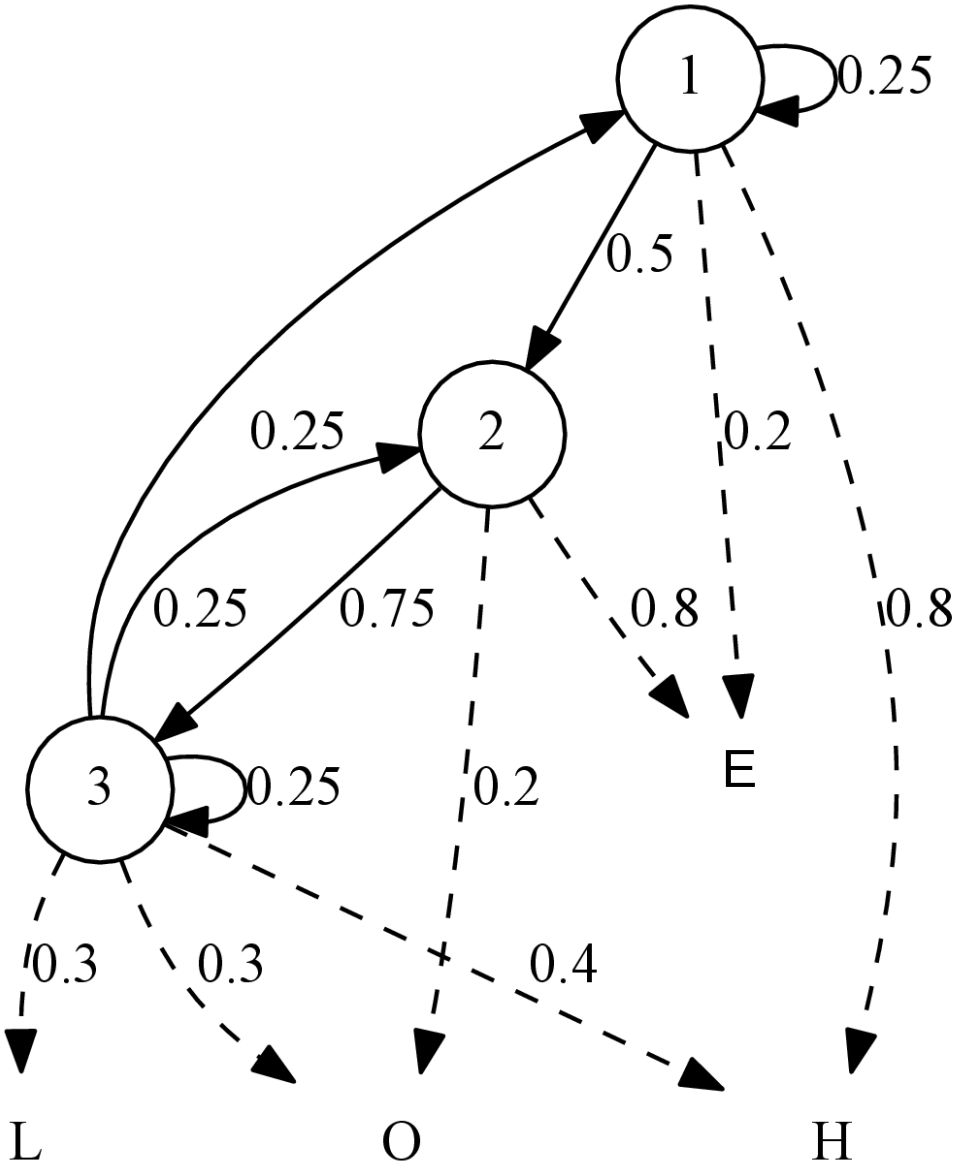
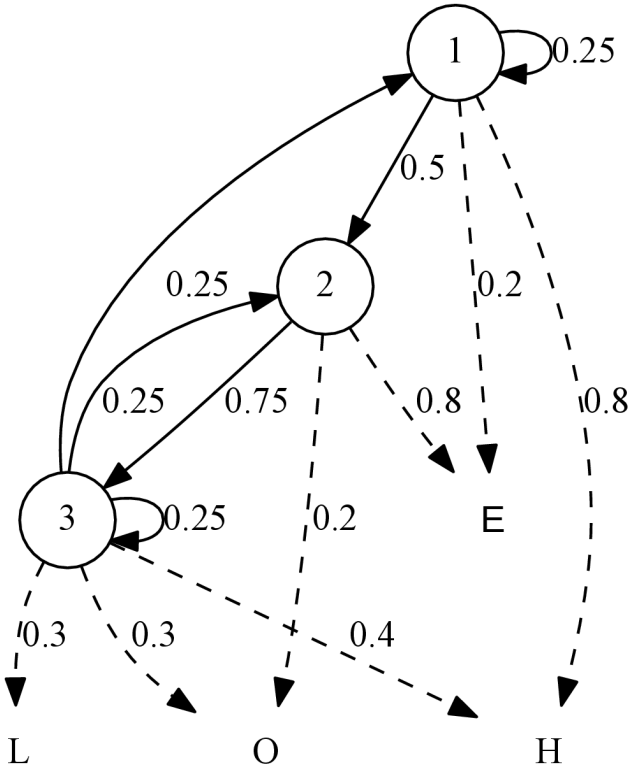
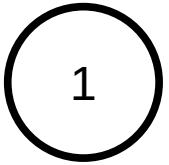

