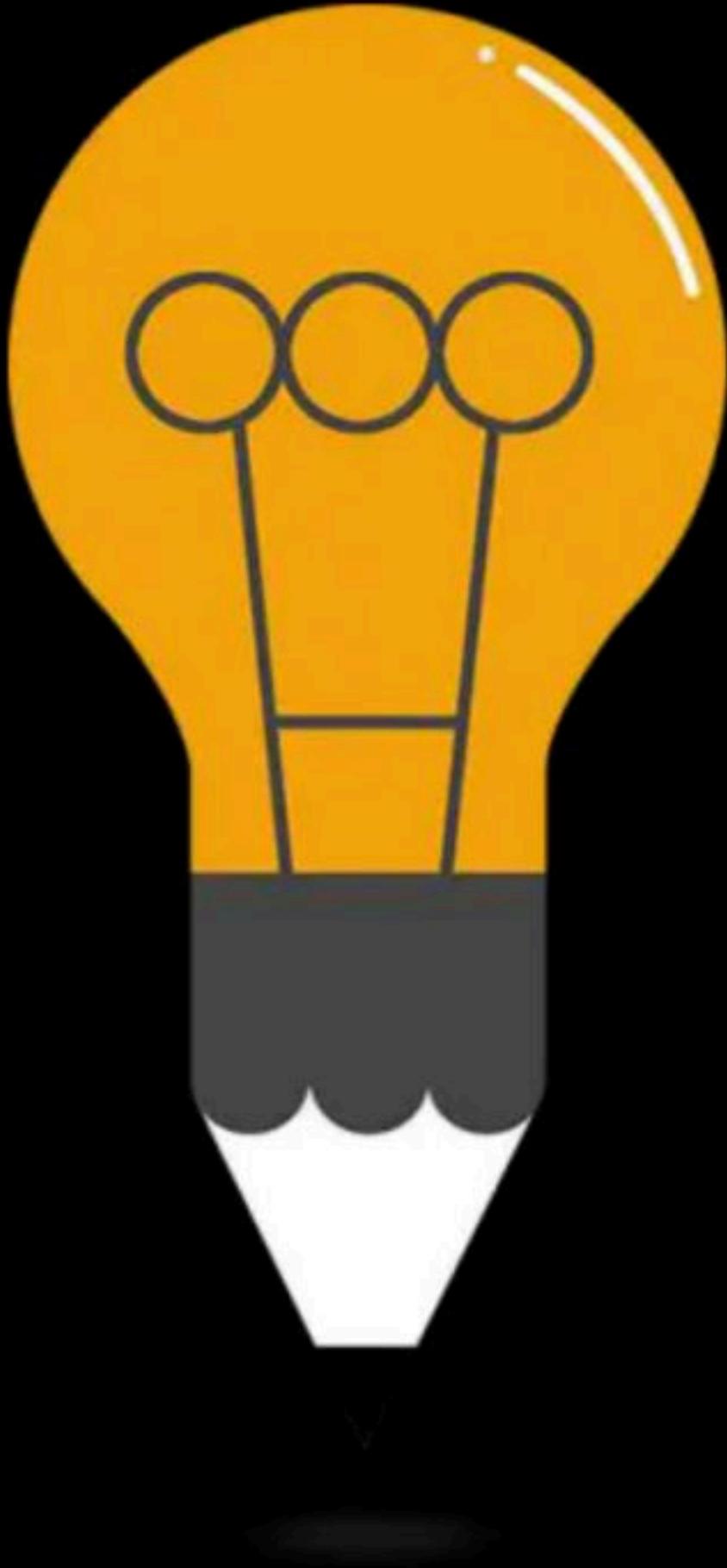


File System & Disk Blocks

Comprehensive Course on Operating System for GATE - 2024/25



Operating System File System

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▲ 1 • Asked by Shreyas

sir hit rate > 1

In a two-level virtual memory, the memory access time for main memory, $t_M = 10^{-8}$ sec, and the memory access time for the secondary memory, $t_D = 10^{-3}$ sec. What must be the hit ratio, H such that the access efficiency is within 80 percent of its maximum value?

$$0.8 \left(3 \times 10^{-8} \right) = \left[H \times 3 \times 10^{-8} + (1-H) \times \left(2 \times 10^{-8} + 10^{-3} \right) \right]$$

A file is a named collection of related information that is recorded on secondary storage.

File Attributes

1. Name
2. Extension
3. Size
4. Date
5. Author
6. Created, Modified, Accessed
7. Attributes: Read-only, hidden
8. Default Program
9. Security Details

