Operating systems

Sheet 11

(EED)

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IO Management and Disk Scheduling

1- For the following disk accesses, compute the number of head movements for the following list of seeks to disk cylinder: 26, 37, 100, 14, 88, 33, 99, and 12. Assume head is initially positioned over 26.

a. FCFS

seeks	26	37	100	14	88	33	99	12
No. movements	0	11	63	86	74	55	66	87

No of movements=11+63+86+74+55+66+87=442

b. SSTF

seeks	26	37	33	14	12	88	99	100
No. movements	0	11	4	19	2	76	11	1

No of movements=11+4+19+2+76+11+1=124

c. SCAN (going up)

seeks	26	33	37	88	99	100	14	12
No. movements	0	7	4	51	11	1	86	2

No of movements=7+4+51+11+1+86+2=162

d. C-SCAN (going up)

seeks	26	33	37	88	99	100	12	14
No. movements	0	7	4	51	11	1	88	2

No of movements=7+4+51+11+1+88+2=164

2- Consider a disk system with 8 sectors per track and 512 bytes per sector. The disk rotates at 3000 rpm and has an average seek time of 15 msec. Also, consider a file consisting of 8 blocks. Compute the total time for accessing the entire file if the following allocation algorithms are used.

a. Contiguous allocation

revolutions=50rps

seek time=15ms

rotational delay=1/ (2*50) =10ms

transfer time= (8*512)/ (50*512*8) =20ms

Total time =15+20+10=45ms

b. Indexed allocation (not contiguous)

transfer time per sector=512/ (50*8*512) =2.5ms

time every sector =15+10+2.5=27.5ms

Total time =8*27.5=220ms

3- Let us assume a disk with rotational speed of 15,000 rpm, 512 bytes per sector, 400 sectors per track and 1000 tracks on the disk, average seek time is 4ms. We want to transmit a file of size 1 MByte, which is stored contiguously on the disk.

a. What is the transfer time for this file?

Speed=250rps

Transfer time=$\frac{b}{rN}=\frac{1048576}{250*400*512}$=20.48ms

b. What is the average access time for this file?

Rotational delay=1/ (2*250) =2ms

Average time to access file=4ms+2ms+20.48ms=26.48ms

c. What is the rotational delay in this case?

Rotational delay=1/ (2*250) =2ms

d. What is the total time to read 1 sector?

Transfer time=$\frac{b}{rN}$=$\frac{512}{250*400*512}$=0.01ms

Total time to read 1sector=4ms+2ms+0.01ms=6.01ms

e. What is the total time to read 1 track?

Transfer time=$\frac{b}{rN}$=$\frac{512*400}{250*400*512}$=4ms

Total time to read 1 track=4ms+2ms+4ms=10ms

4- A magnetic disk with 5 platters has 2048 tracks/platter, 1024 sectors/track (fixed number of sectors per track), and 512-byte sectors. What is its total capacity?

Total number of bytes=512*1024*2048*5=5368709120

Total capacity of disk=5 Gbyte

5- It should be clear that disk stripping can improve the data transfer rate when the strip size is small compared to the I/O request size. It should also be clear that RAID 0 provides improved performance relative to a single large disk, because multiple I/O requests can be handled in parallel. However, in this latter case, is disk stripping necessary? That is, does disk striping improve I/O request rate performance compared to a comparable disk array without striping?

If the time of I/O long so disk striping improves performance and if many I/O requests with short time disk striping doesn't improve performance.

Consider a 4-drive, 200GB-per-drive RAID array. What is the available data storage capacity for each of the RAID levels 0, 1, 2, 3, 4, 5, and 6?

Raid 0: 800GB all drives used for data no redundancy.

Raid 1: 400 GB 4 drives are used as mirror.

Raid 2: depends on number of hamming codes(400 or 600).

Raid 3: 600 GB as single drive is used as redundant disk.

Raid 4: 600 GB as single drive is used as parity disk.

Raid 5: same as raid 4 and raid 5 but distributing parity bits over all drives.

Raid 6: 400 GB

File Management

1-What is the difference between a field and a record?

Field refers to a single unit of data, while a record is a collection of fields that are related to each other.

