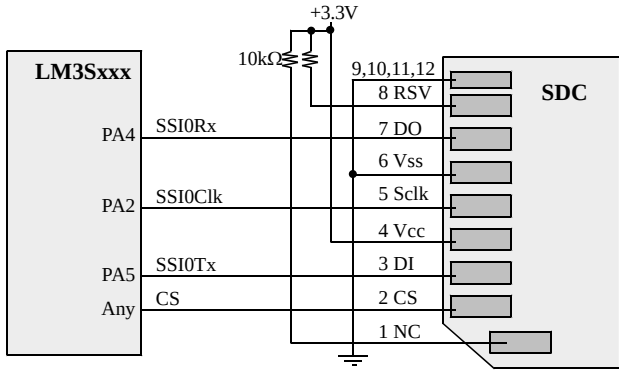
14. File System

Lab 5 File System

- **SSI <-> SDC**
- **eDisk <-> physical blocks**
- **eFile <-> logical data**

Reference EE445M book, chapter 14

SSI to SDC interface



Know your problem

- Read access
  - Sequential versus random access
- Write access
  - Sequential versus random access
  - Insert/Append/Remove
  - Write once (data logger, flight recorder)
- Size, bandwidth, response time
- Reliability
- Security (fail-safe)

Know your disk

- Block size
- Disk size
- Read/write speed
- Types and chances of error
  - Wear leveling
  - Conditional probability

File system responsibilities

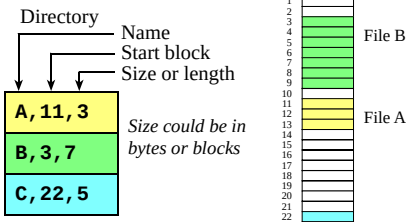
- Logical to physical translation
  - Byte number to block number
- Directory
  - File name to physical translation
- Free space
  - Used
  - Free
  - Damaged

File system performance

- File size
- Disk size
- Number of files
- Speed
  - Time to create, open, close
  - Write bandwidth
  - Read bandwidth
- Fragmentation
  - External if max file size < total free space

File system allocation

- Contiguous allocation
  - First fit
  - Best fit
  - Worst fit



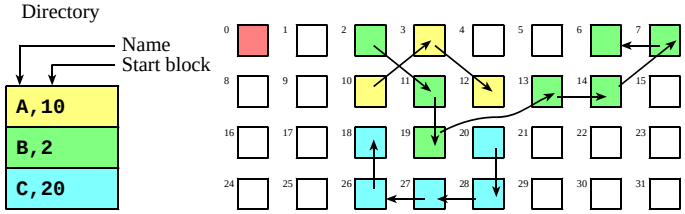
Good for sequential write, never erase
Fast random read access

Internal fragmentation: on average, each file wastes a half a block

External fragmentation

File system allocation

- Linked allocation



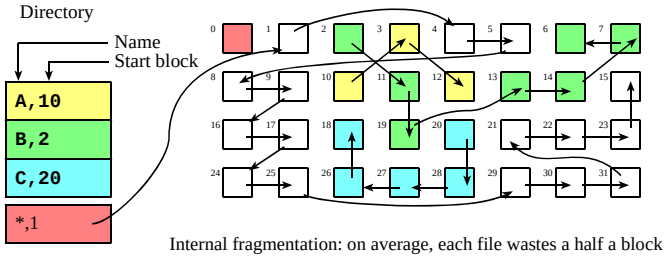
Good for erase, append, delete
No external fragmentation

Each block has a link and a size

Slow for random access

Free space management

- Linked allocation of free space



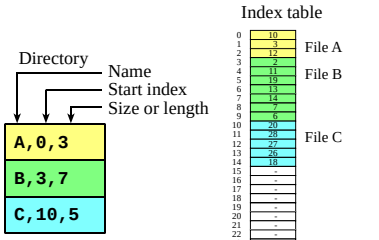
Internal fragmentation: on average, each file wastes a half a block

To handle wear-leveling
free to one end of list
allocate from other end

What if bad block?

File system allocation

- Indexed allocation



Good for erase, append, delete
No external fragmentation

Reliable?

