Algorithms and Computational Thinking Autumn 2016
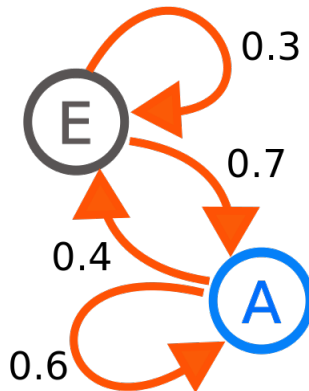
Thursday, 1st December 2016

Exercise 11 - Probabilistic Algorithms

Markov Chain

A Markov Chain model contains states and transition probabilities amongst states as described in the picture below :

Source : wikipedia (`https://en.wikipedia.org/wiki/Markov_chain`).

As depicted in the figure, the Markov Chain model is an oriented graph in which the sum of all outgoing probabilities of each state is equal to 1.0. A Markov Chain can be used to predict the most likely next state from a current state (e.g., A is the most likely next state from the current state A because the probability of moving from A to A is 0.6 compared to moving from A to E, which is only 0.4).

Exercises

Doudou is a hamster which has only three points of interest (i.e., states) in his cage : *wood chips* (0), *wheel* (1) and *feeder* (2). Firstly, you will create his Markov Chain model that can be a state-transition matrix by filling the model with this state sequence (i.e., history of previous movements of Doudou) : (1,2,0,1,1,1,2,0,1,2,1,2,0,1,2,1,0,0,0,1,2,1,2,1,0,2,0,2,1,2,1,2,1,1,1,0,1,0,1,0,1,0). Secondly, you will try to find the most likely next state from the current state *wood chips* by exploring the Markov Chain model.

Tips

In order to create the Doudou's Markov Chain model, you can start by creating a n x n matrix where n is the number of states in which all number of transitions equal to 0, for example a list of lists : [[0,0,0], [0,0,0], [0,0,0]] in this exercise. Then, you can compute the number of transitions by exploring all transitions of the state sequence for the entire matrix before computing the probabilities. Finally, you should be able to compute all transition probabilities on the basis of the previous step.