KARNAVATI UNIVERSITY

Operating Systems

Course Code: **71203002004**

Free Space Management

by -

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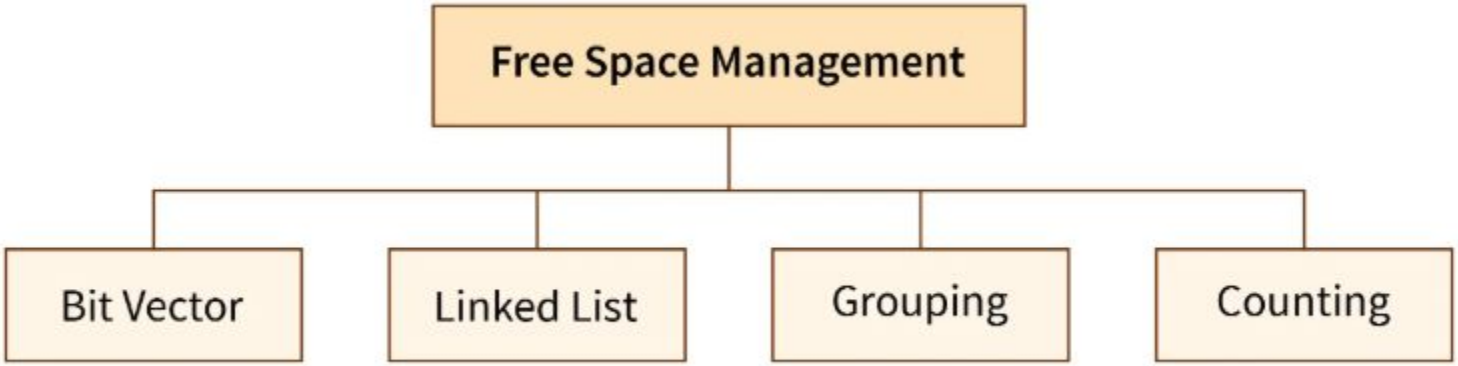
Free Space Management

Free space management is the process of keeping track of free blocks (unused memory space) on the disk.

- When a file is created → OS searches for free blocks and allocates them.
- When a file is deleted → OS frees those blocks and adds them back to the free space list.

There are different methods:

1. Bit Map
2. Linked List Approach
3. Grouping Method
4. Counting Method


Free Space Management
Bit Vector
Linked List
Grouping
Counting

1. Bit Vector (Bitmap)

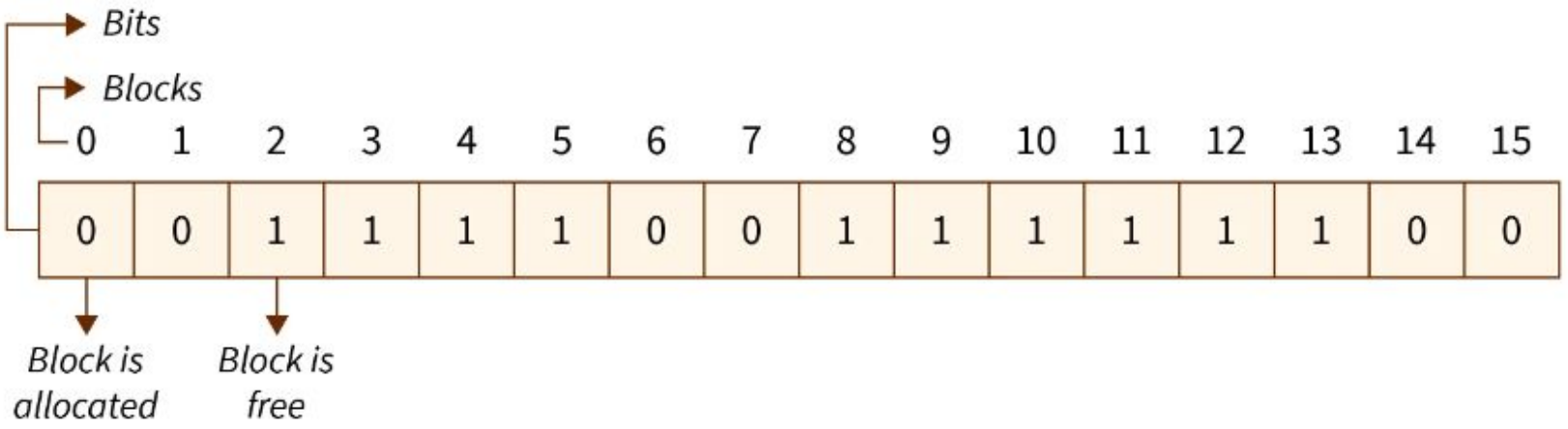
- Each disk block is represented by **one bit**:
  - `0` → free block
  - `1` → allocated block
- Example: `1111000111111001` shows which blocks are free/used.

Pros:

- Very simple to understand.
- Easy to find the first free block.

Cons:

- Searching for free blocks takes time if the disk is large.
- Becomes less efficient with bigger disks.


