Computer Networks
Written Assignment II

1. Consider a slotted ALOHA system with 5 nodes where each node transmits in a slot with probability *p*.
    a. What is the average throughput of the system if *p*=0.1. (throughput = number of packets successfully transmitted per slot)?
    b. What value of *p* maximizes the average throughput and what is the maximum average throughput?

2. A large population of slotted ALOHA users manages to generate on average 200 packets per second with a Poisson distribution, including both originals transmissions and retransmissions. Packets are of size 100 bytes. Time is slotted in units of 2.5 msec. What is the throughput of the system (bytes per seconds).

3. Consider 8 nodes where each node has a packet to transmit with probability ¼.
    a. Assume we use adaptive tree walk protocol. What is the expected number of time slots required to finish the transmission?
    b. How many slots on average has single transmission?

4. Assume there are 12 nodes in the network naming A to L. Assume nodes A, E, F, I, J has packet to transmit. Run adaptive tree walk and find the number of required slots.

5. Consider bit-map protocol where 1 bit is used for packet reservation and 5 bits for the packet transmission. There are 100 nodes. Assume each node has packet to transmit with probability 0.2.
    a. What is the average efficiency of the system?
    b. What is the average delay from the beginning of the reservation time until a node transmits its packet?

6. Consider 512 nodes in a network. Compare the efficiency of the bit map protocol and adaptive three walking in the following cases. Assume that one byte is used for packet reservation in bit map and packet size is 20 bytes in both cases.
    a. Only one node has packet to transmit.
    b. All the nodes have packet to transmit.

7. Consider an FDMA MAC protocol. There are *M* frequency channels available for the nodes. There are *N* nodes in the system. Each node has packet to transmit with probability *p*. Each node selects a channel randomly among M channels and transmits its data over that channel. If one channel is selected by more than one node, there will be collision and none of the nodes can successfully transmit their data.
    a. What is the expected number of nodes which can successfully transmit their data (i.e., data transmitted successfully on a channel if only one node selects that channel)? It's the throughput of the system.
    b. What is the value of *p* which maximizes the answer in part a?
    c. What's the maximum throughput?
    d. If *N* approaches infinity, to which value does the maximum approach?