CS 342302 Operating Systems

Fall Semester 2021

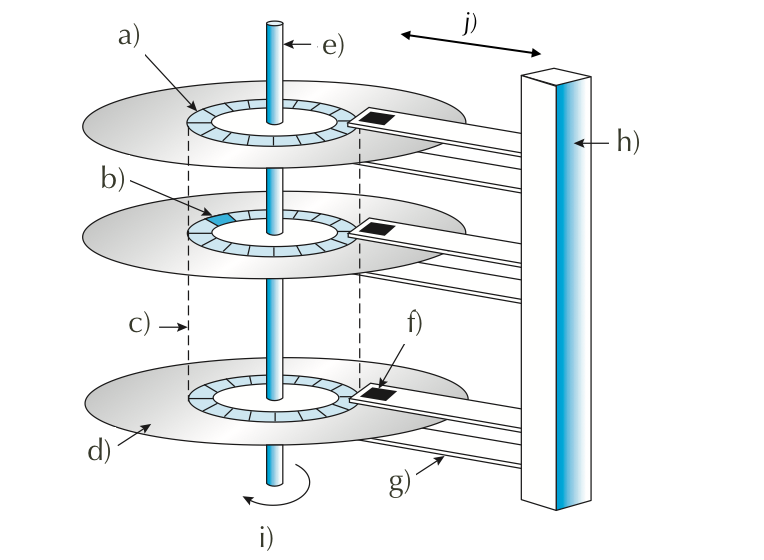
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Weekly Review 12

Scope: Chapter 11, Mass-Storage Systems

## 1. Definitions and Short Answers

1. Name the following parts of a disk (a - h) and the motions (i - j).



1. When accessing data on a magnetic disk,
   1. What is the **rotational latency**?
   2. What is the **seek time**?
   3. What is the **positioning time**?
   4. What is another word for the positioning time?
   5. What are the two components of positioning time in magnetic disk access?
2. What is the difference between a cylinder and a track?
3. For flash memory terminology, assume NAND flash,
   1. What is the minimum unit of reading?
   2. What is the minimum unit of writing?
   3. What is a block?
   4. What happens during an erase?
   5. If you have to modify one byte, what are the steps involved?
4. What is **wear-leveling**, and why is it important for flash memory?
5. What is the primary action that an OS can schedule to improve the performance of a hard disk drive?
6. Of the different disk scheduling algorithms,
   1. is FIFO in general a good policy for HDD? for SSD?
   2. is STSF in general a good policy for HDD? What kind of problem does it have? What about for SSD?
   3. What is the difference between SCAN and C-SCAN?
   4. What is the difference between SCAN and LOOK?
   5. Why does SCAN have more predictable behavior than LOOK?
7. If NVM scheduling does not need to consider rotation or seek time, what does it need to consider?
8. What is a **spare** sector?
9. What is **sector-slipping**?
10. Can a regular file system be used for swap space? What are the advantages and disadvantages?
11. What is a **swap partition**, and why is it a good idea?
12. how do you pronounce SCSI?
13. What does **RAID** stand for?
14. How can RAID achieve higher reliability?
15. How can RAID achieve higher disk performance? In what metric?
16. What is the meaning of the following about disks?
    1. **mean time to failure**
    2. **mean time to repair**, and is it related to mean time to failure?
    3. **mean time to data loss**
17. What is the meaning of
    1. **mirroring**?
    2. **data striping**? Is it related to mirroring?
    3. What is the difference between **bit-level** and **block-level** striping? which is more common?
    4. What is the meaning of **striped mirror**? **mirrored stripes**? Which one is a better choice?

## 2. Programming Exercise

## 3. Disk Scheduling Algorithms [25 points]

You are to implement the disk (seek) scheduling algorithms covered in Chapter 11.

Use the following template ([download](https://drive.google.com/file/d/1R5EUj-fHPWaGPdlTFmtO1Jwyn-bOTnJc/view?usp=sharing) and rename as disk.py):

class DiskScheduler:

\_POLICIES = ['FCFS', 'SSTF', 'SCAN', 'LOOK', 'C-SCAN', 'C-LOOK']

def \_\_init\_\_(self, nCylinders):

self.nCylinders = nCylinders

def schedule(self, initPos, requestQueue, policy, direction):

'''

request is the list of cylinders to access

policy is one of the strings in \_POLICIES.

direction is 'up' or 'down' and applies to (C-)SCAN/LOOK only.

returns the list for the order of cylinders to access.