2-What is the difference between a file and a database?

A file: is a collection of related records stored in a storage.

A database: is a collection of data organized in a manner that allows access, retrieval, and use of that data. A Database Management System is designed for managing large amounts of structured data.

3-What is a file management system?

File Management System: It is a type of software that manages data files in a computer system. It is used for file maintenance operations and has limited capabilities. It organizes files in a storage like a hard disk.

4-What are typical operations that may be performed on a directory?

Creating: Users can create new files and directories.

Searching: Users can search for specific files or directories within a directory.

Deleting: Unwanted files or empty directories can be deleted.

Listing: Users can retrieve a list of files in a directory.

Updating directory: Because some file attributes are stored in the directory, a change in one of these attributes requires a change in the corresponding directory entry.

5-What is the relationship between a path name and a working directory?

the relationship between a pathname and a working directory is that a pathname provides the location of a file or directory in the file system, and the working directory is the current location in the file system. A relative pathname is interpreted based on the working directory.

6-What are typical access rights that may be granted or denied to a particular user for a particular file?

Read Access: The user can read the contents of the file.

Write Access: The user can modify the file.

Execute Access: The user can run the file if it is an executable file.

Delete Access: The user can delete file.

Open: allowing the process to perform functions on the file

Close: The file is closed w.r.t a process, so that the process no longer may perform functions on the file, until the process opens the file again

7- List and briefly define three file allocation methods.

1-Contiguous Allocation: In this method, each file occupies a contiguous set of blocks on the disk. In this method Only a single entry in the file allocation table, but it suffers from external fragmentation.

2-chained Allocation: In this method, each block contains a pointer to the next block in the chain. This method does not support random or direct access. No external fragmentation.

3-Indexed Allocation: In this method, a special block known as the Index block contains the pointers to all the blocks occupied by a file. The index block is like a table of contents. This method requires additional storage space for the index block**.**

Problems

1- a- log2 N /F

b- Less than half the allocated file space is unused at any time.

2. Ignoring overhead for directories and file descriptors, consider a file system in which files are stored in blocks of 16K bytes. For each of the following file sizes, calculate the percentage of wasted file space due to incomplete filling of the last block:

Block size=1024*16=16384 bytes

41,600 bytes.

41600 /16384=2.54

Take 3 blocks=3*16384= 49152 bytes

Wasted space= 49152-41600=7552 bytes

Percentage of wasted space= (7552 /49152) *100=15.36%

640,000 bytes.

640000 /16384=39.06

Take 40 blocks=40*16384= 655360 bytes

Wasted space= 655360-640000=15360 bytes

Percentage of wasted space= (15360/655360) *100=2.34%

4.064,000 bytes.

4064000 /16384=248.046

Take 249 blocks=249*16384= 4079616 bytes

Wasted space= 4079616-4064000=15616 bytes

Percentage of wasted space= (15616/4079616) *100=0.383%

3-What are the advantages of using directories?

Organization: Directories allow for the logical grouping of files, which can help keep related files organized.

Efficiency: A file can be located more quickly when it's properly organized in directories.

Naming: Directories make it convenient for users.

User Separation: Directories are also used to separate the files created by different users.

4-Directories can be implemented either as "special files" that can only be accessed in limited ways or as ordinary data files. What are the advantages and disadvantages of each approach?

Special Files:

Advantages:

Special files ensure that the structure and format of directories remain consistent. Special files can be optimized for directory operations.

Disadvantages:

This approach might limit the flexibility and control users have over their files and directories.

Ordinary Data Files:

Advantages:

This approach allows for more flexibility in managing directories. And It is simpler to implement than a special file approach.

Disadvantages:

There can be multiple copies of the same data in different files leading to redundancy.

5-Some operating systems have a tree–structured file system but limit the depth of the tree to some small number of levels. What effect does this limit have on users? How does this simplify file system design (if it does)?

Effects on Users:

limiting the depth of the tree can restrict how users organize their files.

Effects on File System Design:

Limiting the depth of the tree can simplify the design and implementation of the file system. It reduces the complexity of algorithms needed for operations like searching and traversing the file system.