CMSC611: Advanced Computer Architecture
Homework 6

Question 1: (50 points)

Consider we have a RAID system in which each disk contains 100 GB, with a peak sequential read rate of 400MB/sec and a peak sequential write rate of 200MB/sec. The disks share a bus that can transfer 3GB/sec. The mean time to failure for each disk is 3 million hours.

a) Assume this system uses RAID 5 and contains 8 disks. Draw a diagram showing the basic layout of blocks across disks in this system.

b) If a single disk fails, the RAID system will perform reconstruction - the process of determining what data was on a disk when it failed and restoring that data. For this RAID 5 system, what read and write operations are required to perform reconstruction? What is the expected time until a reconstruction is needed?

c) With offline reconstruction, the RAID system devotes all resources to performing reconstruction and services no other requests until reconstruction is complete. How long will it take at least for the offline reconstruction process to complete in this RAID 5 system? Assume the read operations can be executed in parallel, but the write operation can only be performed after all reads are completed. Ignore the overhead for any XOR computation or memory copying.

d) In online reconstruction, the RAID system continues to service requests while performing reconstruction. This technique removes service interruptions, but the reconstruction process is limited to a fraction of the total system bandwidth. Online reconstruction therefore takes longer than offline reconstruction, leaving the system more vulnerable to a second disk failure. If the reconstruction process is limited to 40 MB/sec, how long will the online reconstruction take in this RAID 5 system? Assume the read and write operations can be executed in parallel. Still ignore the overhead for any XOR computation or memory copying.

Question 2: (50 points)

Read the Wikipedia description <wikipedia.org/wiki/MESIF_protocol> of the MESIF cache coherence protocol. You may also need to refer to their description of the MESI protocol <wikipedia.org/wiki/MESI_protocol>.

a) Draw the state transition diagram for this protocol.

b) Give the MESIF states, transitions, and bus messages for the following sequence of operations between processor 1 and processor 2:

Processor 1	Processor 2
Read address A	
	Read address A
Read address A	
	Write to address A
Read address A	
Read address B (replaces A in cache)	
	Read Address A
	Write to address A