'''

if policy == 'FCFS':

# return the disk schedule for FCFS

if policy == 'SSTF':

# compute and return the schedule for shortest seek time first

if policy in ['SCAN', 'C-SCAN', 'LOOK', 'C-LOOK']:

# sequentially one direction to one end (up or down),

# then sequentially in opposite direction.

# compute and return the schedule accordingly.

def totalSeeks(initPos, queue):

lastPos = initPos

totalMoves = 0

for p in queue:

totalMoves += abs(p - lastPos)

lastPos = p

return totalMoves

if \_\_name\_\_ == '\_\_main\_\_':

def TestPolicy(scheduler, initHeadPos, requestQ, policy, direction):

s = scheduler.schedule(initHeadPos, requestQ, policy, direction)

t = totalSeeks(initHeadPos, s)

print('policy %s %s (%d): %s' % (policy, direction, t, s))

scheduler = DiskScheduler(200)

requestQueue = [98, 183, 37, 122, 14, 124, 65, 67]

initHeadPos = 53

for policy **in** DiskScheduler.\_POLICIES:

if policy[:2] == 'C-' or policy[-4:] in ['SCAN', 'LOOK']:

TestPolicy(scheduler,initHeadPos, requestQueue, policy, 'up')

TestPolicy(scheduler,initHeadPos, requestQueue, policy, 'down')

else:

TestPolicy(scheduler, initHeadPos, requestQueue, policy, '')

print('more tests on SCAN and C-SCAN')

rQs = [[98, 37, 0, 122, 14], [98, 37, 199, 122, 14], [98,0,37,199,14]]

for q **in** rQs:

print('Q=%s' % q)

for policy in ['SCAN', 'C-SCAN']:

for direction in ['up', 'down']:

TestPolicy(scheduler, initHeadPos, q, policy, direction)

You can expect to get output like this:

$ python3 disk.py

policy FCFS (640): [98, 183, 37, 122, 14, 124, 65, 67]

policy SSTF (236): [65, 67, 37, 14, 98, 122, 124, 183]

policy SCAN up (331): [65, 67, 98, 122, 124, 183, 199, 37, 14]

policy SCAN down (236): [37, 14, 0, 65, 67, 98, 122, 124, 183]

policy LOOK up (299): [65, 67, 98, 122, 124, 183, 37, 14]

policy LOOK down (208): [37, 14, 65, 67, 98, 122, 124, 183]

policy C-SCAN up (382): [65, 67, 98, 122, 124, 183, 199, 0, 14, 37]

policy C-SCAN down (386): [37, 14, 0, 199, 183, 124, 122, 98, 67, 65]

policy C-LOOK up (322): [65, 67, 98, 122, 124, 183, 14, 37]

policy C-LOOK down (326): [37, 14, 183, 124, 122, 98, 67, 65]

more tests on SCAN and C-SCAN

Q=[98, 37, 0, 122, 14]

policy SCAN up (345): [98, 122, 199, 37, 14, 0]

policy SCAN down (175): [37, 14, 0, 98, 122]

policy C-SCAN up (382): [98, 122, 199, 0, 14, 37]

policy C-SCAN down (353): [37, 14, 0, 199, 122, 98]

Q=[98, 37, 199, 122, 14]

policy SCAN up (331): [98, 122, 199, 37, 14]

policy SCAN down (252): [37, 14, 0, 98, 122, 199]

policy C-SCAN up (382): [98, 122, 199, 0, 14, 37]

policy C-SCAN down (353): [37, 14, 0, 199, 122, 98]

Q=[98, 0, 37, 199, 14]

policy SCAN up (345): [98, 199, 37, 14, 0]

policy SCAN down (252): [37, 14, 0, 98, 199]

policy C-SCAN up (382): [98, 199, 0, 14, 37]

policy C-SCAN down (353): [37, 14, 0, 199, 98]