

## ECE 655 Test 3: Solutions

Fall 2006

- (1) When all three processors are up, the overall failure rate is  $3\lambda$ ; it drops to  $2\lambda$  when only two processors are up. The mean time to go from 3 functional processors to 2 is therefore  $\frac{1}{3\lambda}$ ; the mean time to go from 2 to 1 (failure state) is  $\frac{1}{2\lambda}$ . The mean time to failure is therefore  $\frac{1}{3\lambda} + \frac{1}{2\lambda} = \frac{5}{6\lambda}$ .
- (2) Not all bugs generate errors at the same rate. Some do so at a high rate and are easy to find during debugging. Others may lurk in the system for a very long time and are hard to catch. The JM model assumes that the contribution of each bug to the error rate is the same, which is not true in most cases.
- (3) See the class notes for the definition and an example of the domino effect.
- (4) See the paper we studied on the Byzantine Generals algorithm.
- (5) If multiple disks are down at any point, we will suffer data loss. The rate of failure when all disks are up is  $4\lambda$ . probability that a second failure will happen within one hour is  $p = 1 - e^{-3\lambda}$ . We can therefore model the system as suffering data loss according to a Poisson process with rate  $4p\lambda$ . The mean time to data loss will therefore be  $\frac{1}{4p\lambda}$ .
- (6) This was done in class.