File Directory

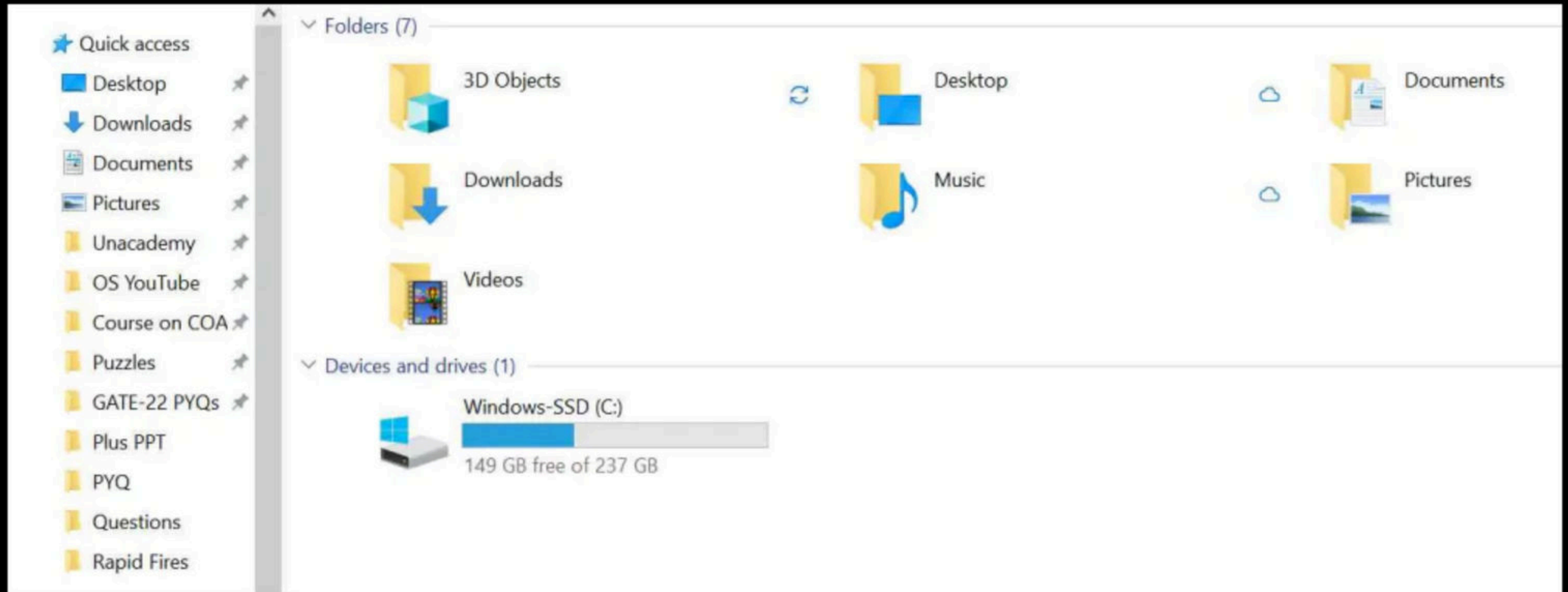
Collection of files

folder

File System

Module of OS which manages, controls and organizes files and related structures

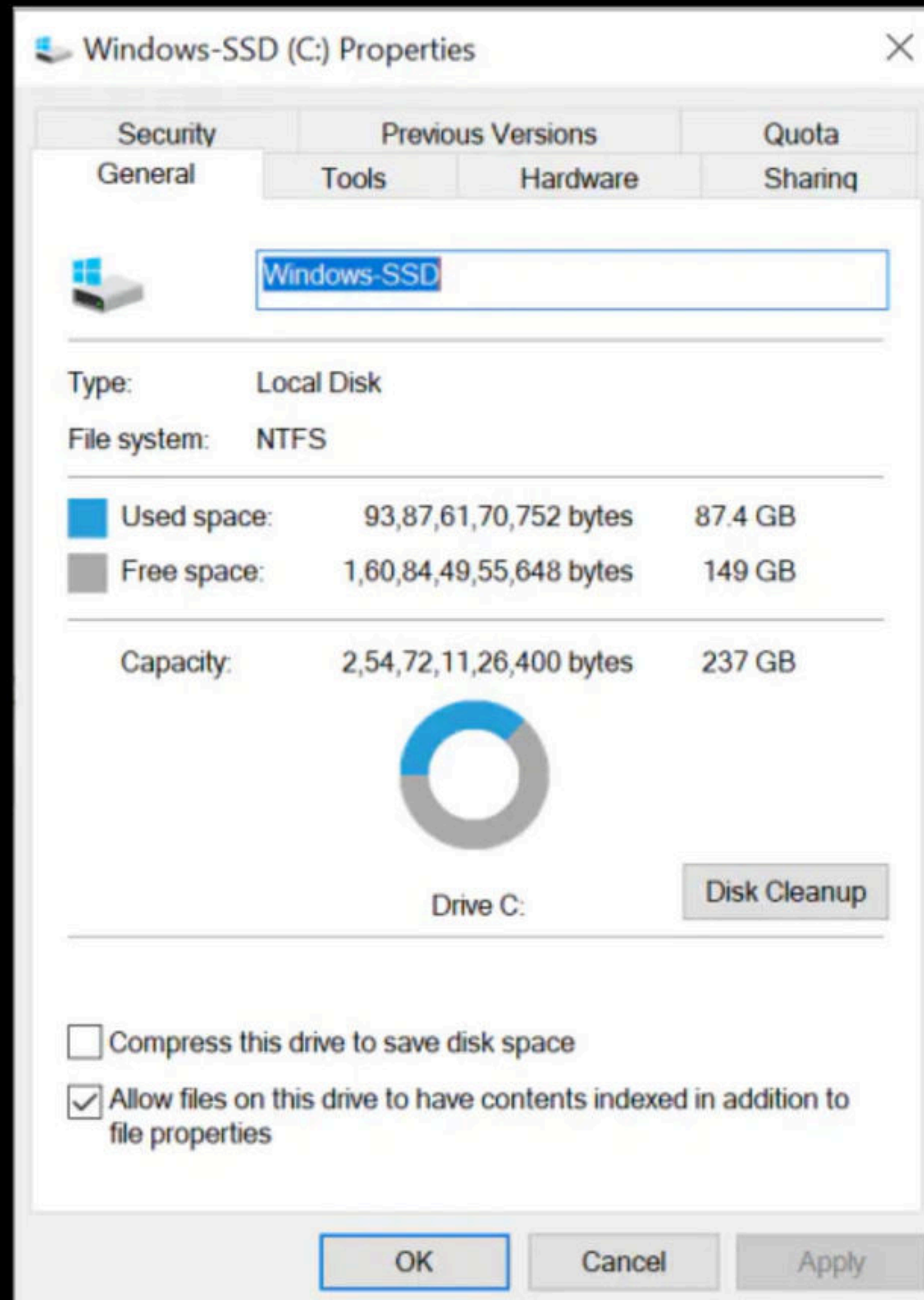
File System



Types of File Systems

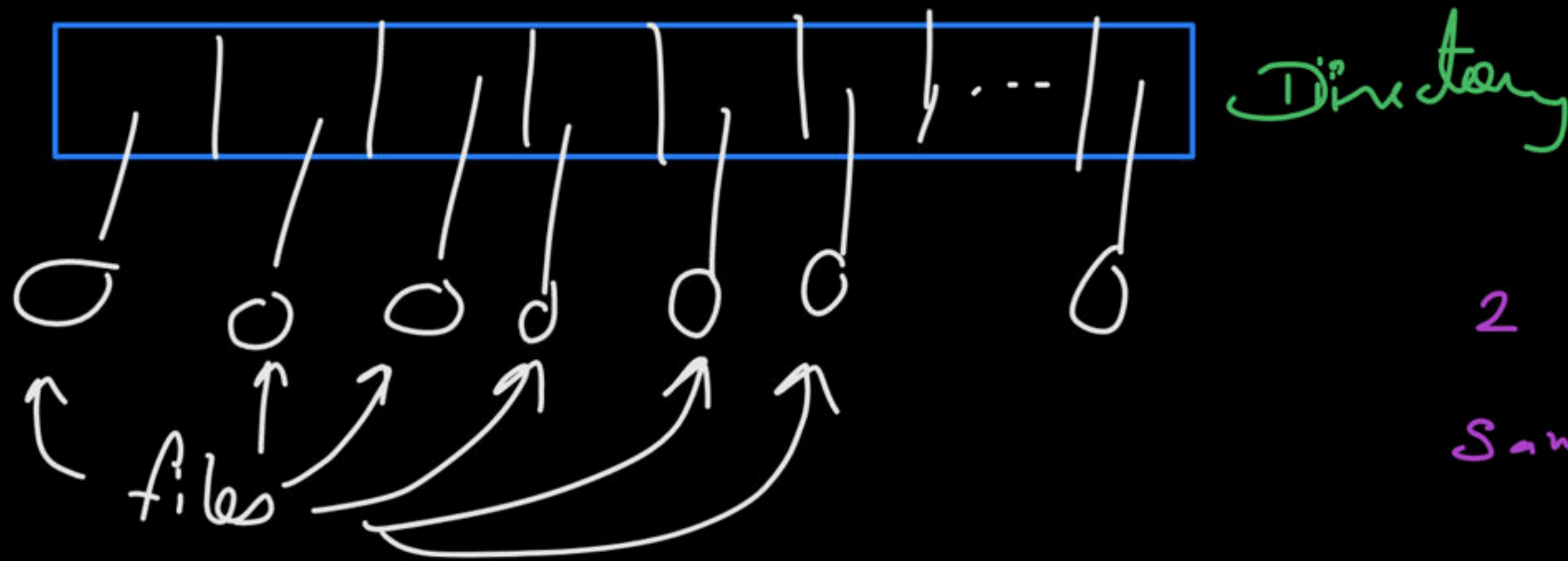
1. FAT32
 2. NTFS
 3. HFS+
 4. Ext2 / Ext3 / Ext4
 5. Swap
-
- ```
graph LR; FAT32 --- UnixLinux[unix & linux]; NTFS --- Windows[windows]; NTFS --- UnixLinux; Ext2_3_4[Ext2 / Ext3 / Ext4] --- UnixLinux; HFSplus[HFS+] --- macOS[macOS]; Swap --- Swap[Swap];
```

