Score:_____ Name:_____

ECE 3055 Quiz - October 26, 2011

1. (*2pts*) List in order of CPU time efficiency (*from lowest to highest*) the three basic techniques that are commonly used to transfer I/O data. List any additional hardware requirements needed for each technique.

I/O Transfer Technique	Additional Hardware Required
Programmed I/O	none
Interrupt Driven	Int. system & controller
DMA	Interrupt & DMA controller

2. (*2pts*) An application is being ported to a new multicore computer system with 16 processor cores. Assuming 80% of the sequential execution time is numerical computations that can be evenly divided among 16 processors and the remaining 20% is I/O that must be performed sequentially on one processor, what is the maximum speedup that could be obtained on the new multicore computer?

$1 / (.2 + .8/16) = 4$

Maximum Speedup = 4

3. (*6pts*) A notebook PC comes with a factory installed Western Digital Scorpio 320GB 7200 RPM 16MB Cache 2.5" SATA 3.0Gb/s Internal Notebook Hard Drive. For this drive, what is the average time to read a 128KB block of file data from the magnetic disk drive assuming that has an average seek time of 12 ms assuming a 16M cache miss? The drive rotates at 7,200 RPM, has an SATA transfer rate of 3Gb/s per second (i.e. Lower case "b" is bits), and 512 byte sectors. Assume the disk is idle and there is a .1 ms controller overhead per 128KB transfer. Ignore the impacts of caching in the drive. (*Note*: In I/O device transfer rates, MB is always 10^6 bytes – not 2^{20} bytes!)

Part 1: Assuming the sectors are located in a contiguous block on a single track and the computer can read or write them all in one pass under the read head, the average observed transfer time would be

$12\text{ms}/4 + 0.5/(7200/60)\ \text{sec} + \frac{256 \times 512 \times 8}{3 \times 10^9\ \text{sec}} + .1\text{ms}$

3pts $3\text{ms} + 4.16\text{ms} + .349\text{ms} + .1\text{ms}$

7.61 (in ms. – *Note: use average seek time adjusted by the book's suggested ¼ correction factor for observed (i.e., typical) seek time for this calculation*)

With this time for a 128KB data transfer, the disk's I/O transfer bandwidth is 17.2 MB/sec

Part 2: Assuming that the data needed was all in the disk's 16M RAM cache, compute the maximum transfer bandwidth for a 128KB transfer. Assume the SATA bandwidth is the limiting factor here and the controller overhead is still present.

2pts. $1000 \times 128\text{KB} / (.349\text{ms} + .1\text{ms}) =$

Maximum transfer bandwidth assuming internal cache hit is 291 MB/sec

Part 3: If you replaced this traditional notebook hard drive with a new Crucial Solid State Drive (SSD) compute the speedup over Part 1 that would result in a 128KB read assuming that it achieves the quoted sustained sequential read value from the datasheet of 415Mb/s.

1pt $(415/8)/17.2$ ≈24 or 8x also OK

SSD Read Speedup = 3 times faster