Faculty of Arts and Science
University of Toronto
CSC 358 - Inbroduction to Computer Networks

Tutorial 1

Topic

In this tutorial, we review some basic concepts of probability theory. These concepts are very important. For example, we will use them when we study the Ethernet protocol or wireless local area networks.

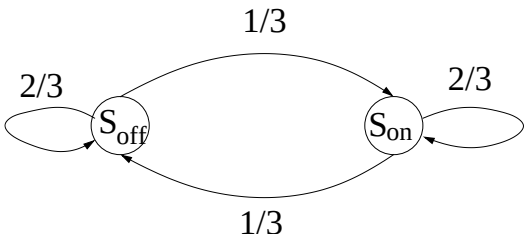
Question 1: Consider a communication link which connects A with B, and suppose that A sends to B a file with N bits. During the transmission, each bit is being corrupted independently with a bit error probability p.

(a) What is the probability P_{tr} that the file is received with out an error at B, i.e. no bit is getting corrupted during the transmission?

(b) Suppose that B accepts the file when there is no bit error, and otherwise asks A to resend the file. Assume that B can detect perfectly whether a bit got corrupted during the transmission. What is the probability P_k that A has to send the file k times to get it accepted by B?

(c) What is the expected number of times that A has to send the file to get it accepted at B?

Question 2: Consider a PDA (Personal Digital Assistant) which can send and receive data over a wireless communication link (for example a Wave-LAN). The PDA can be in one out of two possible states: state S_{off} (when it is not sending/receiving data) and S_{on} (when it is sending/receiving data). Assume that the PDA changes states at discrete time steps $k = 0, 1, 2, 3, ...$ When at time k the state of the PDA is equal to S_{off}, then at time $(k+1)$ it will be in the state S_{off} with probability $2/3$ and be in the state S_{on} with probability $1/3$. Similarly, when at time k in the state S_{on}, then at time $(k+1)$ it is in state S_{off} with probability $1/3$ and in state S_{on} with probability $2/3$. Assume that at time $k = 0$ the PDA is in state S_{off}.



(a) Assume that at time $k = 0$ the PDA is in state S_{off}. What is the probability that the PDA is still in state S_{off} at time $k = 1$?

(b) Assume that at time $k = 0$ the PDA is in state S_{off}. Using (a), what is the probability that the PDA is in state S_{on} at time $k = 2, 3, 4$?

(c) Assume that the PDA is at time $k = 0$ in state S_{off} with probability P_{off} and in state S_{on} with probability P_{on}. Express the probability that the PDA is at time $k = 1$ in state S_{off}, and state S_{on}, as a function of P_{off} and P_{on}.

(d) Find initial probabilities P_{off}, P_{on} such that the PDA is at time $k = 1$ in state S_{off}, and S_{on}, again with probability P_{off}, and P_{on}, respectively. What is the interpretation of the probabilities P_{off} and P_{on}?

(e) Assume that at time $k = 0$ the PDA is in state S_{off}. Using the result of (d), try to guess that probabilities that the buffer is in state S_{on} and S_{off} after a very long time, i.e. as k approaches infinity.