# File System



# File Directory Structure

## 1. Single-Level Directory

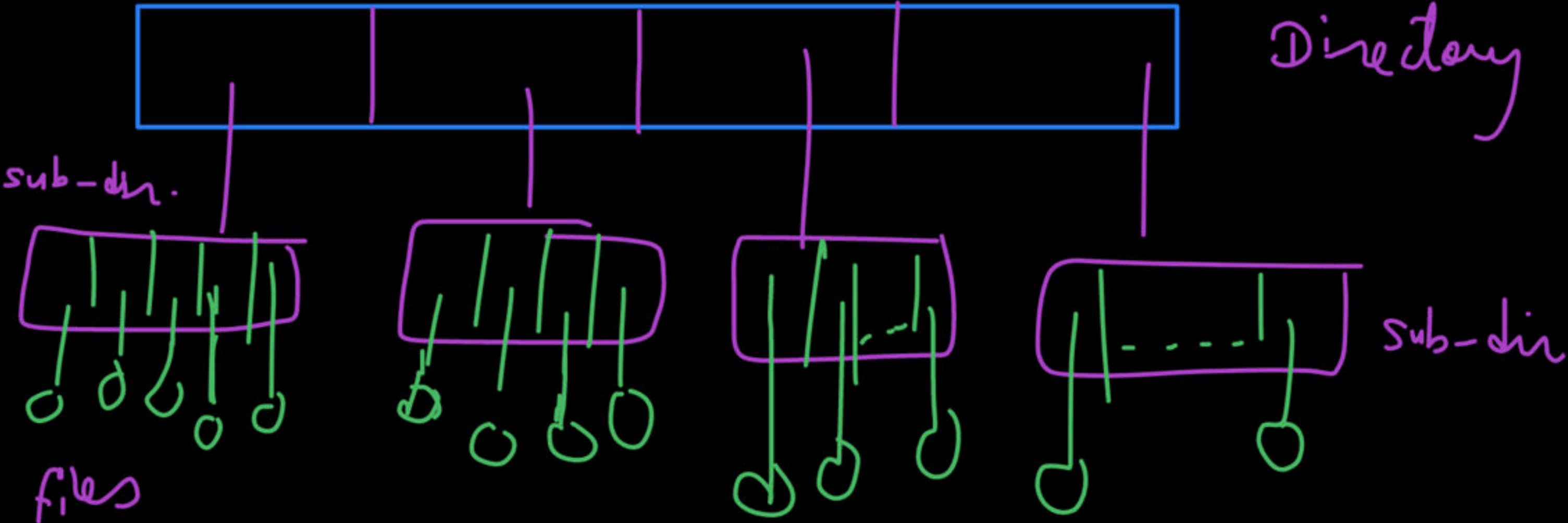


2 files can not have  
same name



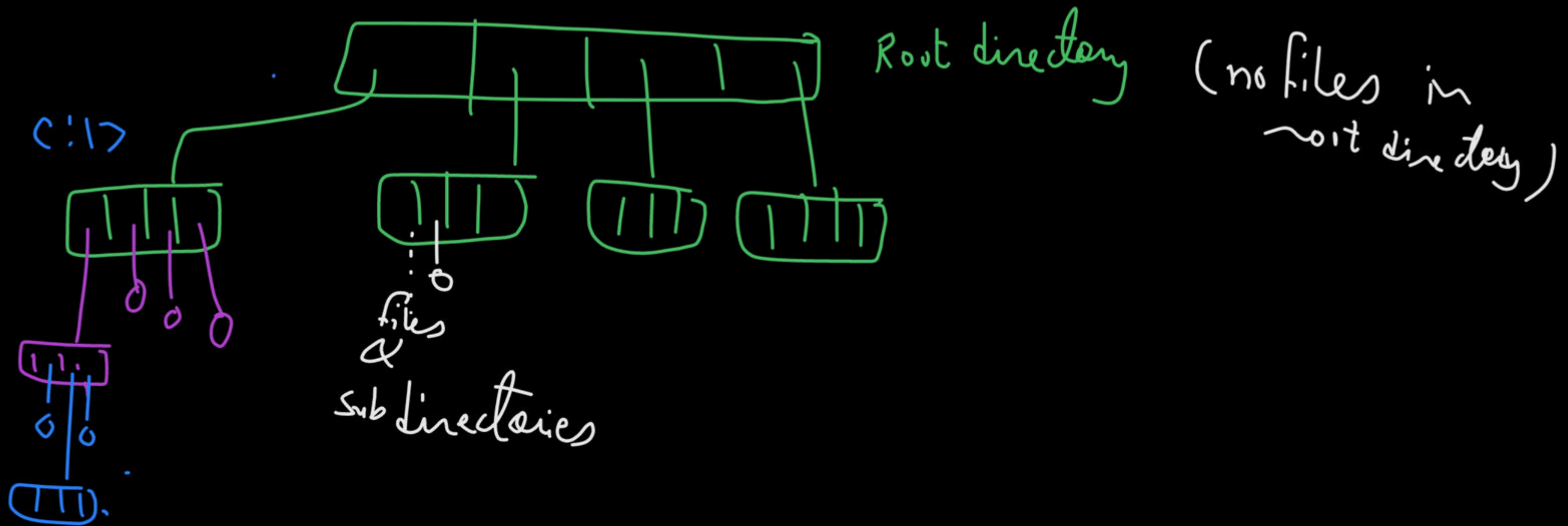
# File Directory Structure

## 2. Two-Level Directory

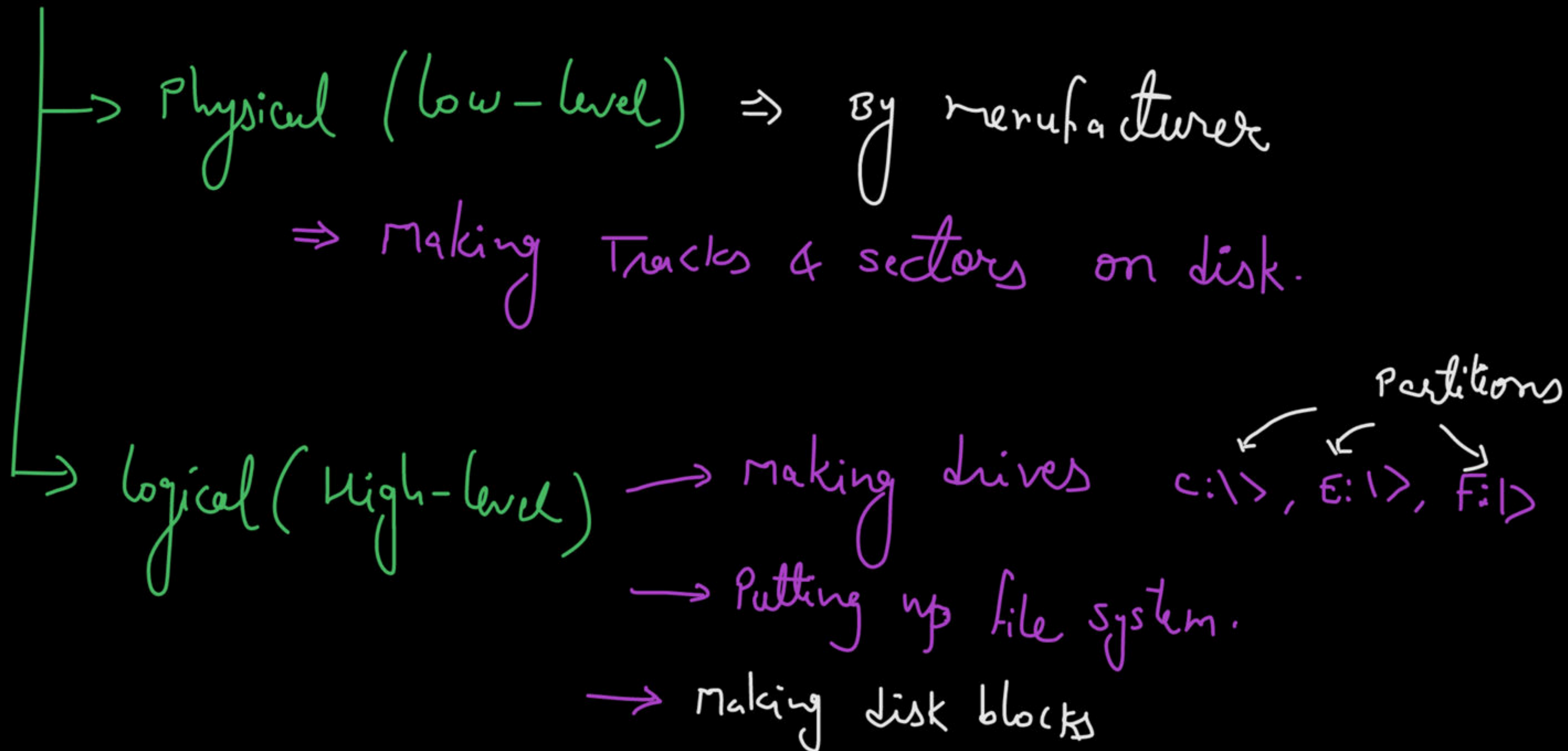


# File Directory Structure

## 3. Tree Structure Directory



# Disk Formatting





## Partition:-

→ Primary  $\Rightarrow$  OS + user files

