

2 Artificial Intelligence II (SBH)

Princess Precious is a very light sleeper, and insists that every night she must sleep on brand new silk sheets. Her younger brother, however, is in the habit of secretly scattering toast crumbs in her bed, to make sure she sleeps badly.

In order to get the week started well, he does this every Sunday with probability 0.9. For the rest of the week, he tends to relent on any given night if he placed crumbs in her bed the previous night, and hence leaves them with a probability of 0.1. On the other hand, if he did not leave crumbs on a given night, his mischievous nature compels him to leave crumbs the next night with probability 0.6.

Precious, being a true princess, tends to be grumpy in the morning if she has not slept well. Consequently, if she has slept with crumbs in her bed she is grumpy with probability 0.95. Being a light sleeper, even if there are no crumbs she is grumpy with probability 0.55.

- (a) Give a detailed definition of a *Hidden Markov Model (HMM)* and show how the scenario described can be modelled as an HMM. [4 marks]
- (b) Give a detailed description of the *Viterbi algorithm* for computing the most probable sequence of states, given that an HMM produces a given sequence of observations. [8 marks]
- (c) It is observed that Princess Precious is grumpy on Monday and Tuesday. However on Wednesday she is radiantly happy. Use the Viterbi algorithm to compute the most likely sequence of activities performed by her brother. [8 marks]