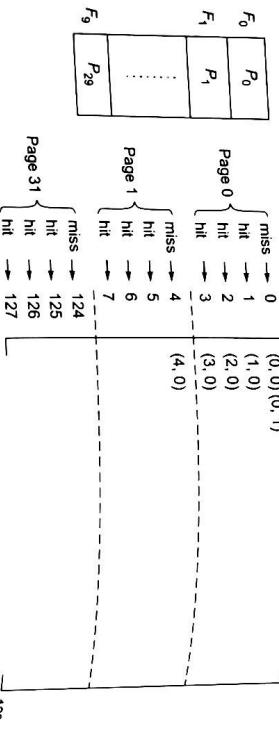


- 4.70 (4096)**
Given array dimension is $D[128][128]$ which is stored in row major order.
It means that, 128 rows and 128 columns.



Given that, each physical frame holds 512 elements of the array D . 30 page frames are allocated to a process. Array access is in column major order $[D[j][l] \mid l = 10]$. As each physical frame holds 512 elements, the 1st 4 rows of the array belongs one page, we can see that, one page fault 4 elements.

Array contains 32 pages, but memory contains 30 Page frames.

$$\therefore n_{\text{out}} \text{ page faults} = \frac{128 \times 128}{4} = \frac{2^{14}}{2^2} = 4096$$

4.71 (5)

Offset = \log_2 (Page size)
= \log_2 (4 KB) = 12 bits

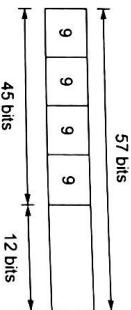
PTE = 8 bytes

For every level page table should fit into a page.

So, number of entries in a page = $\frac{4 \text{ KB}}{8 \text{ B}} = 2^9$

Bits for a level = $\log_2 (2^9) = 9$ bits

Following is representation



So, 5 levels required.

4.72 (6596)

P.A. $\rightarrow (1100111000100)_2 \rightarrow (6596)_{10}$

- 5.1** Which of the following devices should get higher priority in assigning interrupts?
(a) Hard disk
(b) Printer
(c) Keyboard
(d) Floppy disk

[1998: 1 M]

File System and Device Management

- 5.2 (4096)**
Given array dimension is $D[128][128]$ which is stored in row major order.
It means that, 128 rows and 128 columns.

- 5.3 The correct matching for the following pairs is**
- | List-I | List-II |
|-------------------------|------------------|
| A. Disk scheduling | 1. Highspeed RAM |
| B. Batch processing | 2. Disk |
| C. Time sharing | 3. LIFO |
| D. Interrupt processing | 4. FIFO |

- 5.4 Codes:**
- | | |
|------------------------|------------------------|
| (a) A-4, B-3, C-1, D-2 | (b) A-2, B-1, C-3, D-4 |
| (c) A-4, B-3, C-2, D-1 | (d) A-2, B-3, C-4, D-1 |
- 5.5** [1997 : 1 M]

- 5.5 Listed below are some operating system abstractions (in the left column) and the hardware components (in the right column):**
- | | |
|--------------------------|--------------|
| A. Thread | 1. Interrupt |
| B. Virtual address space | 2. Memory |
| C. File system | 3. CPU |
| D. Signal | 4. Disk |

- 5.6** [1998 : 1 M]
Which of the following is true?
(a) Unless enabled, a CPU will not be able to process interrupts.
(b) Loop instructions cannot be interrupted till they complete.
(c) A processor checks for interrupt's before executing a new instruction.
(d) Only level triggered interrupts are possible on microprocessors

- 5.7** [1999 : 1 M]
Listed below are some disk scheduling strategies is likely to give the best throughput?
(a) Farthest cylinder next
(b) Nearest cylinder next
(c) First come first served
(d) Elevator algorithm

- 5.8** [1999 : 1 M]
Which of the following disk scheduling strategies is likely to give the best throughput?
(a) Farthest cylinder next
(b) Nearest cylinder next
(c) First come first served
(d) Elevator algorithm

