

# Homework 11

CS307-Operating System (D), Chentao Wu, Spring 2020.

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- (11.13) Suppose that a disk drive has 5000 cylinders, numbered 0 to 4999. The drive is currently serving a request at cylinder 2150, and the previous request was at cylinder 1805. The queue of pending request, in FIFO order, is:

2069; 1212; 2296; 2800; 544; 1618; 356; 1523; 4965; 3681

Starting from the current head position, what is the total distance (in cylinders) that the disk arm moves to satisfy all the pending requests for each of the following disk-scheduling algorithms?

- a. FCFS;
- b. SCAN;
- c. C-SCAN.

**Solution.** We know that the drive is currently serving a request at cylinder 2150, and the previous request was at cylinder 1805. Hence, the arm is moving in the direction from 0 to 4999. Therefore, the answers to the sub-questions are as follows.

- a. **(FCFS)** The order in which the drive will serve the requests is as follows.

2069; 1212; 2296; 2800; 544; 1618; 356; 1523; 4965; 3681

Hence, we can calculate the total distance as follows.

$$\begin{aligned}\text{total distance} &= (2150 - 2069) + (2069 - 1212) + (2296 - 1212) + (2800 - 2296) \\ &\quad + (2800 - 544) + (1618 - 544) + (1618 - 356) + (1523 - 356) \\ &\quad + (4965 - 1523) + (4965 - 3681) \\ &= 13011 \text{ (cylinders)}\end{aligned}$$

Therefore, the total distance that the disk arm moves to satisfy all the pending requests for FCFS disk-scheduling algorithm is 13011 cylinders.

- b. **(SCAN)** The order in which the drive will serve the requests is as follows.

2296; 2800; 3681; 4965; 2069; 1618; 1523; 1212; 544; 356

Hence, we can calculate the total distance as follows.

$$\text{total distance} = (4999 - 2150) + (4999 - 356) = 7492 \text{ (cylinders)}$$

Therefore, the total distance that the disk arm moves to satisfy all the pending requests for SCAN disk-scheduling algorithm is 7492 cylinders.

- c. **(C-SCAN)** The order in which the drive will serve the requests is as follows.

2296; 2800; 3681; 4965; 356; 544; 1212; 1523; 1618; 2069

Hence, we can calculate the total distance as follows.

$$\text{total distance} = (4999 - 2150) + (4999 - 0) + (2069 - 0) = 9917 \text{ (cylinders)}$$

Therefore, the total distance that the disk arm moves to satisfy all the pending requests for C-SCAN disk-scheduling algorithm is 9917 cylinders.

□

- (11.20) Consider a RAID level 5 organization comprising five disks, with the parity for sets of four blocks on four disks stored on the fifth disk. How many blocks are accessed in order to perform the following?
  - a. A write of one block of data;
  - b. A write of seven continuous blocks of data.

**Solution.** Here are the answers to the sub-questions.

- a. If we only write one block of data, the process is as follows.
  - Read the corresponding parity block;
  - Read the old data in the target block;
  - Calculate the new data of the corresponding parity block by comparing the differences between the old data and the new data and combining the result with the original parity block;
  - Write the new data into the corresponding parity block;
  - Write the new data into the target block.

So if we only write one block of data, we need to access the target block and the corresponding parity block twice (one time for reading the data and one time for writing the data). Therefore, **the total access number is 4 blocks**.

- b. If we write seven continuous blocks of data, then the process may be as follows. Notice here we **assume that the blocks are arranged in four-blocks-alignment**, so seven continuous blocks only need two parity blocks.
  - Calculate the new data of the corresponding parity block of the first four target blocks using the new data of target blocks;
  - Write the new data into the corresponding parity block of the first four target blocks;
  - Write the new data into the first four continuous target blocks;
  - Read the data of the 8th block (the block right after the seven continuous target blocks);
  - Calculate the new data of the corresponding parity block of the last three target blocks and the 8th block by combining the new data of target blocks and the data of the 8th block;
  - Write the new data into the corresponding parity block of the last three target blocks and the 8th block;
  - Write the new data into the last three continuous target blocks.

So if we write seven continuous block of data, under the previous alignment assumption, we need to access all the target blocks once, the 8th block once, two parity blocks once. Therefore, **the total access number is 10 blocks**.

□