**Tutorial 7: File Management**

Q1. (a) List **FOUR**  functions of file managers.

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| **Functions**   * Track where each file is stored. * Determine where and how files will be stored. * Allocate (OPEN) and deallocate (CLOSE) a file * Enforce access policy |

(b) Explain the factors that can affect the efficiency of file managers.

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| **Efficiency depends on:**   * how system’s files are organized (sequential, direct, or indexed sequential). * how they’re stored (contiguously, noncontiguously, or indexed). * how each file’s records are structured (fixed-length or variable-length). * how access to these files is controlled . |

Q2. (a) Explain **FOUR (4)** characteristics which should be considered by a System Analyst when selecting the best organization for a file.

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| **Criteria**   * Volatility of data - frequency with which additions & deletions are made. * Activity of file - amount of records processed during a given run. * Size of file. * Response time - amount of time before requested operation is completed. * Type of storage medium used |

(b) Describe the differences between sequential record organization, indexed sequential record organization and direct file organization

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| **Sequential record organization**   * Records are stored & retrieved serially. * File search requires searching from beginning until record found unless records are sorted before storage   **Indexed sequential record organization**   * An index file is associated with each file. Each entry in index file contains highest record key & physical location of data block where these records & records with smaller keys, are stored. * To access any record in file, system begins by searching index file & then goes to physical location indicated at that entry.   **Direct record organization**   * Records are identified by their relative addresses (their addresses relative to beginning of file). These logical addresses are computed using a hashing algorithm when records are stored & again when records are retrieved. * Accessing any record in any order without having to begin search from beginning of file. |

Q3. (a) Allocation of disk space to files can be done using one of the following techniques:

Contiguous allocation

Linked allocation

Indexed allocation

Assess each allocation technique with respect to disk fragmentation and disk space usage.

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| Contiguous allocation   * External fragmentation occurs when the largest chunk of free disk space is insufficient for a request. * Wastage of disk space is substantial.   Linked allocation   * Eliminate external fragmentation as any block of the disk can be used * However, some percentage of disk space is used to store pointers.   Indexed allocation   * Eliminate external fragmentation as any block of the disk can be used * However space is needed for the index block for every file. |

(b) Which of the allocation technique is the most efficient for random access of data? Explain your answer.

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| Answer could be contiguous or indexed.  Contiguous   * Direct access to block I of a file that starts at block B can be done immediately by accessing block B + I.   Linked   * Random access is time-consuming; access to block I requires I disk reads and maybe I disk seeks.   Indexed   * Direct access to block I of the file is fast by obtaining the Ith pointer from the index block |

(c) “File allocation methods are essentially influencing the efficiency of disk scheduling algorithms”. Do you agree with this statement? Justify.

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| Yes.  Contiguous allocation – consecutive blocks are allocated to a file. Therefore, a program reading a contiguously allocated file will generate several requests that are close together on the disk, resulting in limited head movement.  Under index allocation methods, blocks are widely scattered. Thus access data in indexed allocated files will result in greater head movement. |

Q4. Describe THREE methods that are commonly used in operating systems for managing free disk space. Recommend the most suitable method to be used for a file system that applies the contiguous allocation strategy. Justify your answer.

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| **Methods of implementing the free-space list**   * bit vector * linked list * grouping * counting   Bit vector or counting. Either one is suitable method to be used for a file system that applies the contiguous allocation strategy. Based on students justification. |

Q5. In multi-user environments, the issues of file sharing and protection are important.

A user wanting to share his file X with others has the following options:

Option A: create links from the other user’s home directories to X.

Option B: copy X to the home directories of the other users.

Compare the benefits and drawbacks of each option.

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| **Option A** | **Option B** |
| * Any update is reflected to all users sharing data. * Save storage space * When the owner of data deletes it, dangling pointer may arise. | * Copies of data may become inconsistent and stale information may be used accidentally. * Storage waste * No dangling pointer problem |

\*\*Any other logical answers are acceptable.

**Self-Review**

Q1. Mr. Lucas is a director of a local company. His company is currently using decentralized computer system and he is decided to improve the company current system with centralized database. Suggest an appropriate file allocation method to Mr. Lucas and write a proposal based on your suggested file allocation method to Mr. Lucas.

(Note: Your proposal should include the description of the suggested file allocation method with its strengths and weaknesses.)

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| Contiguous Allocation or Index Allocation. Justification up to individual student.  For the Indexed allocation method is a method that is used for file allocation. In the index allocation method, we have an additional block, and that block is known as the index block.  For each file, there is an individual index block. In the index block, the ith entry holds the disk address of the ith file block.  The advantages of index allocation are:   * The index allocation method solves the problem of external fragmentation. * Index allocation provides direct access.   The disadvantages of index allocation are:   * In index allocation, pointer overhead is more. * It is totally a wastage to create an index for a small file. |

Q2. Based on the proposal that you have written in ***Q1)***, which free space management method would you recommend to Mr. Lucas? Justify your recommendation.

(Note: Your recommendation should include the strengths and the weaknesses of the proposed free space management method.)

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| If students’ answer given in Q1) is  Contiguous Allocation - Recommended free space management method is either bit vector or counting. Recommendation with valid justification.  Indexed Allocation - Recommended free space management method is either grouping or linked allocation.  Any TWO Strengths of the recommended space management method  Any TWO Weaknesses of the recommended space management method  https://www.tutorialandexample.com/file-allocation-methods/ |