→ Extended  $\Rightarrow$  only user files

Ex:-

C:\> 40 GB

E:\> 25 GB

F:\> 15 GB

Disk  
Part 40 GB

Disk 25 GB  
Part

15 GB  
Disk  
part

# Disk Blocks

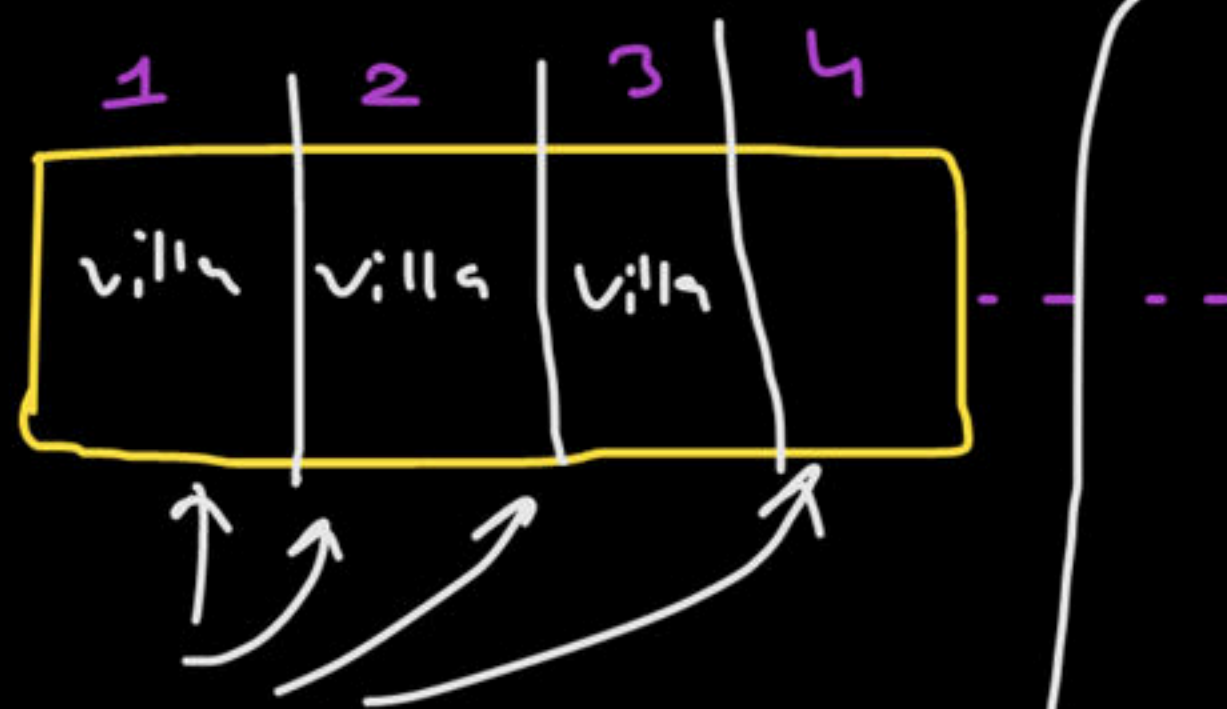
1 disk block  $\Rightarrow$  1 or 2 sectors



40 GB

(so many tracks & sectors)

A logical unit of file system  
to denote sector.



