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**CS 465 - Homework 1 – Fall 2016**

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Team Allowed: maximum of two per team.

State clearly team member names and GMU IDs as comments in source code and each page of submitted report.

Late submissions are not accepted.

How to submit: A zip file answering all questions from Parts 1, 2, and 3. The submission

will be made via a blackboard link available to you. For team projects, only one member of the team should submit the zip file and the other should submit a one-page PDF file stating the names of both members of the team.

Part 3 (30% of grade for homework 1): Exercises related to rotating magnetic disks.

The goal of this homework is to provide you with an understanding of (1) how rotating

magnetic disks operate and (2) their performance characteristics. If you do not understand

the basic operation of rotating magnetic disks, please read section 5.2 of the textbook. For

this homework, you will rely on the specifications of the Seagate Barracuda 7200.9 HDD

Product Manual found at www.cs.gmu.edu/~menasce/cs465/seagate.pdf. Answer the

following questions:

1. [5% of homework 1] Consider the ST3160811AS drive and answer the following

questions:

SectorSize (Number of bytes per sector): 512 bytes/sector

RotSpeed: Rotational speed in RPM: 7200

Formatted capacity (in GBytes): 160

Cache buffer in Mbytes1: 8 Mbytes

Sread (Average typical read seek time (in ms)): <12.9

Swrite (Average typical write seek time (in ms)):<13.9

Shortest seek (aka track-to-track) read seek time (in ms): <0.8

Shortest seek (aka track-to-track) write seek time (in ms): <1.0

TransfRate (Sustained data transfer rate (in Mbytes/sec)): 300

2. [5% of homework 1] Consider a workload that consists of random reads2 only. What is

the average access time per sector? Show your computations first using the variable names (e.g., RotSpeed) given above and then substitute them for their numerical values (give your answer in seconds rounded to three decimal digits).

Average access time = Read seek time + Average rotational latency + Transfer time

Read seek time = 12.9 ms. Since RotSpeed=7200 RPM=120 rev/s=8.33 ms, so average rational latency = 8.33/2=4.16 ms. Because sector size = 512 bytes, and Transfer Rate = 300 Mb/s, so Transfer time = 512 bytes/300 Mb/s = 0.0017 ms.

So Average access time = 12.9 + 4.16 + 0.0017 = 17.1 ms

3. [10% of homework 1] Consider item (2) above. Suppose you are asked to reduce the

access time of your drive by 5%. You are asked to select among the following mutually

exclusive options: (a) increase the transfer rate, (b) increase the rotational speed, and (c)

decrease the average seek time. What should be the values of Sread, RotSpeed, and

TransferRate to achieve such a reduction on average access time?

Based on (2), we want to reduce access time by 5%\*17.1 = 0.855 ms.

1. Since the transfer time = 0.0017 < 0.855, so we can’t reduce access time by increase transfer rate.
2. Since the average rational latency = 4.16 ms, we want it to be 4.16-0.855 = 3.305 ms. So the rational latency = 3.305\*2 = 6.61 ms = 150.28 rev/s = 9077 RPM. So we can increase rotational speed by 9077-7200 = 1877 RPM to reduce access time by 5%.
3. Since the read seek time = 12.9 ms, we can decrease the average read seek time by 0.855 ms which read seek time = 12.9-0.855 = 12.05 ms.

4. [10% of homework 1] Consider that track 0 of the disk is the outermost track of the disk and that initially the head is positioned on that track. Consider that the disk receives the following workload of write requests targeted to the following tracks (in this order): 4, 5, 10, 20, 15, 15, 12, 13.

(a) Assume that after the first write request is satisfied, all other requests are in the

disk’s queue. What is the average seek time per request of this workload

considering that the disk processes the requests in the order of arrival (i.e., First

In First Out)?

(b) Consider now that the disk scheduler orders the requests by increasing order of

track number so that they can all be satisfied by moving the head in a single

direction. What is the average seek time per request in this case?

Deliverables for homework 1:

• A zip file containing:

o For part 1: Your source code file: mips\_ZZZ.asm where ZZZ is your "last names

combined". Do not submit PDF of the MIPS programs, just an .asm file! As part

of the assignment, you need to figure out how to input values and print to the

output in MIPS. As in all programming assignments, your code must be very

well commented.

o For part 1: A pseudo code of the your algorithm as a PDF file. File name:

mips\_pc\_ ZZZ.pdf

o For part 1: The output as a PDF file for the following inputs: 25, 28, 64, 70, 78,

88, and 105. File name: mips\_output\_ ZZZ.pdf.

o For part 2: A pdf file with your answers. File name: Part2\_ ZZZ.pdf

o For part 3: A pdf file with your answers. File name: Part3\_ ZZZ.pdf

2 If reads are random, the chances of finding a sector in the cache can be considered

negligible.