values are the probabilities of getting the observation from the belief state ($P(e_t|X_t)$).

The return value of the function **forward** is a dictionary. It represents probability distribution of the belief

states ($X_t$) given one step forward information.
In the main function, these pieces of information are provided:

1. (1) e - A list containing $e_{1:t}$. The first element of the list
2. (2) pX0 - A dictionary containing prior distribution of belief states ($P(X_{t-1}|e_{1:t-1})$).
3. (3) transitionTable - A dictionary whose keys are belief states ($X_{t-1}$) and values are dictionaries whose keys are the next belief states ($X_t$) and values are the probabilities of transitioning from $X_{t-1}$ to $X_t$ ($P(X_t|x_{t-1})$).

(4) sensorTable - A dictionary whose keys are belief states (X) and values are dictionaries whose keys are observations (e) and values are the probabilities of getting the observation from the belief state (P (e|x)).

**Task 2 - Unit test**

You are supposed to complete the **TestForward** object in the *testForward.py* file. In this object you can perform a unit test on your **forward** function in the *forward.py*.

Fill in at least two set of data and complete the **test_forward** function. You have to calculate what result your function should return and see if it passes the test. **Do not use the set of data provided in** *forward.py*.

**Submission**

Please submit a completed *forward_YourLastName_YourFirstName.py* file and a completed *testForward_YourLastName_YourFirstName.py* on CCLE before due. **Please submit two seperate files. Do not zip them! The due date and time of this homework assignment is Sunday, 11/27/2022 11:59pm**.