Consider a disk,

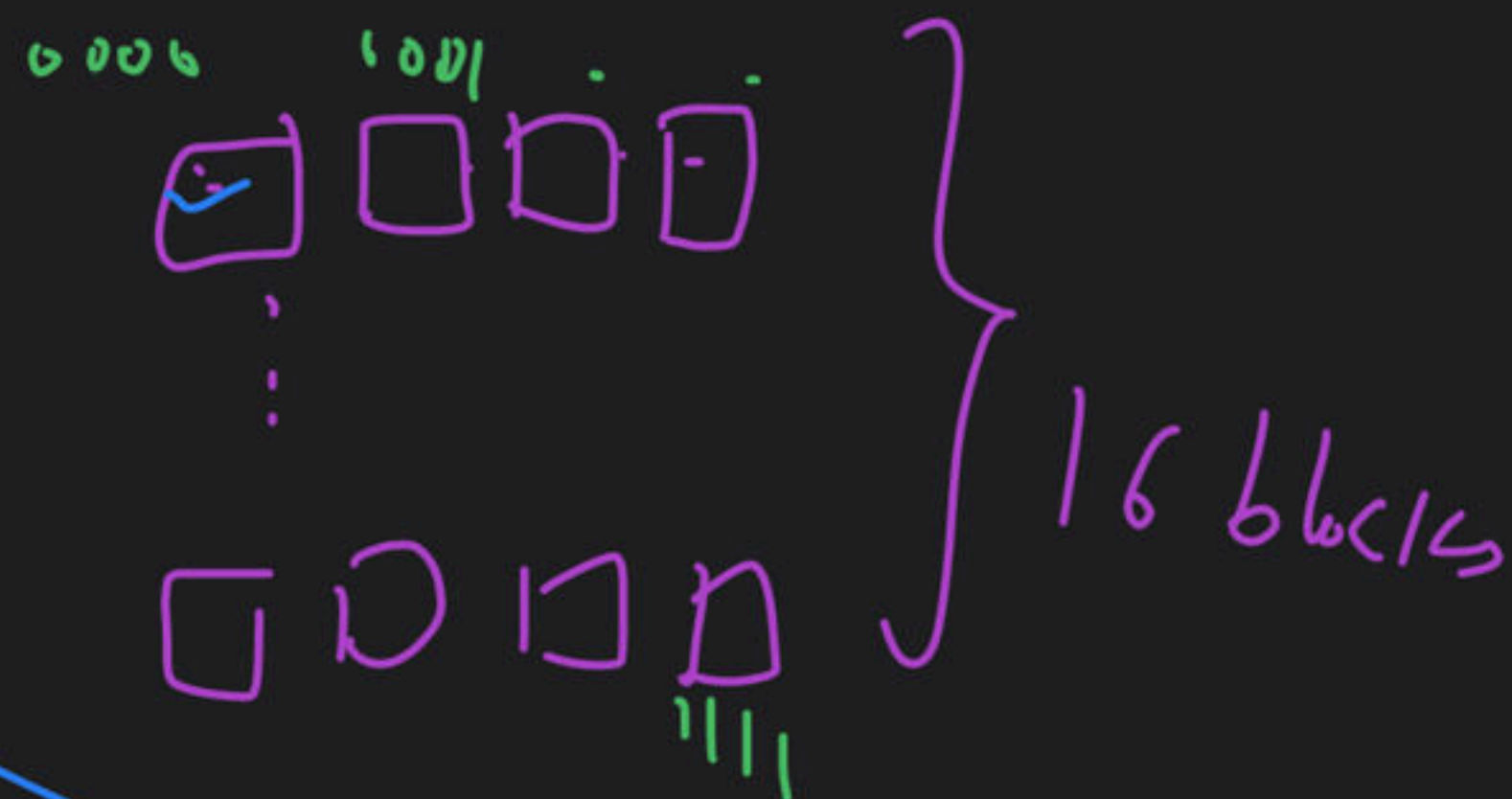
no. of blocks = 16 blocks

block size = 1KB

Disk size = no. of blocks \* block size

= 16 \* 1KB

= 16KB



numbers  
 0000 }  
 1111 } 4-bit



Disk size = 64 Mbytes

block size = 2 Kbytes

no. of blocks in disk = ?

$$= \frac{64 \text{ MB}}{2 \text{ KB}}$$

$$= 32 \text{ K} = 2^{15}$$

Disk block number of add. =  $\log(2^{15}) = 15$  - bits



D.B. Address (DBA) = 12 bits

Disk block size = 1 Kbytes

Disk size = ?

no. of blocks in disk =  $2^{12}$

Disk size =  $2^{12} * 1KB$

= 4 Mbytes

# Disk Blocks

Number of disk blocks =  $2^{16}$

Size of each block = 1KB

Total Size of disk?  $2^{16} \times 1\text{KB} = 64\text{MB}$

# Disk Blocks

Disk block address= 24-bits

Size of each block = 2KB

$$\begin{aligned}\text{Total Size of disk?} &= 2^{24} * 2 \text{ KB} \\ &= 2^5 \text{ GB} \\ &= 32 \text{ GB}\end{aligned}$$



# Disk Blocks

Total disk size = 256GB

Block Size = 2KB

Disk block address? 27 bits

$$\text{no. of blocks} = \frac{256 \text{ GB}}{2 \text{ KB}}$$

$$= 128 \times 2^{26}$$

$$= 2^{27} \Rightarrow \text{DBA} = 27\text{-bits}$$

# Free Space Management

1. Free List
2. Bitmap Method

# Free Space Management

1. No searching in free list, but in bitmap we search for first zero
2. Free list is faster in allocating a free block
3. Free list size is variable, where as bitmap size is constant

# Question

A particular disk unit uses a bit string to record the occupancy or vacancy of its disk blocks with '0' denoting vacant block and '1' denoting occupied block. A 32-bit part of this string has Hexadecimal value of D4F2A001. The percentage of occupied blocks on the disk for this part is?

# Question

A system directory is kept in 4 disk blocks each of size 2Kbytes. It is a single level-directory and each directory entry is of size 32-bits. The maximum number of files possible in this system is?

# Question

Disk block address = 14 bits

Each disk block size = 1KB

Maximum size of a file = ?





# File Allocation Methods

→ How a file must be stored on multiple blocks; and how the directory entry should be made.

↓  
on which-which block files  
are stored.

