Improving Performance Using a Disk Cache

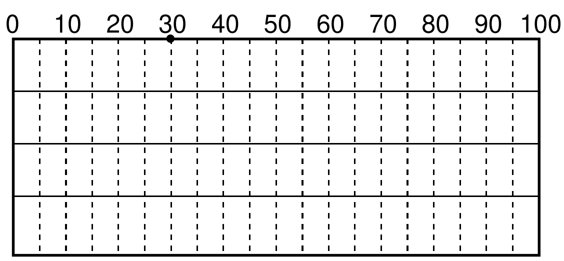
- Have OS (not hardware) manage a *disk block cache* to improve performance
  - Use part of main memory as a cache
  - When OS reads a file from disk, it copies those blocks into the cache
  - Before OS reads a file from disk, it first checks the cache to see if any of the blocks are there (if so, uses cached copy)
- Replacement policies for the blocks:
  - Same options as paging
    - FIFO, LRU using clock / second chance
  - Easy to implement exact LRU
    - OS just records time along with everything else it has to update when a block is read
  - But — sequential access degrades LRU
    - Solution: free-behind policy for large sequentially-accessed files — as block is read, remove previous one from cache

Improving Performance with Disk Head Scheduling

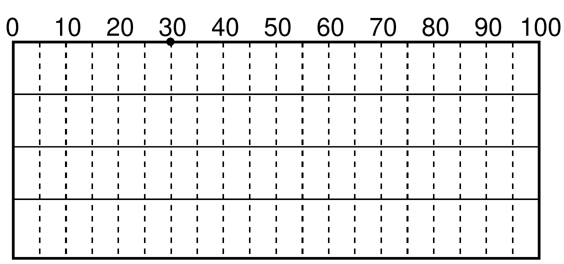
- Permute the order of the disk requests
  - From the order that they arrive in
  - Into an order that reduces the *distance* of seeks
- Examples:
  - Head just moved from lower-numbered track to get to track 30
  - Request queue: 61, 40, 18, 78
- Algorithms:
  - First-come first-served (FCFS)
  - Shortest Seek Time First (SSTF)
  - SCAN (0 to 100, 100 to 0, …)
  - C-SCAN (0 to 100, 0 to 100, …)

Disk Head Scheduling (cont.)

- FCFS (used in Nachos)
  - Handle in order of arrival

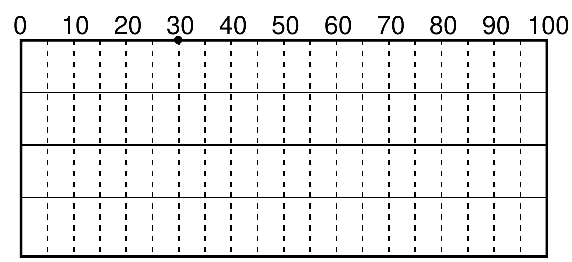


- SSTF
  - Select request that requires the smallest seek from current track

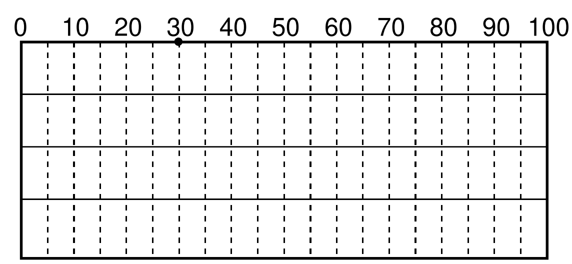


Disk Head Scheduling (cont.)

- SCAN (Elevator algorithm)
  - Move the head 0 to 100, 100 to 0, picking up requests as it goes

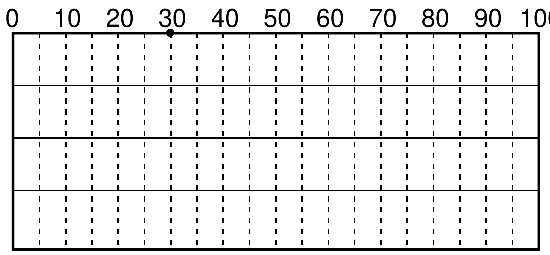


- LOOK (variation on SCAN)
  - Don't go to end unless necessary

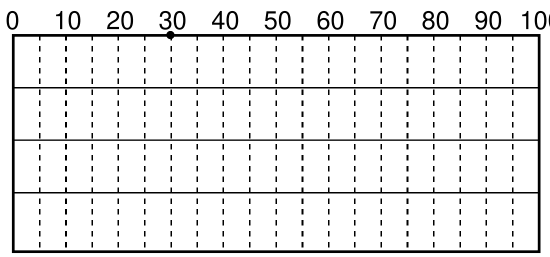


Disk Head Scheduling (cont.)

- C-SCAN (Circular SCAN)
  - Move the head 0 to 100, picking up requests as it goes, then big seek to 0



- C-LOOK (variation on C-SCAN)
  - Don’t go to end unless necessary



Improving Disk Performance

- Keep some structures in memory
  - Active inodes, file tables
- Efficient free space management
  - Bitmaps
- Careful allocation of disk blocks
  - Contiguous allocation where possible
  - Direct / indirect blocks
  - Good choice of block size
  - Cylinder groups
  - Keep some disk space in reserve
- Disk management
  - Cache of disk blocks
  - Disk scheduling

Disk Management

- Disk formatting
  - Physical formatting — dividing disk into sectors: header, data area, trailer
  - Most disks are preformatted, although special utilities can reformat them
  - After formatting, must partition the disk, then write the data structures for the file system (logical formatting)
- *Boot block* contains the “bootstrap” program for the computer
  - System also contains a ROM with a bootstrap loader that loads this program
- Disk system should ignore bad blocks
  - When disk is formatted, a scan detects bad blocks and tells disk system not to assign those blocks to files
  - Disk may also do this as disk is used

Disk Management (cont.)

- Swap space management
  - Swap space in normal file system
  - Swap space in separate partition
    - One big file — don’t need whole file system, directories, etc.
    - Only need manager to allocate/deallocate blocks (optimized for speed)
- Disk reliability
  - Data normally assumed to be persistent
  - Disk striping — data broken into blocks, successive blocks stored on separate drives
  - Mirroring — keep a “shadow” or “mirror” copy of the entire disk
  - Stable storage — data is never lost during an update — maintain two physical blocks for each logical block, and both must be same for a write to be successful