执行测验: Homework 4

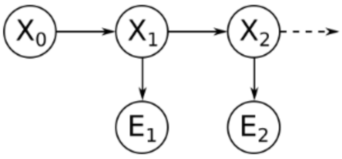
测试信息

描述	
说明	
多次尝试	不允许。此测试只能进行一次。
强制完成	本测试可保存并可稍后继续。

问题完成状态:

问题 1 20 分 已保存

Consider the HMM shown below.



The prior probability $P(X_0)$, dynamics model $P(X_{t+1}|X_t)$, and sensor model $P(E_t|X_t)$ are as follows:

X_0	$P(X_0)$
0	0.35
1	0.65

X_{t+1}	X_t	$P(X_{t+1}\|X_t)$
0	0	0.05
1	0	0.95
0	1	0.05
1	1	0.95

E_t	X_t	$P(E_t\|X_t)$
a	0	0.15
b	0	0.3
c	0	0.55
a	1	0.7
b	1	0.05
c	1	0.25

We perform a first dynamics update, and fill in the resulting belief distribution $B'(X_1)$.

X_1	$B'(X_1)$
0	0.05
1	0.95

We incorporate the evidence $E_1 = c$.We fill in the evidence-weighted distribution $P(E_1 = c|X_1)B'(X_1)$, and the (normalized) belief distribution $B(X_1)$.

X_1	$P(E_1 = c\|X_1)B'(X_1)$
0	0.0275
1	0.2375

X_1	$B(X_1)$
0	0.103773584906
1	0.896226415094

You get to perform the second dynamics update. Fill in the resulting belief distribution $B'(X_2)$.

X_2	$B'(X_2)$
0	0.0500
1	0.9500

Now incorporate the evidence $E_2 = b$. Fill in the evidence-weighted distribution $P(E_2 = b|X_2)B'(X_2)$, and the (normalized) belief distribution $B(X_2)$.

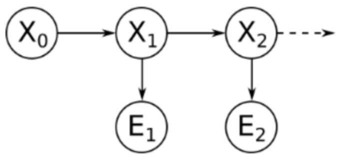
X_2	$P(E_2 = b\|X_2)B'(X_2)$
0	0.0150

1	0.0475

X_2	$B(X_2)$
0	0.2400
1	0.7600

问题 2 20 分 已保存

Consider the same HMM.



The prior probability $P(X_0)$, dynamics model $P(X_{t+1}|X_t)$, and sensor model $P(E_t|X_t)$ are as follows:

X_0	$P(X_0)$
0	0.5
1	0.5

X_{t+1}	X_t	$P(X_{t+1}\|X_t)$
0	0	0.5
1	0	0.5
0	1	0.2
1	1	0.8

E_t	X_t	$P(X_{t+1}\|X_t)$
a	0	0.5
b	0	0.3
c	0	0.2
a	1	0.8
b	1	0.1
c	1	0.1

In this question we'll assume the sensor is broken and we get no more evidence readings. We are forced to rely on dynamics updates only going forward. In the limit as $t \to \infty$, our belief about X_t should converge to a stationary distribution $\tilde{B}(X_\infty)$ defined as follows:

$$\tilde{B}(X_\infty) := \lim_{t\to\infty} P(X_t|E_1, E_2)$$

Recall that the stationary distribution satisfies the equation

$$\tilde{B}(X_\infty) = \sum_{X_\infty} P(X_{t+1}|X_t)\tilde{B}(X_\infty)$$

for all values in the domain of X.

In the case of this problem, we can write these relations as a set of linear equations of the form

$$\begin{bmatrix} a & b \\ c & d \end{bmatrix} \begin{bmatrix} \tilde{B}(X_\infty = 0) \\ \tilde{B}(X_\infty = 1) \end{bmatrix} = \begin{bmatrix} \tilde{B}(X_\infty = 0) \\ \tilde{B}(X_\infty = 1) \end{bmatrix}$$

In the spaces below, fill in the coefficients of the linear system. The system you have written has many solutions (consider (0,0), for example), but to get a probability distribution we want the solution that sums to one. Fill in your solution in the table below. (Hint: to check your answer, you can also write some code and run till convergence.)

Your answers will be evaluated to 4 decimal places.

coefficient	value
a	0.5000
b	0.2000
c	0.5000
d	0.8000

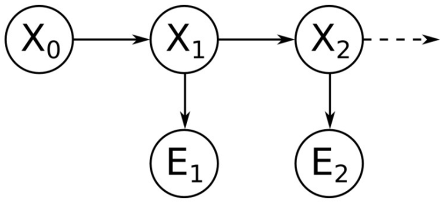
X_∞	$\tilde{B}(X_\infty)$

0	0.2857
1	0.7143

问题 3

30 分 已保存

Consider this HMM.