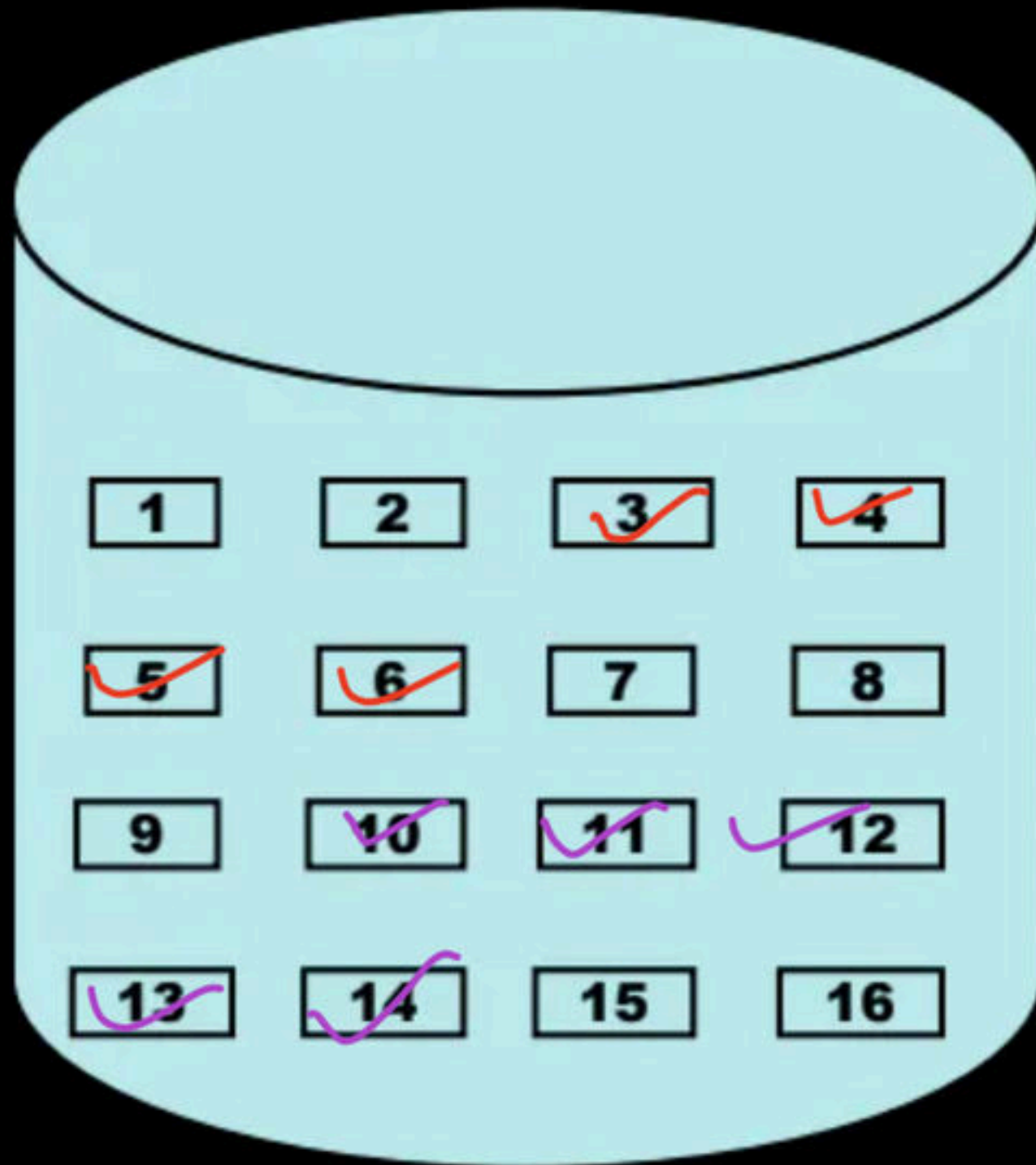


# File Allocation Methods

1. Contiguous Allocation  *like array*
2. Linked Allocation  *like linked-list*
3. Indexed Allocation

# Contiguous Allocation

→ A file is stored on consecutive blocks.



| file name     | starting block no. | no. of blocks |
|---------------|--------------------|---------------|
| Baahubali.mov | 3                  | 4             |
| Sanak.mp4     | 10                 | 5             |

new file

Vdsirance.mp4

size = 4 blocks

Can't store

← because 4 consecutive blocks not available

external fragmentation

# Contiguous Allocation

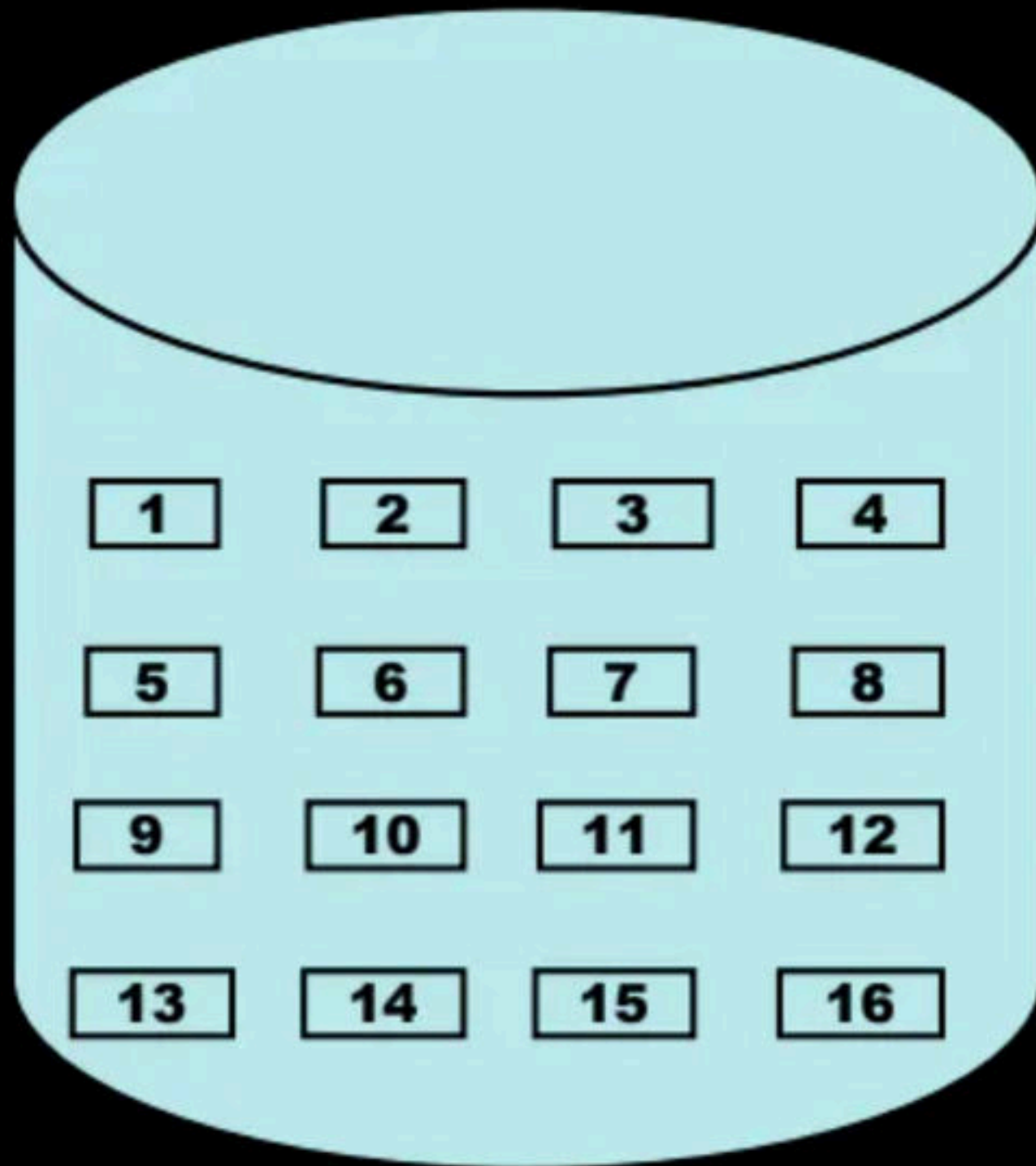
## Performance:

1. Fragmentation: Internal, External
2. Increase in File size: Inflexible
3. Type of access: Sequential, Random/direct

sol<sup>n</sup> of external fragmentat<sup>n</sup>  $\Rightarrow$  defragmentation