1
0.25
0.5
2
0.25
0.2
0.25
0.75
0.8
0.8
3
0.25
0.2
E
0.3
0.3
0.4
L
O
H

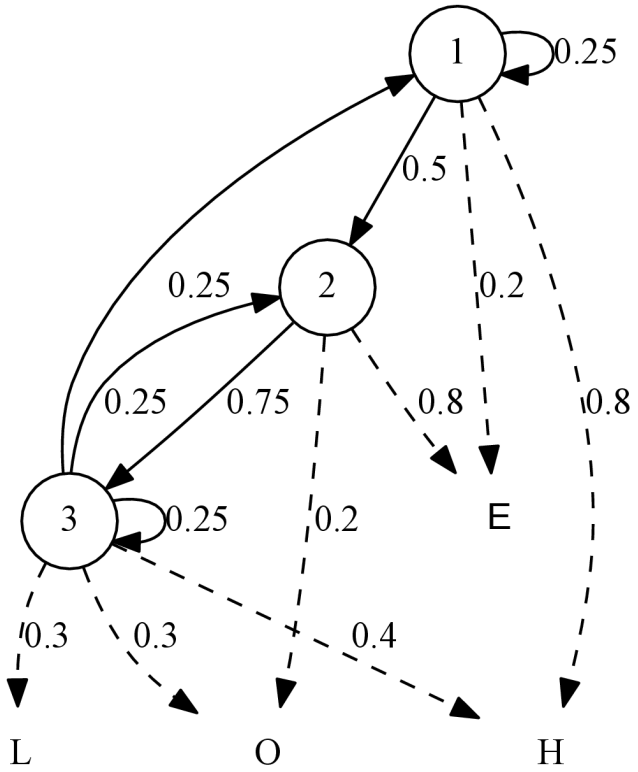


(a) Specify the set of states A and the set of observations B. Deduce the transition matrix D and the output matrix F from the model.