- 5.9** [1999 : 1 M]
Which of the following requires a device driver?
(a) Register
(b) Cache
(c) Main memory
(d) Disk

- 5.10** [2001 : 1 M]
In the index allocation scheme of blocks to a file, the maximum possible size of the file depends on
(a) the size of the blocks, and the size of the address of the blocks.
(b) the number of blocks used for the index, and the size of the blocks.
(c) the size of the blocks, the number of blocks used for the index, and the size of the address of the blocks.
(d) None of the above

- 5.11** [2002 : 2 M]
Using a larger block size in a fixed block size file system leads to
(a) better disk throughput but poorer disk space utilization

[120, 72, 2], [180, 134, 1], [60, 20, 0],
 [212, 86, 3], [56, 116, 2], [118, 16, 1]

Currently the head is positioned at sector number 100 of cylinder 80 and is moving towards higher cylinder numbers. The average power dissipation in moving the head over 100 cylinders is 20 milliwatts and for reversing the direction of the head movement once is 15 milliwatts. Power dissipation associated with rotational latency and switching of head between different platters is negligible.

The total power consumption in milliwatts to satisfy all of the above disk requests using the Shortest Seek Time First disk scheduling algorithm is _____.

[2018 : 2 M]

The index node (inode) of a Unix-like file system has 12 direct, one single-indirect and one double-indirect pointers. The disk block size is 4 kB and the disk block address is 32-bits long. The maximum possible file size is (rounded off to 1 decimal place) _____ GB. [2019 : 2 M]

5.31 Consider the following five disk access requests of the form (request id, cylinder number) that are present in the disk scheduler queue at a given time.
 (P, 155), (Q, 85), (R, 110), (S, 30), (T, 115)
 Assume the head is positioned at cylinder 100. The scheduler follows Shortest Seek Time First scheduling to service the requests. Which one of the following statements is FALSE?

- (a) R is serviced before P.
- (b) T is serviced before P.
- (c) Q is serviced after S but before T.
- (d) The head reverses its direction of movement between servicing of Q and P.

[2020 : 2 M]

5.32 Consider a linear list based implementation in a file system, where each node contains a list of nodes, where each node contains file name along with the file metadata, containing the list of pointers to the data blocks. Consider a directory foo.

Which of the following operations will necessarily require a full scan of foo for successful completion?

- (a) Opening of an existing file in foo
- (b) Renaming of an existing file in foo
- (c) Creation of a new file in foo
- (d) Deletion of an existing file from foo

[2021 (Set-1) : 1 M]

5.33 Consider two files systems A and B, that use contiguous allocation and linked allocation respectively. A file of size 100 blocks is already stored in A and also in B. Now, consider inserting a new block in the middle of the file (between 50th and 51st block), whose data is already available in the memory. Assume that there are enough free blocks at the end of the file and the file control blocks are already in memory.

Let the number of disk accesses required to read a block in the middle of the file in A and B are n_A and n_B , respectively, then the value of $n_A + n_B$ is _____.

[2022 : 2 M]

5.34 Consider a 512 GB hard disk with 32 storage surfaces. There are 4096 sectors per track and each sector holds 1024 bytes of data. The number of cylinders in the hard disk is _____.

[2024 (Set-1) : 2 M]

5.35 Consider a disk with the following specifications: rotation speed of 6000 RPM, average seek time of 5 milliseconds, 500 sectors/track, 512 byte sectors. A file has content stored in 3000 sectors located randomly on the disk. Assuming average rotational latency, the total time (in seconds, rounded off to 2 decimal places) to read the entire file from the disk is _____.