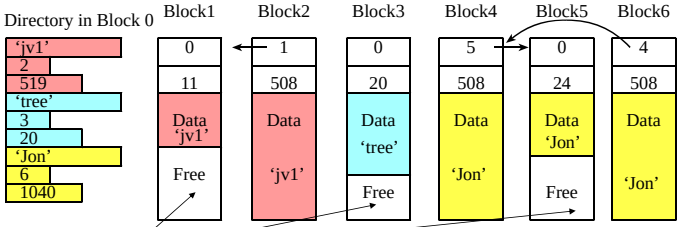
Fast for random access

Two level index table?

Smaller than 32Meb

Directory

- Name, Type, Date, Size, How to access



Internal fragmentation

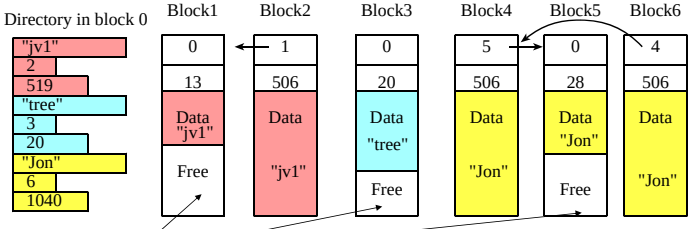
4 bytes for link to next block
2 bytes for size

How many files?

Larger than 32Meb

Directory

- Name, Type, Date, Size, How to access

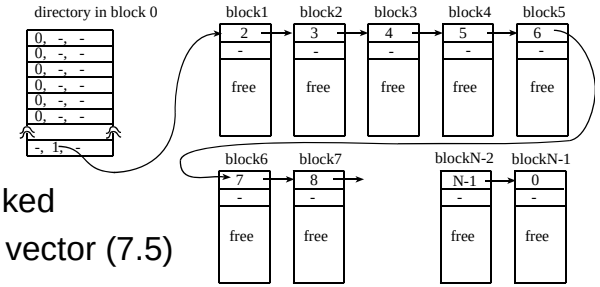


Internal fragmentation

4 bytes for link to next block
2 bytes for size

How many files?

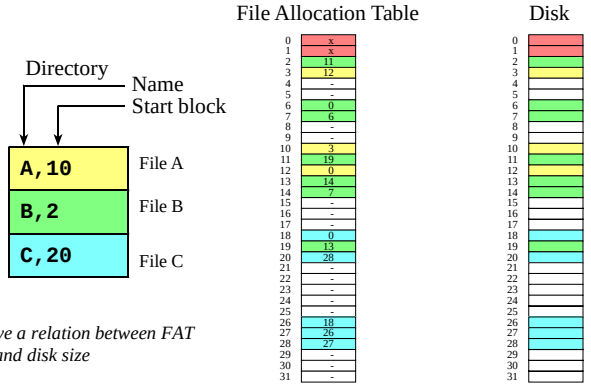
Free space management



- Linked
- Bit vector (7.5)

What percentage of the disk is wasted using a) linked; b) bit vector?

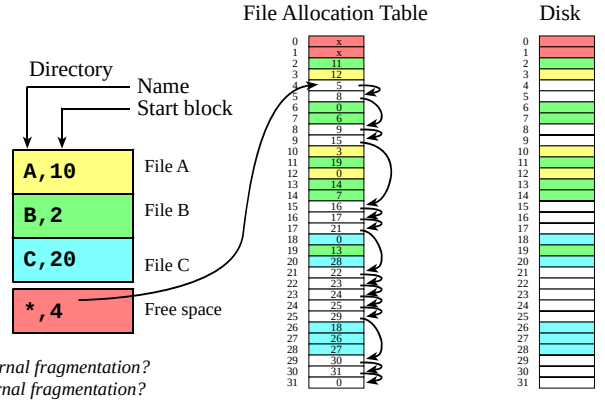
File Allocation Table



Derive a relation between FAT size and disk size

What if bad block?

File Allocation Table



External fragmentation?
Internal fragmentation?

Why cluster?

Summary

- Internal fragmentation
- External fragmentation
- Speed
  - Random versus sequential
  - Read versus write
- Reliability, recover from errors
  - Error detection
  - Redundant Array of Independent Disks
  - Wear-leveling
- Clustering
- Size
- Number of files
- Legacy
- Low voltage