3.1 Disks

- Compared with time for memory access, disk access is always expensive.
- Disk drives belong to a class of devices called direct access storage devices(DASDs).
- Hard-disks offer high capacity and low cost per bit(commonly used).
- Floppy disks are inexpensive, slow and hold little data.
- Removable disks use disk cartridges that can be mounted on same drive at different times.data can be accessed directly.

3.1.1 Organization of Disks

- The information on disk is stored on the surface of 1 or more platters.(Fig 3.1)
- The information is stored in successive **tracks** on the surface of the disk.(Fig 3.2)
- Each track is divided into **sectors**.
- A sector is the smallest addressable portion of a disk.
- Disk drives have a number of platters.
- The tracks directly above one another form a **cylinder(Fig 3.3)**
- All information on a single cylinder can be accessed without moving the arm that holds the read/write heads.
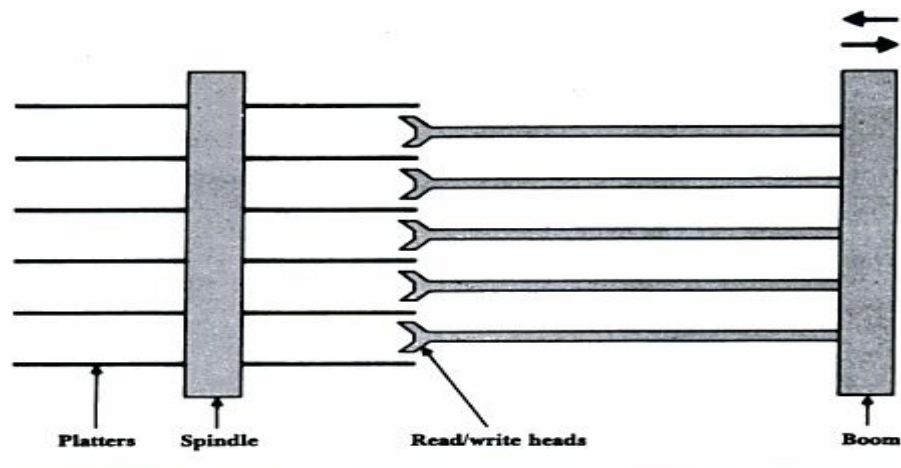- Moving this arm is called seeking.

Platters   Spindle   Read/write heads   Boom

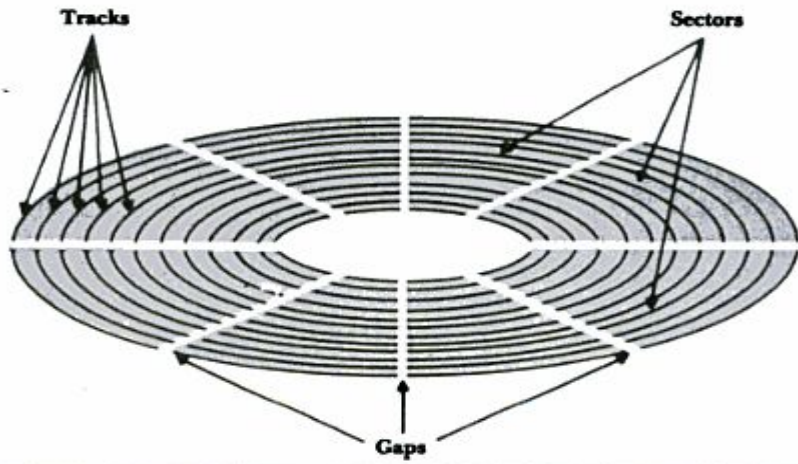**Figure 3.1** Schematic illustration of disk drive.

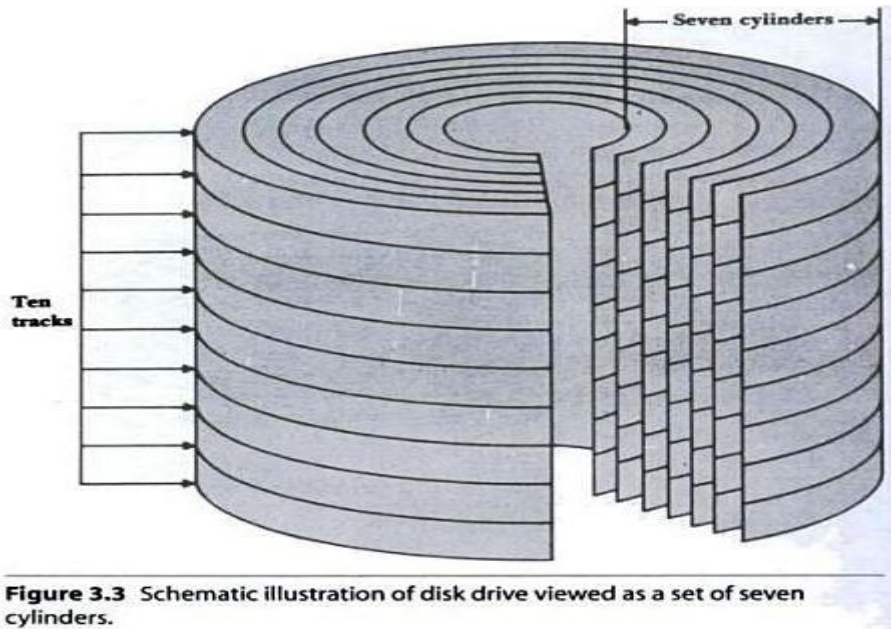**Figure 3.2** Surface of disk showing tracks and sectors.

