

## 1 Blocks, Pages and Access Times

Consider a disk with a sector size of 512 bytes, 2000 cylinders, 50 sectors per cylinder, 5 double-sided platters, and a block size of 1024 bytes. Suppose that a file containing 100,000 records of 100 bytes each is to be stored on such a disk such that no record is allowed to span more than one block.

1. How many records fit onto a block?
2. How many blocks are required to store the entire file? If the file is arranged sequentially on disk (filling up one surface after the other), how many surfaces are needed? What is the optimum way to arrange the data on disk?
3. How many records of 100 bytes each can be stored using this disk?
4. Given that the time to move the head between 2 tracks is at least 4 msec whereas the head switch time is 1 msec, the average seek time is 10 msec, the disk platters rotate at 5400 rpm, and 1 track of data can be transferred per rotation: how much time is required to read the entire file sequentially?. How much time is required to read the entire file assuming random scan access? (assume both sequential and optimal arrangement of data)

## 2 Levels of Redundancy

Given the following configuration options for your RAID solution:

1. RAID 0
2. RAID 1
3. RAID 5
4. RAID 6

Discuss which of these RAID configurations are better in terms of: (a) read vs. write performance and (b) reliability.

## 3 Sequential Scans and Extents

Define what an extent is and discuss how the distribution and sizing of extents impacts sequential scan performance. What are potential interactions with prefetching and block usage factor?

## 4 Buffer Management

1. Consider the following page reference sequence:

1, 2, 3, 4, 2, 1, 5, 6, 2, 1, 2, 3, 7, 6, 3, 2, 1, 2, 3, 6

How many page misses would occur using LRU, FIFO, or an optimal replacement strategy, assuming a main memory with 1, 2, 4, or 7 frames.

2. Assume variable-length pages, explain why the discussed replacement strategies might not work. Develop 2 replacement strategies based on LRU and FIFO that would work for the case of variable-length pages.