States:



Observation: „E”

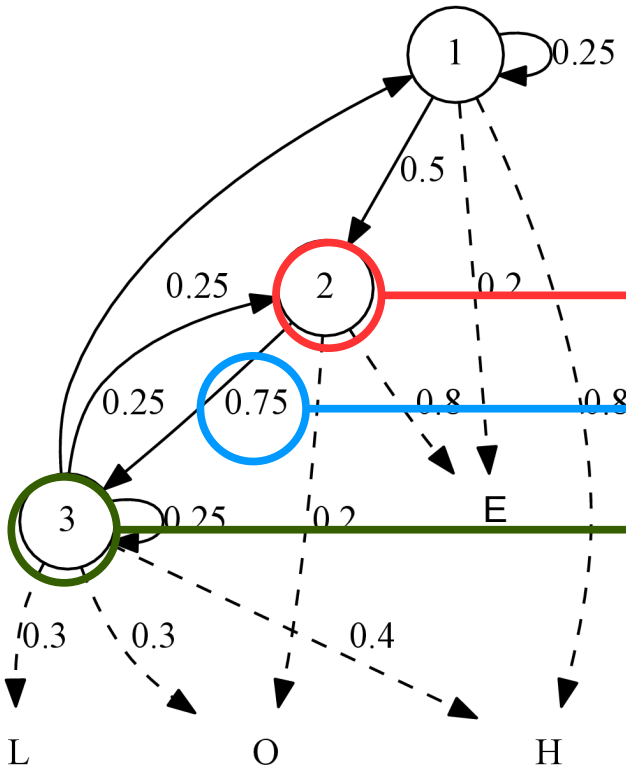


(a) Specify the set of states A and the set of observations B. Deduce the transition matrix D and the output matrix F from the model.

Set of states: { 1, 2, 3 }

Set of observations: { E, H, L, O }

(a) Specify the set of states A and the set of observations B. Deduce the transition matrix D and the output matrix F from the model.



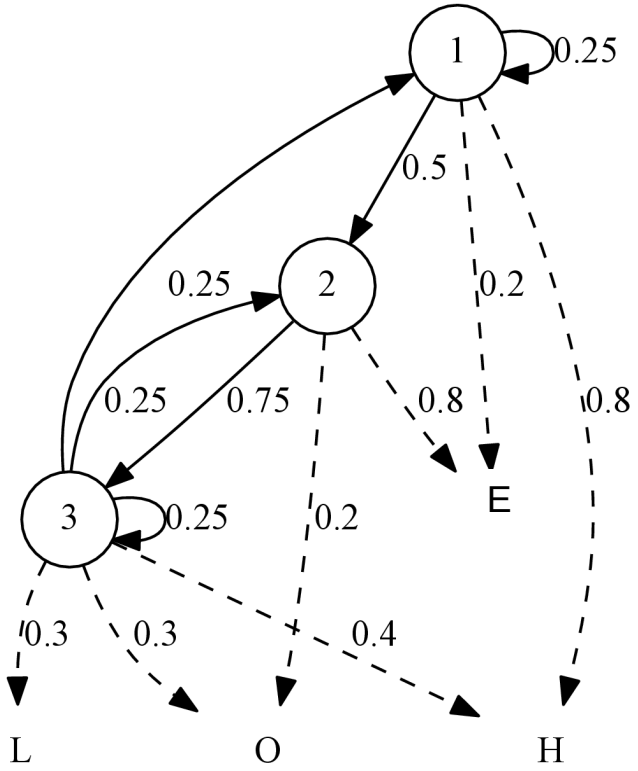
Transition matrix

To:

From:	–	1	2	3
–				
1				
2				.75
3				

Set of states: { 1, 2, 3 }

Set of observations: { E, H, L, O }



(a) Specify the set of states A and the set of observations B. Deduce the transition matrix D and the output matrix F from the model.

