**Homework 4 Problems**

Due: Wednesday, 22 May 19

1. [12 points] Explain each of the following concepts:
2. Verification.

Verification answers the question of whether or not the model’s implementation accurately reflects the system whose performance we are trying to assess.

1. Validation

Validation indicates how accurately the model allows us to evaluate a system.

1. Accreditation

Accreditation is the official declaration that the simulation software meets a set of stated objectives.

1. [10 points] In your own words, answer the following questions with respect to burstiness.
2. What does burstiness mean?

Burstiness indicates that a traffic source is non-deterministic, and there will be periods where traffic comes at a much higher “peak” intensity, and other low-intensity periods. A bursty source generates traffic in random clusters.

1. As a network designer, why should you be concerned about the burstiness of your traffic?

If you don’t account for burstiness, the traffic load from a burst can cause QoS problems in a network, can cause overflow and lost traffic. There are ranges of “burstiness”: deterministic sources have no burstiness, while Poisson and Bernouli processes are bursty as single processes.

1. [12 points] In your own words, answer the following questions with respect to the Hurst parameter.
2. What does the Hurst parameter attempt to convey or represent?

The Hurst parameter is a measure of long-term memory of time series.

Essentially, it represents the relative tendency to regress to the mean, or to cluster in a particular direction.

1. As a network designer, what value of the Hurst parameter do you want your traffic to have?

You want a value of H = 0.5. This would indicate that events are completely uncorrelated.

1. Explain why you want the value given in part b.

With a value of H < 0.5, or H > 0.5, the common assumption that events are uncorrelated decays. With H > 0.5, past increments are correlated with present increments.

1. [18 points] Create an inverse function capable of producing a random variable with the following Cumulative Distribution Function using a random variable with a uniform Probability Density Function. X=Fx-1 (Y) and Y=Fx (X). Express the inverse function Fx-1 mathematically (or in pseudo code).



1/λ

1

x

1/λ

1

Y

The inverse function is taking the square root of Y, and dividing by lambda.

1. [24 points] A medium access protocol, slotted *Just One Try* Aloha, has the following operational characteristics:

* *If no new packet arrives, do not transmit*
* *If a new packet arrives, transmit the packet in the next slot*
* *Always assume that a transmission is successful (packets never backlog)*

Assume that the system is slotted with slots of length 1 time unit, that arrivals to the system are Poisson with a total rate of , that each slot with a transmission is either a collision ( if there are two or more transmissions) or a perfect reception (if there is exactly one transmission), that there are an infinite number of nodes (all packets are accepted), and that nodes have no buffering (they can hold only one packet which will be transmitted in the next slot).

a.) What is the probability of an idle slot (no transmission)?

An idle slot indicates that no packets arrived during that time, and there are no backlogs so there are no retransmissions.

Thus, the probability is the Poisson probability of 0 arrivals:

b.) What is the probability of a successful (collision-free) transmission?

Using the same equation, a successful transmission is the probability that exactly 1 packet arrived:

c.) Suppose that special coding is used so that up to three stations can transmit successfully in one slot. What is the system throughput of successfully transmitted packets with this modification?

The throughput of any given successful transmission is simply the number of packets transmitted, yielding the below throughput:

1. [24 points] Another medium access protocol, slotted Blind Three Strikes Aloha, has the following operational characteristics:

* If no new packet arrives, then do not transmit
* No feedback is available
* To improve reliability, packets are sent three times as follows:
  + If a new packet arrives, transmit the packet in the next slot
  + Wait a random number of slots then transmit again
  + Again wait a random number of slots and transmit again.

Assume that the system is slotted with slots of length 1 time unit, that arrivals to the system are Poisson with a total rate of , that each slot with a transmission is either a collision (if there are two or more transmissions) or a perfect reception (if there is exactly one transmission), that there are an infinite number of nodes (all packets are accepted), and that nodes have no buffering (they can hold only one packet which will be transmitted three times).

**Notes:**

a.) What is the probability of an idle slot (no transmission)?

b.) What is the probability of a successful (collision-free) transmission?

Probability of success is the probability that exactly 1 packet tries to transmit, which is the probability that one packet arrives.

c.) What is the system throughput of useful work?

Packet X has a probability of success of , this also means it has a probability of failure of

Each of the 3 retransmissions is independent, thus, the probability of all three failures is the product:

Thus, the throughput of useful work is the actual arrival rate , multiplied by the probability of success of a given packet