Bits
Blocks
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
0 0 1 1 1 1 0 0 1 1 1 1 1 1 0 0
Block is allocated
Block is free

2. Linked List Approach

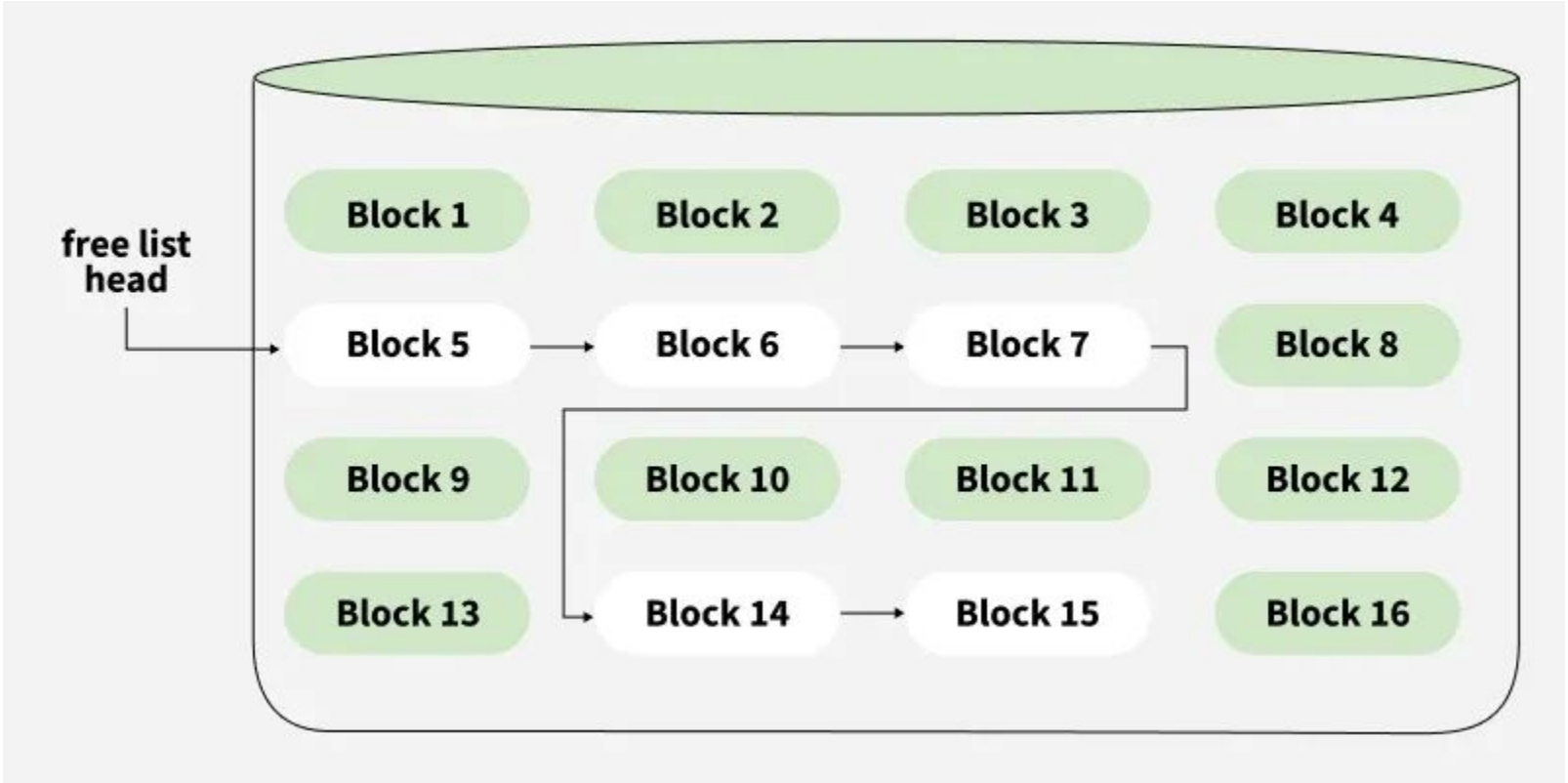
- Free blocks are linked together in a **chain**.
- Each free block stores the address of the **next free block**.

Pros:

- Uses space efficiently.
- Easy to add/remove free blocks dynamically.

Cons:

- Maintaining pointers becomes difficult with large lists.
- Slower, since traversal is needed.
- Requires extra I/O to follow the list.


free list head
Block 1
Block 2
Block 3
Block 4
Block 5
Block 6
Block 7
Block 8
Block 9
Block 10
Block 11
Block 12
Block 13
Block 14
Block 15
Block 16

