CMSC 411 – Spring 2014
Homework #5 – Unit 6 – Storage Systems

1. Problems D.8, D.9, D.10 from Hennessy & Patterson (online)

2. Assume that we have the following two magnetic disk configurations: a single disk and an array of four disks. Each disk has 12 surfaces, 27,723 tracks per surface, and 528 sectors per track. Each sector holds 512 bytes, and it revolves at 10,000 RPM. The minimum, maximum, and average seek times are 0.5ms, 10.5ms, and 4.9ms, respectively. Use the seek time formula in the fallacy starting on page D-45 in Hennessy and Patterson, including the equations in Figure D.23 (page D-46). The time to switch between surfaces is the same as to move the arm one track. In the disk array all the spindles are synchronized, meaning that sector 0 in every disk rotates under the head at the exact same time, and the arms on all four disks are always over the same track. The data is "striped" across all four disks, so four consecutive sectors on a single-disk system will be spread one sector per disk in the array. The delay of the disk controller is 0.3ms per transaction, either for a single disk or for the array. Assume the performance of the I/O system is limited only by the disks and that there is a path to each disk in the array.
   Calculate the performance in both I/Os per second and megabytes per second of these two disk organizations assuming the request pattern is reads of 4KB of **sequential** sectors where the average seek distance is 10 tracks. Assume the 4KB are aligned under the same arm on each disk in the array.

3. Start with the same assumptions as in Problem 2. Now calculate the performance in both I/Os per second and megabytes per second of these two disk organizations assuming the request pattern is random reads of 1MB of sequential sectors. You can assume that the read of 1MB only requires one seek. (Also, if it matters, assume the disk controller allows the sectors to arrive in any order.)