Transition matrix

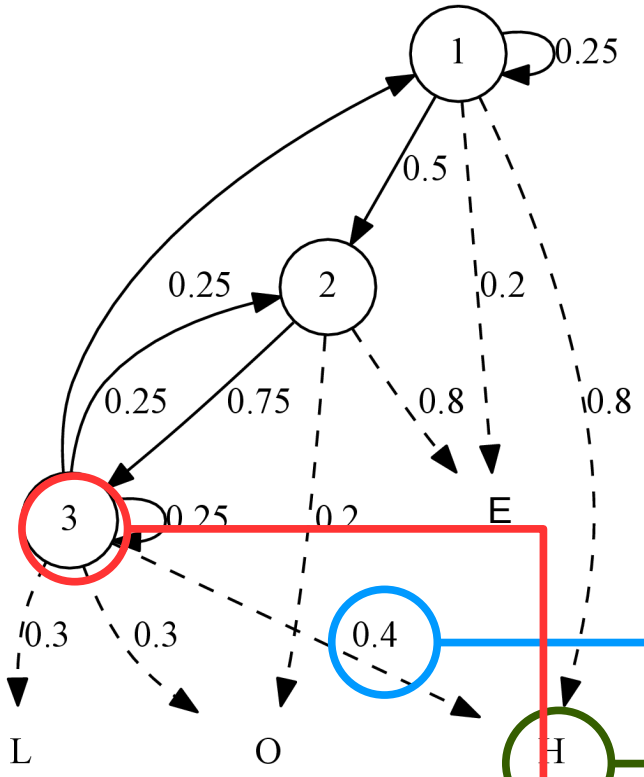
		To:		
	–	1	2	3
–	–	.33	.33	.33
From: 1	.25	.25	.5	–
2	.25	–	–	.75
3	.25	.25	.25	.25

Uniformly distributed

Row sum: 1

Set of states: { 1, 2, 3 }

Set of observations: { E, H, L, O }



(a) Specify the set of states A and the set of observations B. Deduce the transition matrix D and the output matrix F from the model.

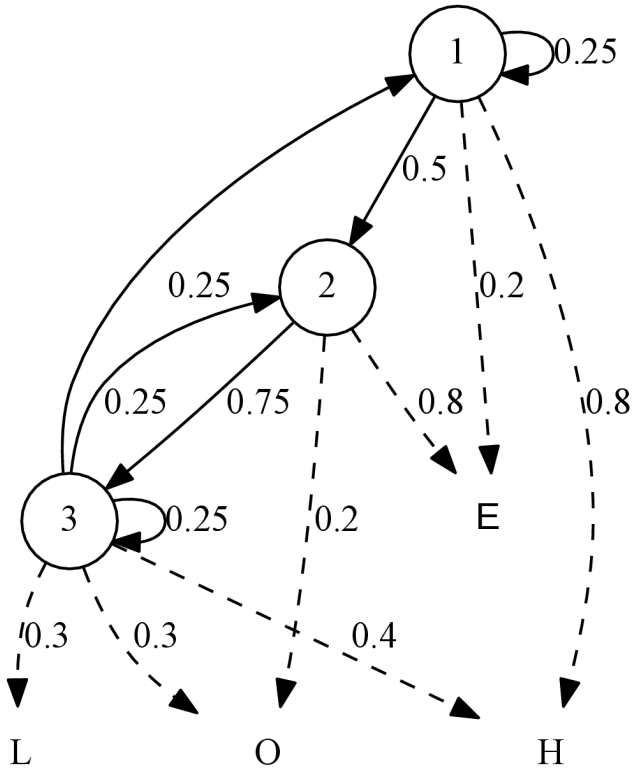
Output matrix:
From A to B

	E	H	L	O
1				
2				
3		.4		

Set of states: { 1, 2, 3 }
Set of observations: { E, H, L, O }

Transition matrix

	–	1	2	3
–	–	.33	.33	.33
1	.25	.25	.5	–
2	.25	–	–	.75
3	.25	.25	.25	.25



(a) Specify the set of states A and the set of observations B. Deduce the transition matrix D and the output matrix F from the model.