3. Grouping

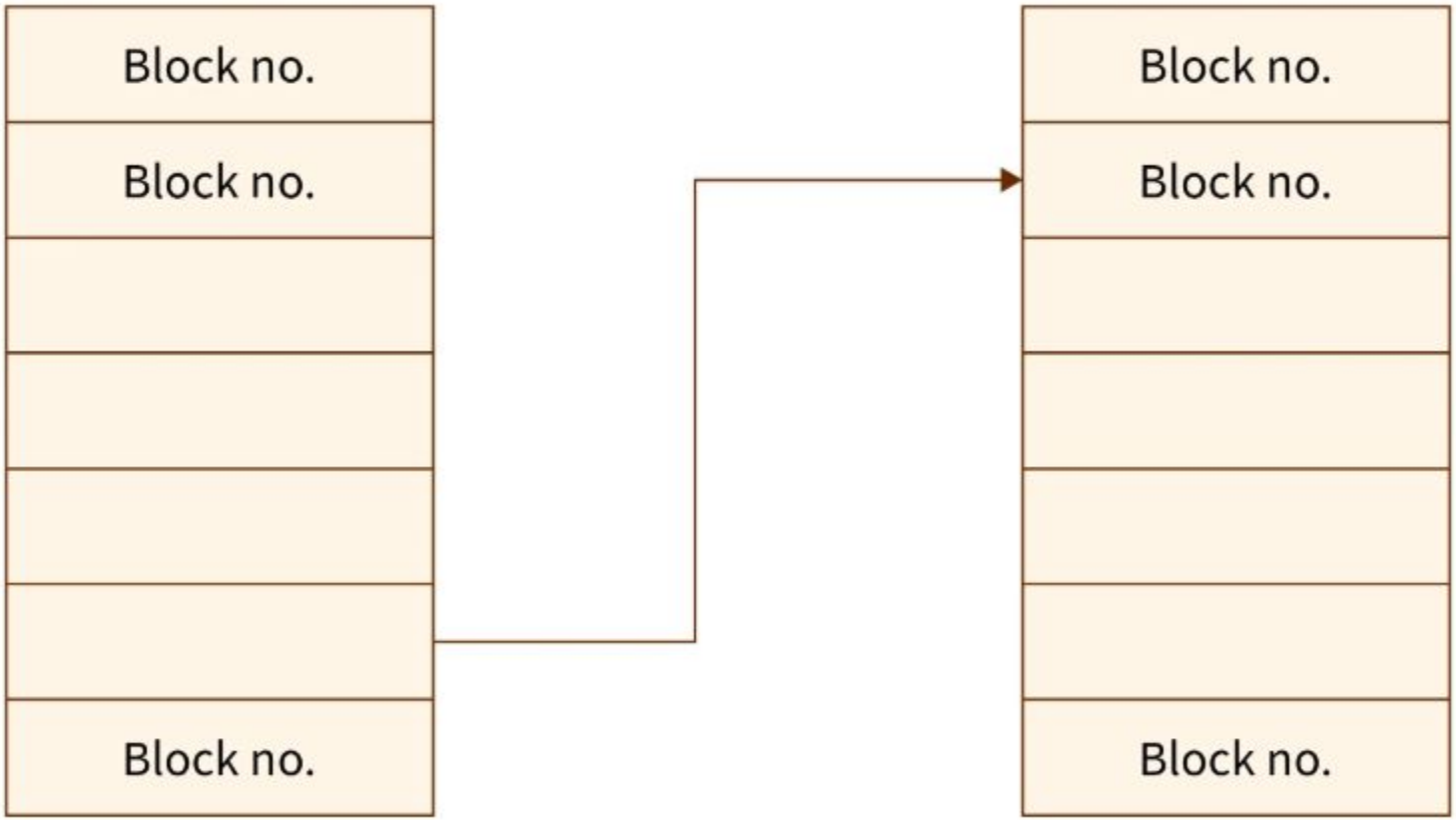
- A variation of the linked list method.
- First free block stores the addresses of a group of free blocks (say n blocks).
- The last block in the group points to the next group of free blocks.

Advantages:

Quickly finds a large number of free blocks

Disadvantages:

If one block is occupied, the entire list may need changes


Block no.
Block no.
Block no.
Block no.
Block no.
Block no.
Block no.
Block no.
Block no.
Block no.

4. Counting

- Free space list stores:
  - Address of the first free block
  - Number of consecutive free blocks (n)
- Useful when many blocks are free in a sequence.

Advantages:

- Fast allocation of groups of blocks
- List size is smaller

Disadvantages:

Needs extra space to store block count

Advantage vs Disadvantage - Free Space Management

Advantages	Disadvantages
Efficient use of disk space	Fragmentation may occur
Faster file access in some methods	Extra overhead (pointers, index blocks)
Simple to implement (e.g., linked list)	Some methods don’t scale well for large disks
	Risk of data loss in certain techniques

Efficiency Considerations

- Bitmap: Simple but not efficient for very large disks.
- Linked List: Easy but slow for searching.
- Grouping/Counting: More efficient, reduce overhead.
- Choice depends on disk size, fragmentation, and OS needs.

DISCUSSION & REVISION

1. Which method of free space management uses 1 and 0 bits to represent blocks?
2. In which method are free blocks connected by pointers?
3. Which method is a modified form of Linked List?
4. Which method stores the first free block and the number of consecutive free blocks?
5. What problem can occur in free space management that reduces efficiency?

REFERENCES

1. https://www.geeksforgeeks.org/operating-systems/free-space-management-in-operating-system/
2. https://www.scaler.com/topics/free-space-management-in-os/