

## ELEN E6761: Computer Communication Networks

### Homework 3: ALOHA

Due: 10/10/2016

1. Consider the slotted ALOHA protocol with centralized control with infinitely many stations. In the class, we analyzed the delay performance of the protocol assuming that the arrival process is Poisson. In this homework, we assume a simpler model where the arrival process is also time slotted, i.e. at each time slot  $t$ , there is either a packet arrival with probability  $\lambda \in (0, 1)$  or no arrivals with probability  $(1 - \lambda)$ . Further, *arrivals happen at the beginning of time slots, and then possible packet transmissions happen according to ALOHA.*
  - (i) Argue that the average delay of packets under this model is less than the mean delay of a *Geo/Geo/1* queue (i.e., inter-arrival times are iid Geometric with parameter  $\lambda$  and the service times are Geometric with parameter  $1/e$ ).
  - (ii) Calculate the mean delay of the corresponding *Geo/Geo/1* queue using two approaches:
    - (a) draw the state transition diagram and use the steady state probability distribution
    - (b) use a mean value approach similar to the analysis in the class.
  - (iii) What is the stability condition of the *Geo/Geo/1* queue?
  - (iv) What is the stability condition of the ALOHA with centralized control in this model?