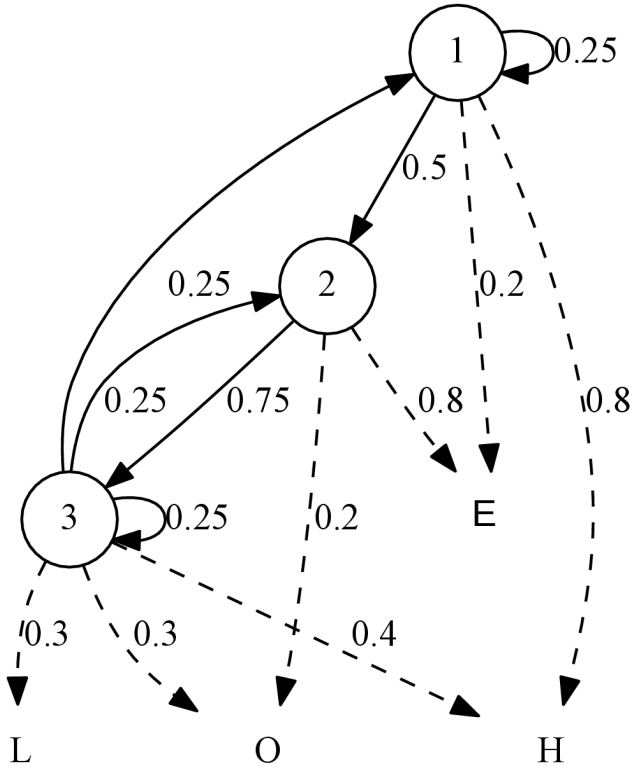
Output matrix:
From A to B

	E	H	L	O
1	.2	.8	–	–
2	.8	–	–	.2
3	–	.4	.3	.3

Set of states: { 1, 2, 3 }
Set of observations: { E, H, L, O }

Transition matrix

	–	1	2	3
–	–	.33	.33	.33
1	.25	.25	.5	–
2	.25	–	–	.75
3	.25	.25	.25	.25



(a) Specify the set of states A and the set of observations B. Deduce the transition matrix D and the output matrix F from the model.

Set of states: { 1, 2, 3 }

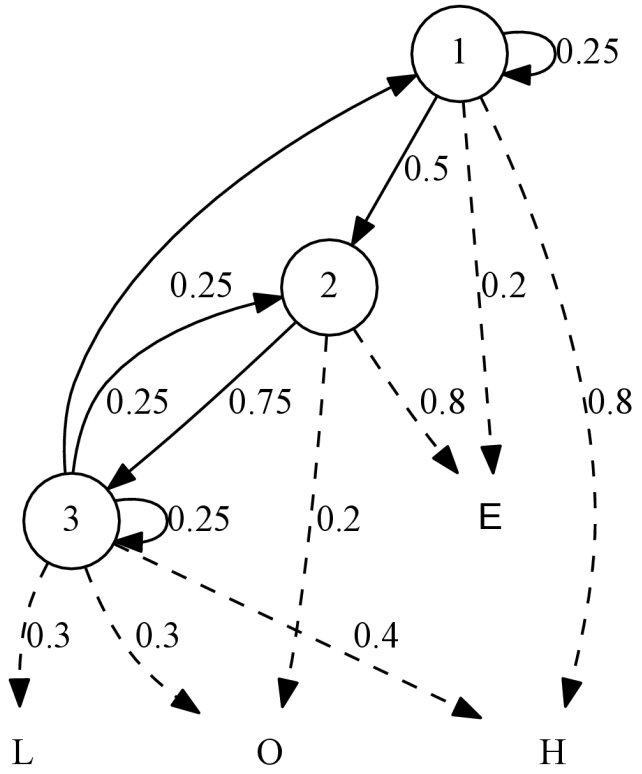
Set of observations: { E, H, L, O }

Transition Matrix

	–	1	2	3
–	–	.33	.33	.33
1	.25	.25	.5	–
2	.25	–	–	.75
3	.25	.25	.25	.25

Output matrix:

	E	H	L	O
1	.2	.8	–	–
2	.8	–	–	.2
3	–	.4	.3	.3



(b) Calculate the probability that the observation $O_1 = \{H, E, L, L, O\}$ is generated by the HMM.