Figure 3.3 Schematic illustration of disk drive viewed as a set of seven cylinders.

3.1.2 Estimating Capacities and space needs

In a disk, each platter has 2 surfaces, so number of cylinders is same as number of tracks on a single surface.

Since a cylinder consists of a group of tracks, a track consists of a group of sectors, a sector has a group of bytes, track,cylinder and drive capacities can be computed as follows

Track capacity = number of sectors per track × bytes per sector
Cylinder capacity = number of tracks per cylinder × track capacity
Drive capacity = number of cylinders × cylinder capacity.

Given a disk with following characteristics

Number of bytes per sector = 512
Number of sectors per track = 63
Number of tracks per cylinder = 16
Number of cylinders = 4092

How many cylinders does the file require if each data record requires 256 bytes? Since each sector can hold two records, the file requires

$$\frac{50\ 000}{2} = 25\ 000 \text{ sectors}$$

One cylinder can hold

$$63 \times 16 = 1008 \text{ sectors}$$

so the number of cylinders required is approximately

$$\frac{25\ 000}{1008} = 24.8 \text{ cylinders}$$

3.1.3 Organizing Tracks by Sector

Two ways to organize data on disk: by sector and by user defined block.

The physical placement of sectors
Different views of sectors on a track:

- Sectors that are adjacent, fixed size segments of a track that happen to hold a file(Fig 3.4a). When you want to read a series of sectors that are all in the same track, one right after the other, you often cannot adjacent sectors. In Fig 3.4a, it takes thirty-two revolutions to read the entire 32 sectors of a track.
- Interleaving sectors: leaving an interval of several physical sectors between logically adjacent sectors. Fig 3.4(b) illustrates the assignment of logical sector content to the thirty-two physical sectors in a track with interleaving factor of 5. In Fig 3.4b, It takes five revolutions to read the entire 32 sectors of a track.
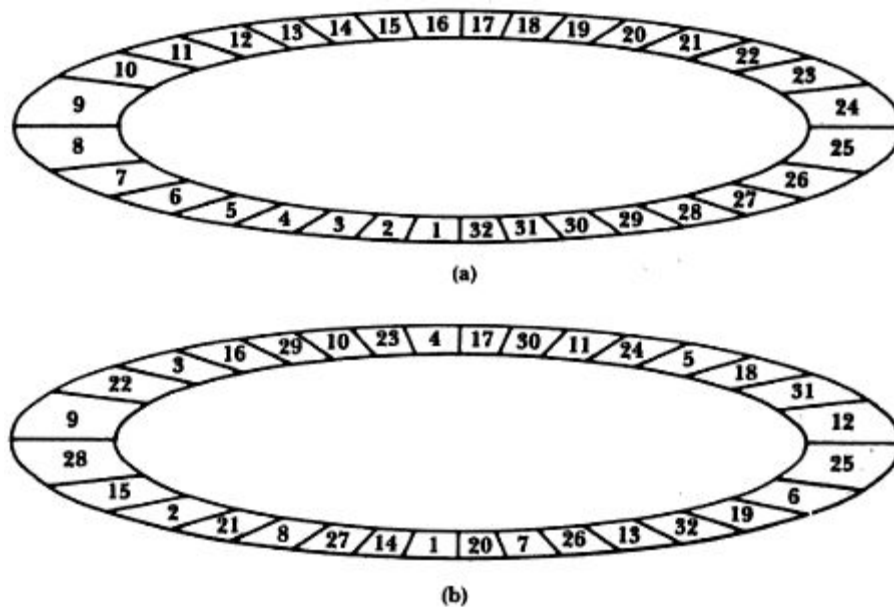
Figure 3.4 Two views of the organization of sectors on a thirty-two-sector track.

cluster

    A group of sectors handled as a unit of file allocation. A cluster is a fixed number of contiguous sectors

extent

    A physical section of a file occupying adjacent clusters.

fragmentation

    Unused space within a file.

- Clusters are also referred to as allocation units (ALUs).
- Space is allocated to files as integral numbers of clusters.
- A file can have a single extent, or be scattered in several extents.

- Access time for a file increases as the number of separate extents increases, because of seeking.
- Defragmentation utilities physically move files on a disk so that each file has a single extent.
- Allocation of space in clusters produces fragmentation.
- A file of one byte is allocated the space of one cluster.
- On average, fragmentation is one-half cluster per file.