The prior probability $$P(X_0)$$, dynamics model $$P(X_{t+1} | X_t)$$, and sensor model $$P(E_t|X_t)$$ are as follows:

X_0	$P(X_0)$
0	0.5
1	0.5

X_{t+1}	X_t	$P(X_{t+1}\|X_t)$
0	0	0.5
1	0	0.5
0	1	0.2
1	1	0.8

E_t	X_t	$P(E_t\|X_t)$
a	0	0.5
b	0	0.3
c	0	0.2
a	1	0.8
b	1	0.1
c	1	0.1

If the $E_1 = a, E_2 = b, E_3 = c$, what is the most likely explanation $X^*_{1:3} = argmax P(X_{1:3} | E_{1:3})$

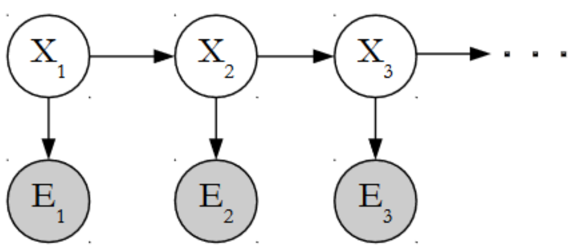
X^*_1 = 1

X^*_2 = 1

X^*_3 = 1

问题 4

10 分 已保存



The Viterbi algorithm finds the most probable sequence of hidden states $X_{1:T}$, given a sequence of observations $e_{1:T}$. For the HMM structure above, which of the following probabilities are maximized by the sequence of states returned by the Viterbi algorithm? Select all correct option(s).

☐ A. $P(X_{1:T})$

☐ B.

$P(X_T | e_T)$

☑ C. $P(X_{1:T} | e_{1:T})$

☑ D. $P(X_{1:T}, e_{1:T})$

☑ E.

$P(X_1)P(e_1|X_1) \prod_{t=2}^{T} P(e_t|X_t)P(X_t|X_{t-1})$

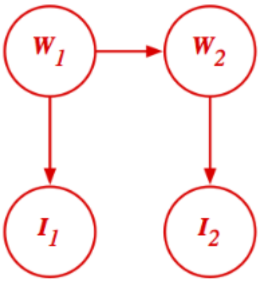
☐ F.

$P(X_1) \prod_{t=2}^{T} P(X_t|X_{t-1})$

☐ G. None of above

问题 5 **30 分** 已保存

Consider the following graph, where **W₁** and **W₂** can be either be **R** or **S**, and **I₁** and **I₂** can be either be **T** or **F**:



The conditional probability distributions are given by:

$W_1 = \text{S}$	$W_1 = \text{R}$
.6	.4

(a) $P(W_1)$

	$W_2 = \text{S}$	$W_2 = \text{R}$
$W_1 = \text{S}$	.7	.3
$W_1 = \text{R}$	.5	.5

(b) $P(W_2|W_1)$

	$I = \text{T}$	$I = \text{F}$
$W = \text{S}$	.9	.1
$W = \text{R}$	.2	.8

(c) $P(I|W)$

Now we want to try approximate inference through sampling. Applying likelihood weighting, suppose we generate the following six samples given the evidence **I_1 = T** and **I_2 = F**:

$$(W_1, I_1, W_2, I_2) = \Big\{ \langle \text{S}, \text{T}, \text{R}, \text{F} \rangle, \langle \text{R}, \text{T}, \text{R}, \text{F} \rangle, \langle \text{S}, \text{T}, \text{R}, \text{F} \rangle, \langle \text{S}, \text{T}, \text{S}, \text{F} \rangle, \langle \text{S}, \text{T}, \text{S}, \text{F} \rangle, \langle \text{R}, \text{T}, \text{S}, \text{F} \rangle \Big\}$$

Then the weight of the first sample **(S, T, R, F)** is **0.72** .

The result from likelihood weighting is:

$\hat{P}(W_2 = R \,|\, I_1 = T,\ I_2 = F)$	**0.8889**
$\hat{P}(W_2 = S \,|\, I_1 = T,\ I_2 = F)$	**0.1111**

问题 6 **20 分** 已保存

After observing step of particle filtering, the particles and its weight are as follow:

Particles	Weight
A	0.3
B	0.4
C	0.9
D	0.5
A	0.3
C	0.9
A	0.3
D	0.5
D	0.5
A	0.3

Fill in the weighted sample distribution $P'(X)$ you used in the resampling step. Your answers will be evaluated to 4 decimal places.

P'(A) = 0.2449

P'(B) = 0.0816

P'(C) = 0.3673

P'(D) = 0.3061

单击“保存并提交”以保存并提交。单击“保存所有答案”以保存所有答案。

保存所有答案 关闭窗口 保存并提交