# Linked Allocation

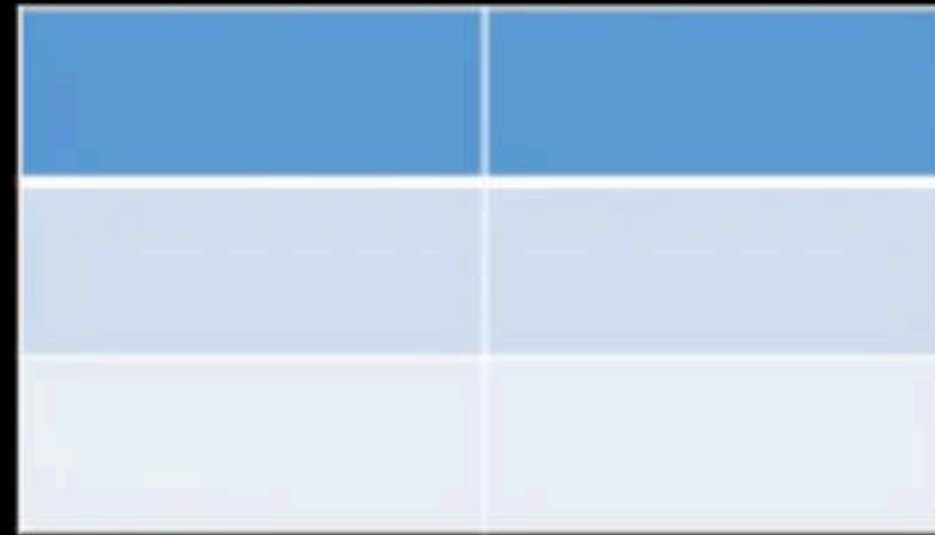
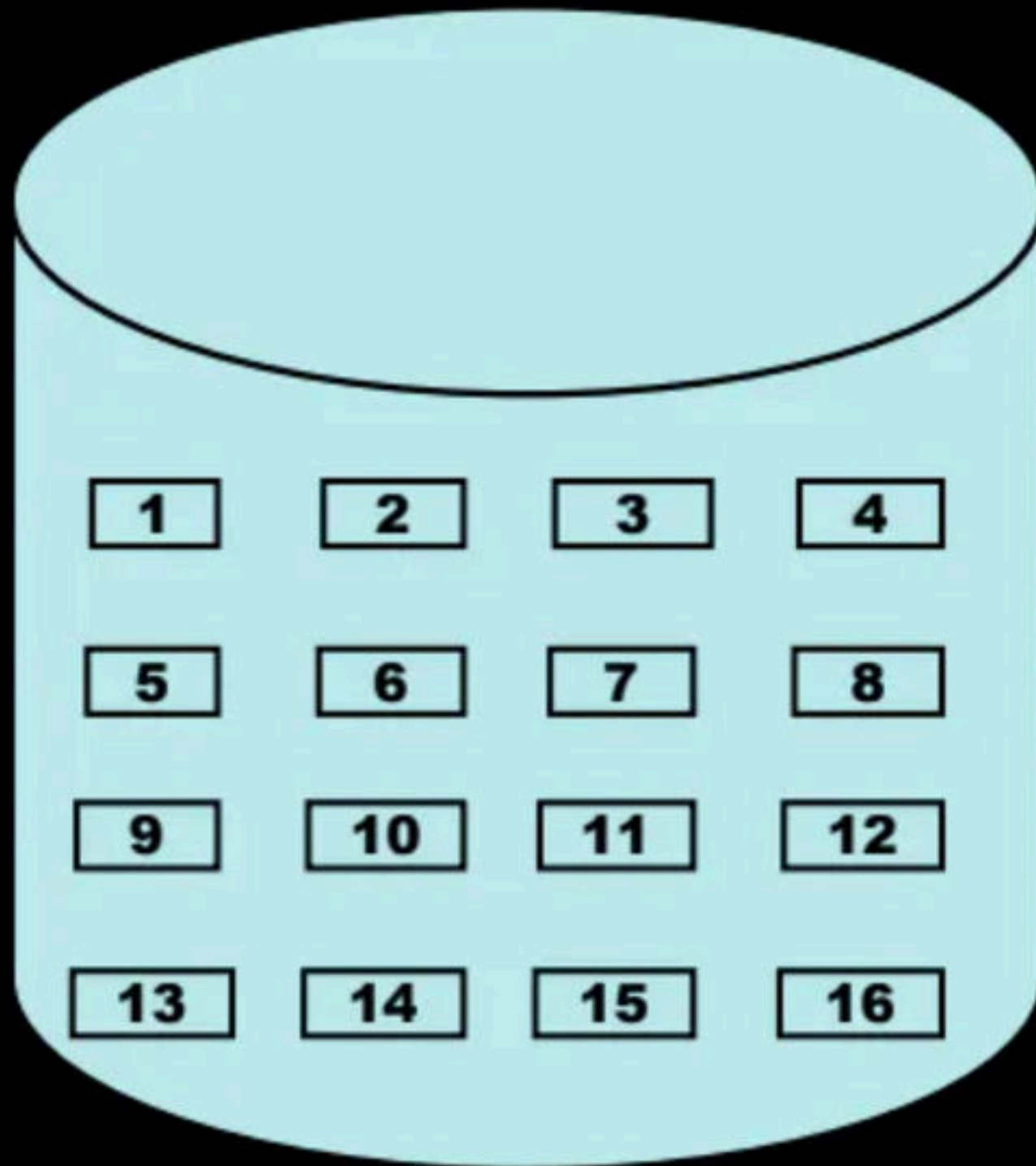


# Linked Allocation

## **Performance:**

1. Fragmentation: Internal
2. Increase in File size: Flexible
3. Type of access: Sequential

# Indexed Allocation



# Indexed Allocation

## **Performance:**

1. Fragmentation: Internal
2. Increase in File size: Flexible
3. Type of access: Sequential, Random/direct



# Question

Disk block address = 16 bits

Disk block size = 1KB

Index block = 1KB

Maximum file size?

# Happy Learning.!