[2024 (Set-2) : 2 M]

Answers

Question No.	Answer
5.2	(c)
5.3	(b)
5.4	(d)
5.5	(a)
5.6	(a, c)
5.7	(c)
5.8	(b)
5.9	(d)
5.10	(c)
5.20	(d)
5.21	(b)
5.22	(b)
5.23	(b)
5.24	(3)
5.25	(99, 6)
5.26	(10)
5.27	(346)
5.28	(d)
5.29	(85)
5.30	(4)
5.31	(c)
5.32	(b, c)
5.33	(3)
5.34	(153)
5.35	(4096)

File System and Device Management

- DMA I/O → Disk
 Cache → High speed RAM
 Interrupt I/O → Printer
 Condition code register → ALU
- Disk scheduling → SCAN
 Batch processing → FIFO (Queue)
 Time sharing → Round Robin (uses time slice)
 Interrupt processing → LIFO (stack)
- I/O redirection helps to use an existing file as input file for a program.
- When an interrupt occurs, may change state of interrupted process to 'blocked' and schedule another process.
- Hard disk should be higher priority compared to printer, keyboard, and floppy disk. Because all user programs and OS stored at hard disk.
- When interrupt is enabled, a CPU will be able to process the interrupt.
- CPU checks for interrupts before executing a new instruction.
- Thread → CPU
 Virtual address space → Memory
 File system → Disk
 Signal → Interrupt

5.8 (b)

Shortest seek time next or nearest cylinder next gives the best throughput.

5.9 (d)

Disk requires a device driver in computer system.

5.10 (c)

$\frac{\text{DB size}}{\text{DBA}} = \text{Number of DBA's possible in one disk block.}$

5.11 (a)

In a fixed block size file system, larger block size gives better disk throughput but poorer disk space utilization.

5.12 (c)

The number of disk block pointers that will be fit in one block

$$\frac{2^{10} \text{ byte}}{32 \text{ bit}} = \frac{2^{10} \text{ byte}}{4 \text{ byte}} = 256$$

Maximum file size due to single indirection pointer
 $= 256 \times 1 = 256 \text{ KB}$

Maximum file size due to direct pointer
 $= 10 \times 1 = 10 \text{ KB}$

Maximum file size due to double indirection pointer
 $= 256 \times 256 \times 256 \times 1 \text{ KB}$

So the maximum file size
 $= 256 \times 256 \times 256 \times 1 \text{ KB}$
 $= 2^9 \times 2^8 \times 2^8 \times 2^10 \text{ bytes}$
 $= 2^{24} \times 2^{10} \text{ bytes} = 2^{34} \text{ bytes}$

Miscellaneous

5.33 (153)

$$(84 - 63) + (92 - 87) + (121 - 92) + (191 - 121) \\ + (191 - 10) + (11 - 10) + (38 - 11) + (47 - 38) \\ = 24 + 5 + 29 + 70 + 181 + 1 + 27 + 9 = 346$$

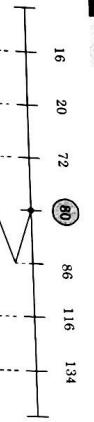
5.28

(d)

Linked and indexed allocations are non contiguous so, they will not suffer from external fragmentation.

5.29

(85)



Required = $n_A + n_B$
= 101 + 52 = 153

5.34 (4096)

$$\text{Disk capacity} = \text{Number of surfaces} \times \text{Number of tracks per surface} \times \text{Number sectors per track} \times \text{Number of bytes per sector}$$

$$512 \text{ GB} = 32 \times x \times 4096 \times 1024 \text{ B}$$

$$2^{39} \text{ B} = 2^5 \times x \times 2^{12} \times 2^{10} \text{ B}$$

$$2^{39} \text{ B} = 2^{27} x \text{ B}$$

$$x = \frac{2^{39}}{2^{27} \text{ B}} = 2^{12}$$

$$x = 4096$$

$$3 \text{ direction changes } 3 \times 15 = 45$$

$$40 + 45 = 85$$

5.30 (4)

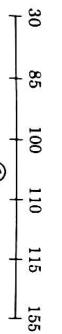
Size of disk block = 4 kB
Disk block address = 32 bit = 4 B

Number of address in one disk block = $\frac{4 \text{ kB}}{4 \text{ B}} = 2^{10}$

12 direct, 1 single indirect, 1 double indirect pointers.