Sequences of states which can produce the sequence {H,E,L,L,O}:

1-2-3-3-2
1-2-3-3-3
3-2-3-3-2
3-2-3-3-3

P(1|-) × P(2|1) × P(3|2) × P(3|3) × P(2|3) × P(-|2)
= .33 × .5 × .75 × .25 × .25 × .25 = .001933594

P(H|1) × P(E|2) × P(L|3) × P(L|3) × P(O|2)
= .8 × .8 × .3 × .3 × .2 = .01152

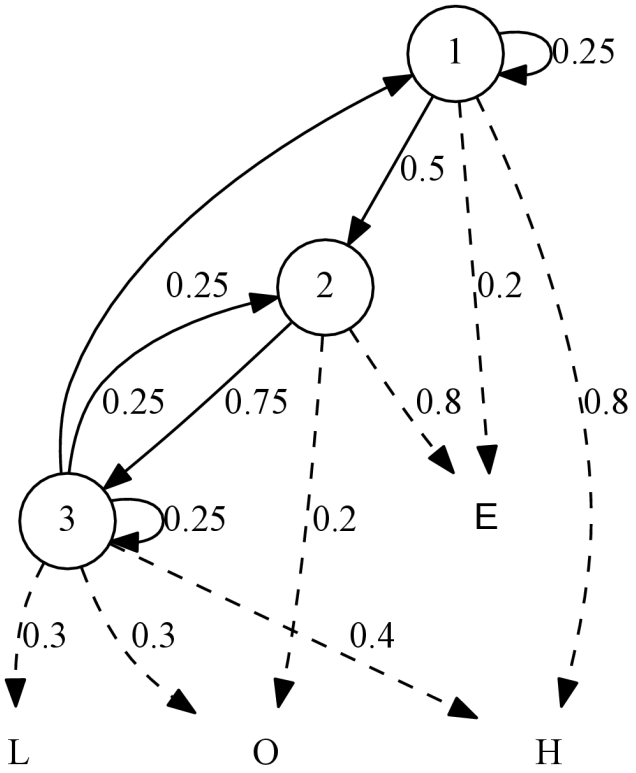
P(HELLO) = P(12332) × P(HELLO | 12332)
+ P(12333) × P(HELLO | 12333)
+ P(32332) × P(HELLO | 32332)
+ P(32333) × P(HELLO | 32333)

P(H|1) × P(E|2) × P(L|3) × P(L|3) × P(O|3)
= .8 × .8 × .3 × .3 × .3 = .01728

P(1|-) × P(2|1) × P(3|2) × P(3|3) × P(3|3) × P(-|3)
= .33 × .5 × .75 × .25 × .25 × .25 = .001933594

Transition matrix

	–	1	2	3
–	–	.33	.33	.33
1	.25	.25	.5	–
2	.25	–	–	.75
3	.25	.25	.25	.25



(b) Calculate the probability that the observation $O_1 = \{H, E, L, L, O\}$ is generated by the HMM.

Sequences of states which can produce the sequence {H,E,L,L,O}:

