Score:_____ Name:_____

ECE 3055 Quiz 8 - March 10, 2009

1. *(4 pts.)* What is the average time to read a 32KB block of file data on a new Western Digital VelociRaptor disk drive that has an average seek time of 4.2 ms. The drive rotates at 10,000 RPM, has an SATA transfer rate of 3Gb/s per second, and 512 byte sectors (i.e. lower case "b" is bits). Assume the disk is idle and there is a .8 ms controller overhead per sector. (*Note*: In I/O device transfer rates, MB is always 10^6 bytes – not 2^{20} bytes! 64 sectors = 32K/512

$4.2 + .5/10000/60 + 64 \times \left(\frac{512 \times 8}{3 \times 10^6} + .8\right) = 58.5$

Part 1: Assuming the sectors are located in a contiguous block on a single track and the computer can read them all in one pass under the read head, the average transfer time is = 58.5 (in ms. – *Note: use average seek time without book's ¼ correction factor for measured seek time*)

$64 \times (4.2 + 3 + \frac{512 \times 8}{3 \times 10^6} + .8)$

Part 2: If the sectors were all randomly distributed across the entire surface of the disk on different tracks, the average transfer time could take as long as 512 (in ms. – *Note: use average seek time without book's ¼ correction factor for measured seek time and assume ½ revolution is still needed for each sector on average*). This is why defragmentation of files can improve disk performance.

2. *(2 pts.)* A PC's PCI bus has a 67 Mhz clock and can transfer 32-bit data packets from successive memory locations every three clock cycles after using an initial clock cycle to send out the starting address. Assuming the typical PCI burst transfer size is four 32-bit data packets in 13 clocks, compute the maximum I/O bandwidth of the bus in megabytes per second.

$(67 \times 10^6 \times 4 \times 4)/13$

Maximum I/O bandwidth = 82.5 (in megabytes per second)

3. *(2 pts.)* An application is being ported to a parallel computer system with 64 processors. Assuming 92% of the sequential execution time is numerical computations that can be evenly divided among 64 processors and the remaining 8% is I/O that must be performed sequentially on one processor, what is the maximum speedup that could be obtained on the parallel computer?

$1/(.92/64 + .08)$

Maximum Speedup = 10.59

4. *(2 pts.)* Rank and name the three different techniques that are commonly used to transfer I/O data in terms of the hardware requirements (*from lowest to highest*).

1. polling or programmed I/O
2. interrupts
3. DMA