Maximum possible file size
= $(12 + 2^{10} + 2^{10} \times 2^{10}) \times 4 \text{ kB}$
= 4.00395 GB \cong 4 GB

5.31 (c)



- Option (a) is correct as P is serviced last.
- Option (b) is correct as P is serviced last.
- Option (c) is false as Q is serviced before S.
- Option (d) is correct.

$$\text{Average Rotational latency} = \frac{1}{2} \times 10 \text{ ms} = 5 \text{ ms}$$

$$1 \text{ revolution time} \rightarrow 500 \text{ sectors}$$

$$? \quad \swarrow \quad 1 \text{ sector}$$

$$= \frac{10 \text{ ms}}{500} = 0.02 \text{ ms}$$

5.35 (30.06)

$$\text{Average seek time} = 5 \text{ ms}$$

$$6000 \text{ revolutions} \rightarrow 1 \text{ min (60 sec)}$$

$$1 \text{ revolution} \quad ?$$

Given to this process, what is the mode in which the signal handling routine executes?

- (a) kernel mode (b) super user mode
(c) privileged mode (d) user mode

[2005 : 1 M]

6.3 A user level process in Unix traps the signal sent on a Ctrl-C input, and has a signal handling routine that saves appropriate files before terminating the process. When a Ctrl-C input is given to this process, what is the mode in which the signal handling routine executes?

- (a) kernel mode (b) super user mode
(c) privileged mode (d) user mode

[2005 : 1 M]

- 6.4** A student wishes to create symbolic links in a computer system running Unix. Three text files named "file1", "file2" and "file3" exist in her current working directory, and the student has read and write permissions for all three files. Assume that file1 contains information about her hobbies, file2 contains information about her friends and file3 contains information about her courses. The student executes the following sequence of commands from her current working directory.

ln -s file1 file2
ln -s file2 file3

- Which of the following types of information would be lost from her file system?
- I. Hobbies
II. Friends
III. Courses
- (a) I and II only (b) II and III only
(c) II only (d) I and III only
- 6.5** The shell command
- find -name password -print
- is executed in /etc directory of a computer system running Unix. Which of the following shell commands will give the same information as the above command when executed in the same directory?
- (a) ls passwd
(b) cat passwd
(c) grep name passwd
(d) grep print passwd
- 6.6** Consider n jobs J_1, J_2, \dots, J_n such that job J_i has execution time t_i and a non-negative integer weight w_i . The weighted mean completion time of the jobs is defined to be $\frac{\sum_{i=1}^n w_i T_i}{\sum_{i=1}^n w_i}$ where T_i is the completion time of job J_i . Assuming that there is only one processor available, in what order must the jobs be executed in order to minimize the weighted mean completion time of the jobs?
- (a) Non-decreasing order of t_i
(b) Non-increasing order of $w_i t_i$
(c) Non-increasing order of $w_i t_i$
(d) Non-increasing order of $w_i t_i$
- 6.7** [2007 : 2 M]

Answers **Miscellaneous****6.1** (c) **6.2** (d) **6.3** (a) **6.4** (b) **6.5** (a) **6.6** (d)**Explanations** **Miscellaneous****6.1** (c)

Linker definition: Linker is a program which links the compiled code with library files.

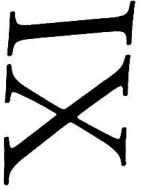
6.2 (d)

An interrupt: An interrupt is a signal from a device attached to a computer or from a program within the computer that causes the main program that operates the computer to stop and figure out what to do next. After the interrupt signal is sensed, it may change state of interrupted process to 'blocked' and schedule another process.

6.3 (a)

When user level process trapping the Ctrl+C signal then the trap signal is going through system call and that's why mode changed to Kernel mode from user mode and then the request is handling.

One more thing kernel mode and privilege mode are same, answer is Kernel mode (privilege mode).

Databases**UNIT****CONTENTS**

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