13 Exercises – Hidden Markov model

1. **HMM probabilities**

   An HMM (hidden Markov model) is a probabilistic graphical model with three types of probabilities.

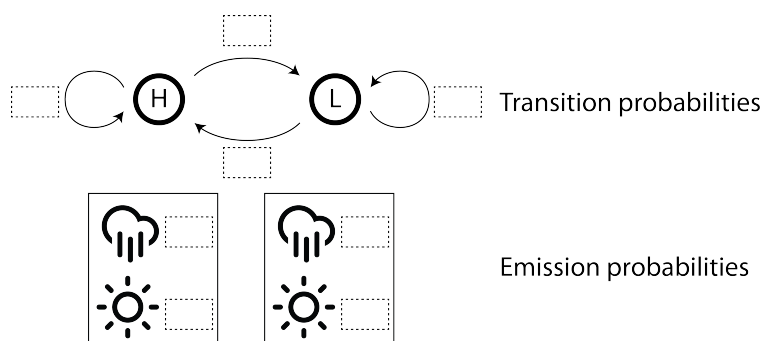   Transition probabilities:

	L_t	H_t
L_{t-1}	0.2	0.8
H_{t-1}	0.4	0.6

   Emission probabilities:

	L	H
Sunny	0.5	0.7
Rain	0.5	0.3

   Initial transition probabilities:

   $$(L, H) = (0.3, 0.7)$$

   (a) Add the transition and emission probabilities to the graph.

   (b) What are the joint probabilities for (Rain, Rain, Sunny) and (H, L, L)?

   (c) What are the joint probabilities for (Sunny, Rain, Sunny) and (L, H, L)?

2. **HMM profile**

A path of an HMM profile represents an alignment between an input sequence and the profile.

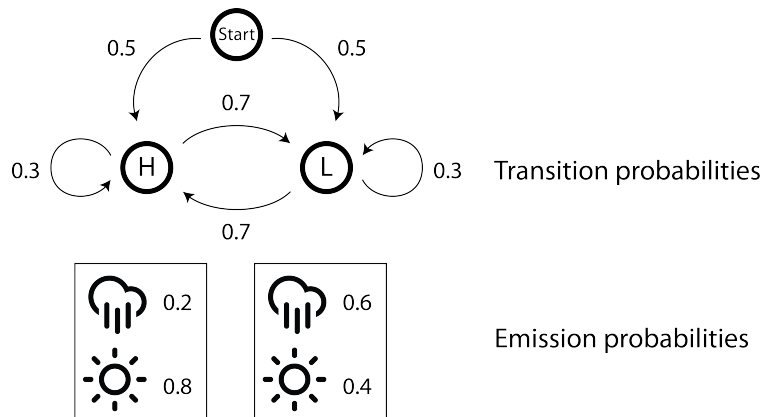(a) Assume Seq1 = q1 q2 and its path is indicated with solid lines. Draw the alignment of Seq1 and the profile.
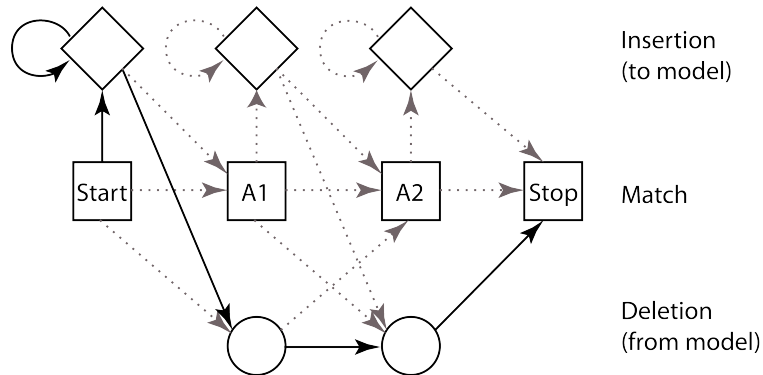
(b) Assume Seq2 = q1 q2 q3 q4 q5 q6 and its path is indicated with solid lines. Draw the alignment of Seq2 and the profile.
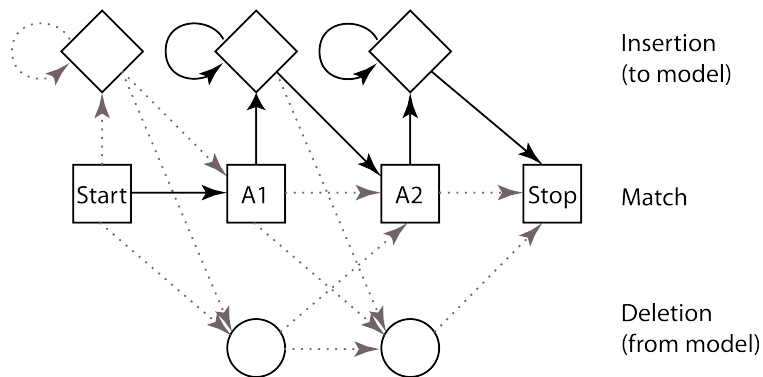
3. **The Viterbi algorithm**

The Viterbi algorithm is a dynamic programming based method to find the optimal path of an HMM with hidden status.

(a) Find the optimal path when observed weather conditions are (Rain, Sunny).

	H	L
Rain		
Sunny		

(b) Find the optimal path when observed weather conditions are (Sunny, Sunny, Rain).

	H	L
Sunny		
Sunny		
Rain		