File Systems

* Old OS: before bytes, files were a sequence of records
* Files: • regular files (ASCII readable, Binary executable) • special files (Char/byte I/O, Block hard drive)
* File access: • sequential (must go in order, magnetic tape) • random (can access any part)
• Directories: files that organize a hirearchy of other files
* UNIX sees the disk as a sequence of physical blocks of fixed size. each disk can be divided into partitions each with its own file system.

Disk: [MBR | partition 1 | partition 2 | ...]
Master Boot Record
- boots the PC
- ends with a partition table

only 1 can be active at a time

Partitions: [Boot Block | superblock]
- # of blocks in FS
- FS size
- index of 1st free block
- list of free blocks
- size of inode table
- list of free inodes
- index of first free inode

Disk Allocation Layouts:

1- Contiguous: Store each file as a contiguous set of physical data blocks

adv: - quick & easy to find block holding my data
- almost no seek required for sequential data.
- excelled file reading performance

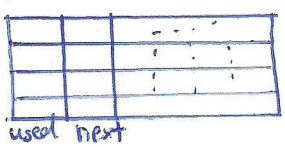
disadv: - file grows => may have to move it.
- internal fragmentation inside a single block
- external fragmentation between files

2- Linked List: the first word of each block contains the address of the next block

adv: - no more variable sized file allocation
- no external fragmentation.

disadv - terrible performance in some cases
- long seek time
- ammount of data per block is no longer a power of 2

3- Linked List with File Allocation Table (FAT): one entry per physical block
The table is loaded into memory on fs boot.



adv: - size of block is full (of data)
- random access much easier since entire chain is in the memory.

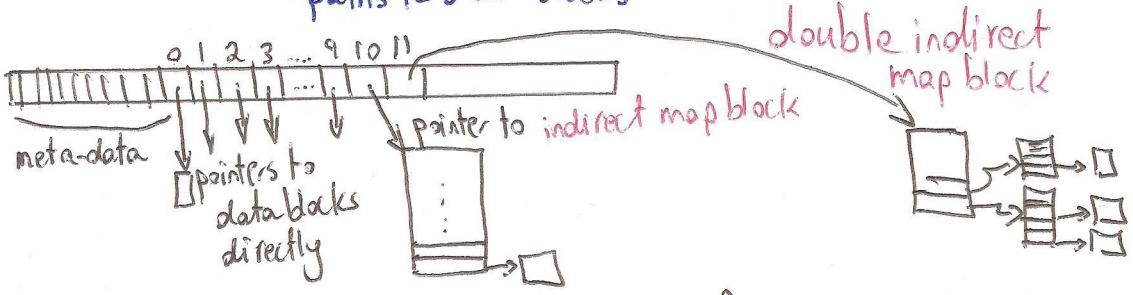
disadv - entire table must be in memory at all times.

4 - inodes: (UNIX) a data structure associated with the file.

open file => store in inode and release when closed.

The inode contains – management (metadata)
– paths to data blocks

- ex)



1 KB block & 4B pointer (entry)

=> 1KB/4 = 256 entries in map block

0 → 9: 1kB each => 10 kB

if file > 10 kB => use 10

10: 256 entries => 256 kB

if file > 266 kB => use 11

11: $(256)^2$ kB

12: $(256)^3$ kB

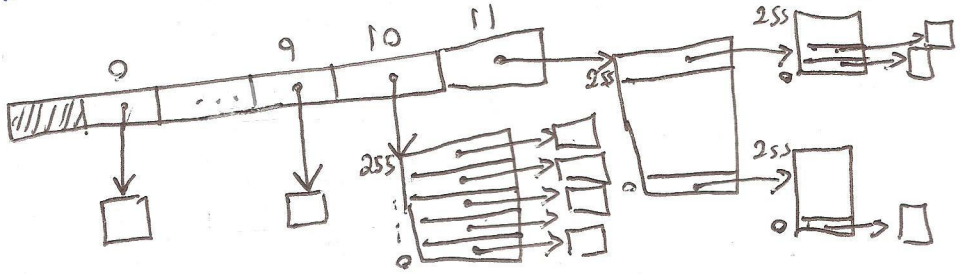
=> if we go up to 12 we can store $10\,kB + 256\,kB + 256^2\,kB + 256^3\,kB \approx 16\,GB$ max file size

- Effective size of file = (# map blocks x block size) + (# data blocks x block size) + size(inode)

Note: . map block: blocks that **hold tables**

. data block: blocks that hold data.

ex)



data blocks: 0-9: 10 + 10: 256 + 11: 256^2

map blocks: **1 + 1 + 256**