COMP 7500/7506 Advanced Operating Systems
Homework 2: Storage Systems

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Points Possible: **100**
Submission via **Canvas**

This is an individual assignment; no collaboration among students. Students shouldn't share any homework solution with any other student. Collaborations among students in any form will be treated as a serious violation of the University's academic integrity code.

Learning Objectives:

- To study mass storage systems including RAID systems
- To explore I/O scheduling algorithms
- To evaluate the performance of an I/O system

Questions:

1. [20 points] Suppose we apply the SSTF scheduling algorithm (shortest seek time first) to schedule disk requests. Which type of cylinders does SSTF favor? You must justify your answer. **Hint:** There are three types of cylinders, namely, middle cylinders, innermost cylinders, and outermost cylinders.
   Middle cylinder. The center of the disk is the location having the smallest average distance to all other tracks. Thus the disk head tends to move away from the edges of the disk.The new request is more likely to be in the group that includes the center of the disk; thus, the head is more likely to move in that direction.

2. [50 points] Let's consider the following disk request queue: 85, 288, 54, 153, 9, 223, 162, 134 with the disk head initially at the track 40 and the tail track being at 299.

   2.1 [10 points] What is the total head movement if the FCFS algorithm (i.e., first-come, first-served) is employed to schedule these disk requests?
   (85-40) + (288-85) + (288-54) + (153-54) + (153-9) + (223-9) + (223-162) + (162-134) = 1028

   2.2 [10 points] What is the total head movement if the SSTF algorithm (i.e., Shortest Seek Time First) is employed to schedule these disk requests?

14 + 31 + 49 + 19 + 9 + 61 + 65 + 279 = 527

2.3 [10 points] What is the total head movement if the SCAN algorithm (i.e., Elevator) is employed to schedule these disk requests? **Assumption:** We assume that the disk head starts moving toward track 0 first.

40+288=328

2.4 [10 points] What is the total head movement if the C-SCAN algorithm (i.e., Circular Scanning) is employed to schedule these disk requests? **Assumption:** We assume that the disk head starts moving toward track 0 first. We also assume that the big jump from track 0 to track **199(?)** isn't counted as head movement

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40+(299-54)=285

2.5 [10 points] What is the total head movement if the LOOK algorithm (i.e., Advanced C-SCAN) is employed to schedule these disk requests? **Assumption:** We assume that the disk head starts moving toward track 0 first.

(40-9)+(288-9)= 310

3. [15 points] Let's compare two RAID systems (i.e., a RAID-0 system and its RAID-1 counterpart), which share the same number of disks.

3.1 [5 points] Can you explain why in normal cases the RAID-0 system outperforms the RAID-1 system in terms of read performance?
Because of the same number of disks, In RAID-0, data storage is separated to all the disk, you can read the data concurrently. So the read performance is better(data striping).But in RAID-1, half of the disks are just mirror and the mirror cannot speed the read performance .

3.2 [10 points] Please describe a scenario in which RAID-1 may be superior to RAID-0.
If one data block crush, RAID-1 can still work but RAID-0 cannot. So RAID-1 is more reliable than RAID-0.

4. [15 points] Rebuilding a failed RAID-5 system requires reading data from all surviving disks. Please describe a potential problem during the read-intensive RAID-5 rebuilding process.
 RAID-5 can only rebuild one disk at one time. If there are two disks crush, RAID-5 cannot work. One parity can only rebuild one disk.

Submission:

- Submit your solution as a PDF file named as ""hw2.pdf" through Canvas

Late Submission Penalty:

- Ten percent (10%) penalty per day for late submission. For example, an assignment submitted after the deadline but up to 1 day (24 hours) late can achieve a maximum of 90% of points allocated for the assignment. An assignment submitted after the deadline but up to 2 days (48 hours) late can achieve a maximum of 80% of points allocated for the assignment.
- Assignment submitted more than 3 days (72 hours) after the deadline will not be graded.

Rebuttal period:

- You will be given a period of one week (i.e., 7 days) to read and respond to the comments and grades of your homework or project assignment. The TA may use this opportunity to address any concern and question you have. The TA also may ask for additional information from you regarding your homework or project.