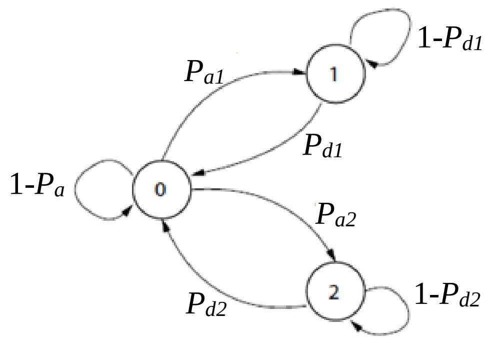
Principles of Computer Networks

Tutorial 7

Problem 1. Midterm revisit:

Assume that a system is in following states S_0, S_1, S_2 with probability P_0, P_1, P_2 respectively. Also assume $\frac{P_{a1}}{P_{d1}} = \frac{1}{2}$ and $\frac{P_{a2}}{P_{d2}} = \frac{1}{3}$ and $P_a = P_{a1} + P_{a2}$. Compute the steady state probability P_0, P_1, P_2.



Problem 2. Timeout interval:

Suppose that the three measured SampleRTT values are 106 ms, 120 ms, and 140 ms. Compute the EstimatedRTT after each of these SampleRTT values is obtained, using a value of $\alpha = 0.125$ and assuming that the value of EstimatedRTT was 100 ms just before the first of these five samples were obtained. Compute also the DevRTT after each sample is obtained, assuming a value of $\beta = 0.25$ and assuming the value of DevRTT was 5 ms just before the first of these five samples was obtained. Last, compute the TCP TimeoutInterval after each of these samples is obtained.

Problem 3. Comparison of GBN, SR, and TCP:

Compare GBN, SR, and TCP (no delayed ACK). Assume that the timeout values for all three protocols are sufficiently long such that 5 consecutive data segments and their corresponding ACKs can be received (if not lost in the channel) by the receiving host (Host B) and the sending host (Host A) respectively. Suppose Host A sends 5 data segments to Host B, and the 2nd segment (sent from A) is lost. In the end, all 5 data segments have been correctly received by Host B.

a) How many segments has Host A sent in total and how many ACKs has Host B sent in total? What are their sequence numbers? Answer this question for all three protocols.

b) If the timeout values for all three protocol are much longer than 5 RTT, then which protocol successfully delivers all five data segments in shortest time interval?

Problem 4. Additive increase, multiplicative decrease:

Consider sending a large file from a host to another over a TCP connection that has no loss.

a) Suppose TCP uses AIMD for its congestion control without slow start. Assuming cwnd increases by 1 MSS every time a batch of ACKs is received and assuming approximately constant round-trip times, how long does it take for cwnd increase from 6 MSS to 12 MSS (assuming no loss events)?

b) What is the average throughout (in terms of MSS and RTT) for this connection up through time = 6 RTT?

Problem 5. Loss rate:

Recall the macroscopic description of TCP throughput. In the period of time from when the connection's rate varies from $W/(2 \cdot \text{RTT})$ to W/RTT, only one packet is lost (at the very end of the period).

a) Show that the loss rate (fraction of packets lost) is equal to

$$\text{Loss rate} = \frac{1}{\frac{3}{8}w^2 + \frac{3}{4}w}$$

b) Use the result above to show that if a connection has loss rate L, then its average rate is approximately given by

$$\text{Average throughput} = \ = \frac{1.22 \cdot MSS}{RTT \cdot \sqrt{L}}$$