

## Free Space Management

### Definition:

Free space management refers to the methods used by an Operating System to track free disk blocks so they can be allocated to files when needed and released when files are deleted.

### Why Free Space Management is Needed:

- Efficient utilization of disk space
- Fast allocation and deallocation of disk blocks
- Avoid fragmentation and wastage

### Methods of Free Space Management:

#### 1. Bit Vector / Bit Map

Uses one bit for each disk block.

0 → Free block, 1 → Allocated block.

**Advantages:** Simple, fast, easy to find contiguous blocks.

**Disadvantages:** Bitmap must be stored in memory; size depends on disk size.

#### 2. Linked List

All free blocks are linked together, each pointing to the next free block.

**Advantages:** No need for large memory, easy to manage.

**Disadvantages:** Slow traversal, difficult to find contiguous blocks.

#### 3. Grouping

First free block stores addresses of multiple free blocks; last entry points to next group.

**Advantages:** Faster than linked list, reduces disk I/O.

**Disadvantages:** Slightly complex, sequential at group level.

#### 4. Counting

Free space is represented as (starting block, number of free blocks).

**Advantages:** Very compact, fast allocation of large spaces.

**Disadvantages:** Works well only when free space is mostly contiguous.

### Conclusion:

Among all methods, Bit Map is most commonly used due to simplicity and efficiency.