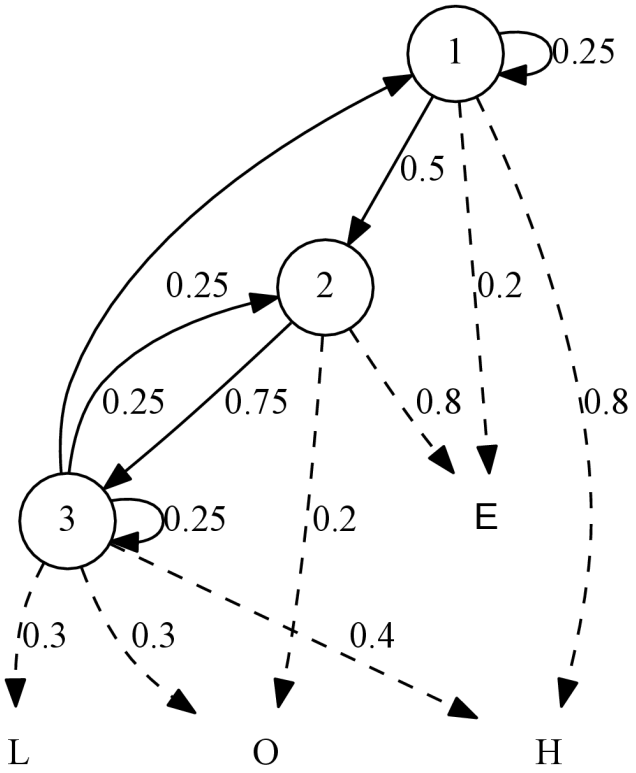
1-2-3-3-2
1-2-3-3-3
3-2-3-3-2
3-2-3-3-3

Transition matrix

	–	1	2	3
–	–	.33	.33	.33
1	.25	.25	.5	–
2	.25	–	–	.75
3	.25	.25	.25	.25

P(HELLO) = P(12332) × P(HELLO | 12332)
+ P(12333) × P(HELLO | 12333)
+ P(32332) × P(HELLO | 32332)
+ P(32333) × P(HELLO | 32333)

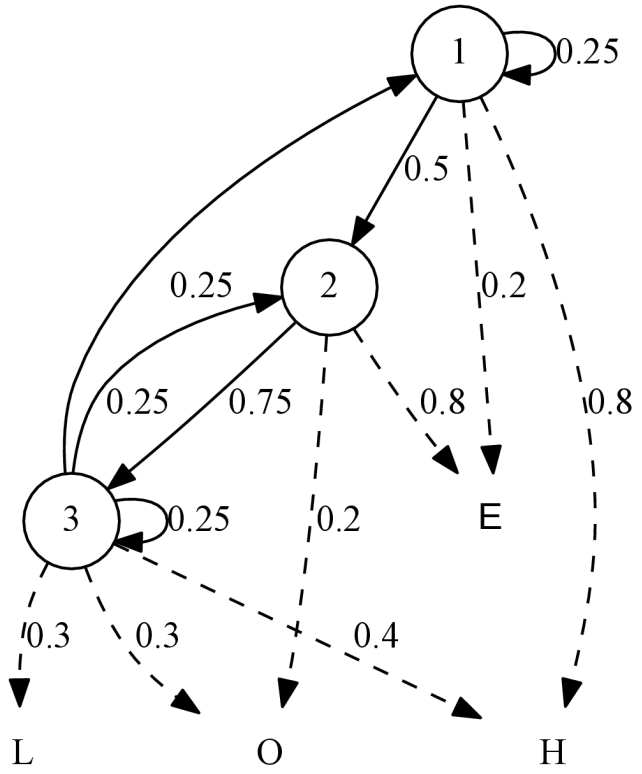
= 0,001933594 x 0,01152
+ 0,001933594 x 0,01728
+ 0,000966797 x 0,00576
+ 0,000966797 x 0,00864
= 0,000069609



(c) Which sequence (s_1,s_2,...,s_k) with $s_i \in A$ explains the observation $O_1 = \{H, E, L, L, O\}$ best?

Sequences of states which can produce the sequence {H,E,L,L,O}:

1-2-3-3-2
1-2-3-3-3
3-2-3-3-2
3-2-3-3-3



(c) Which sequence $(s_1, s_2, \ldots, s_k)$ with $s_i \in A$ explains the observation $O_1 = \{H, E, L, L, O\}$ best?

Sequences of states which can produce the sequence {H,E,L,L,O}:

P(HELLO ∧ 1-2-3-3-2) = 0.000022275

P(HELLO ∧ 1-2-3-3-3) = 0.0000334125

P(HELLO ∧ 3-2-3-3-2) = 0.00000556875

P(HELLO ∧ 3-2-3-3-3) = 0.00000835312

Efficent solution: **Viterbi-Algorithm**