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Operating Systems

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Lab 9 - File System Interface

Objective

- Understand how Linux manage files on secondary storage devices.
- Introduce i-node data structure.

File System

- File System is used to control how data is stored in and retrieved from a storage medium. Particularly, file system are structure and logic rules used to manage groups of information and their identifiers.
- In Linux, filesystem consist of files and directories.
  - File? Directory?
- File system could be divided into two categories:
  - User data: “actual” data.
  - Metadata: data describes data: superblocks, i-nodes, directories

Blocks

- Storage space is divided into blocks (typically 4KB each).
  - Just a software construct, different from hard disk sector size (typically 512 bytes).
- Block size affects:
  - Maximum file size
  - Space utilization
  - Performance
- Blocks are grouped into block groups.

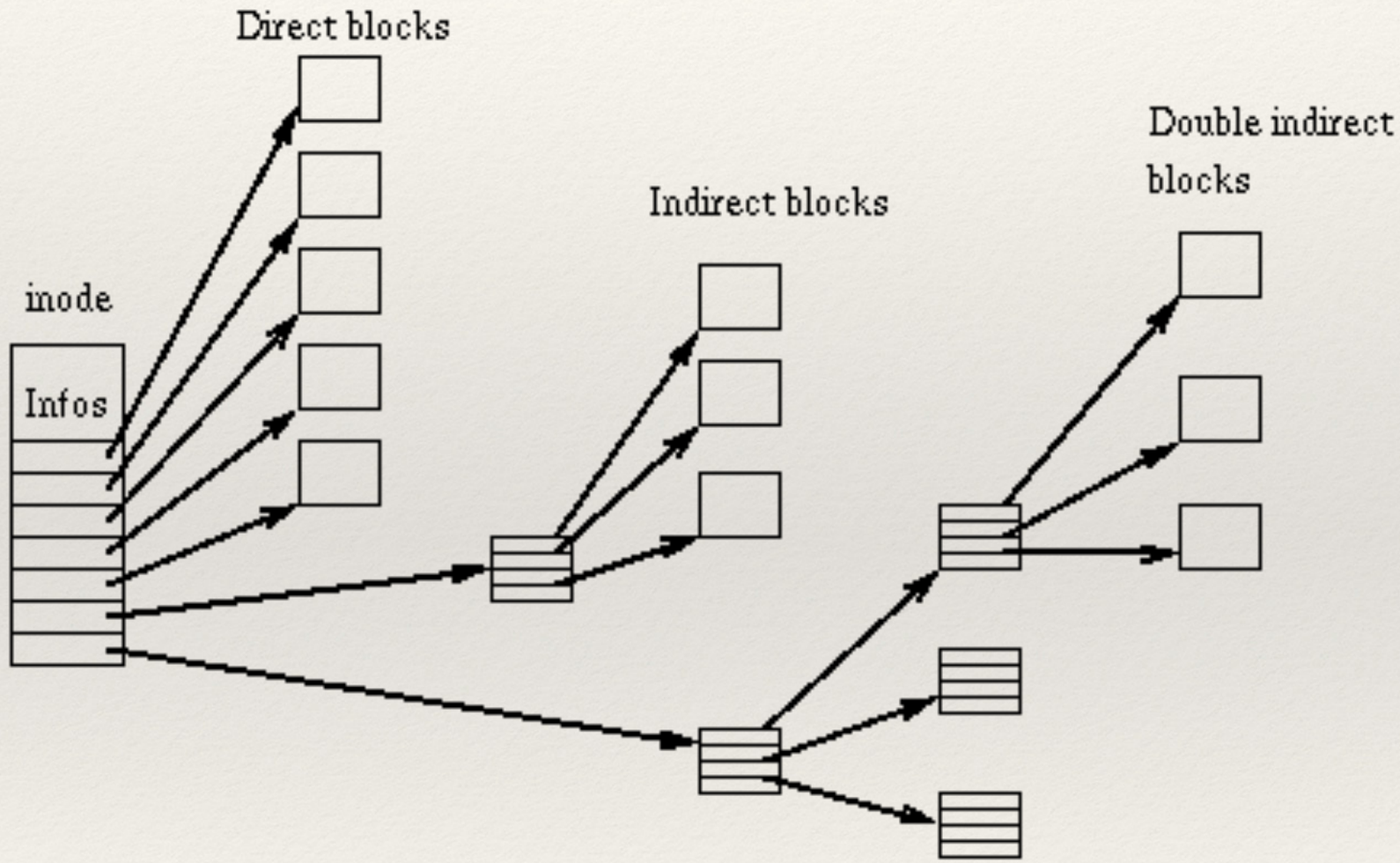
Superblocks

- Superblocks store metadata of the file system.
  - Number of blocks in the file system
  - Number of free blocks
  - i-nodes per block group
  - Blocks per block group
  - …
- There are many copies of superblocks spread across the storage device.

i-node

- An i-node represent information of an object in the file system.
  - File type
  - Permissions
  - File size
  - Number of links
  - …
- Each i-node is identified by a unique i-node number within the file system.
- Exercise: Use ls -ai command to find out i-node number of files and directories.

i-node


Direct blocks
Indirect blocks
Double indirect
blocks
inode
Infos

i-node

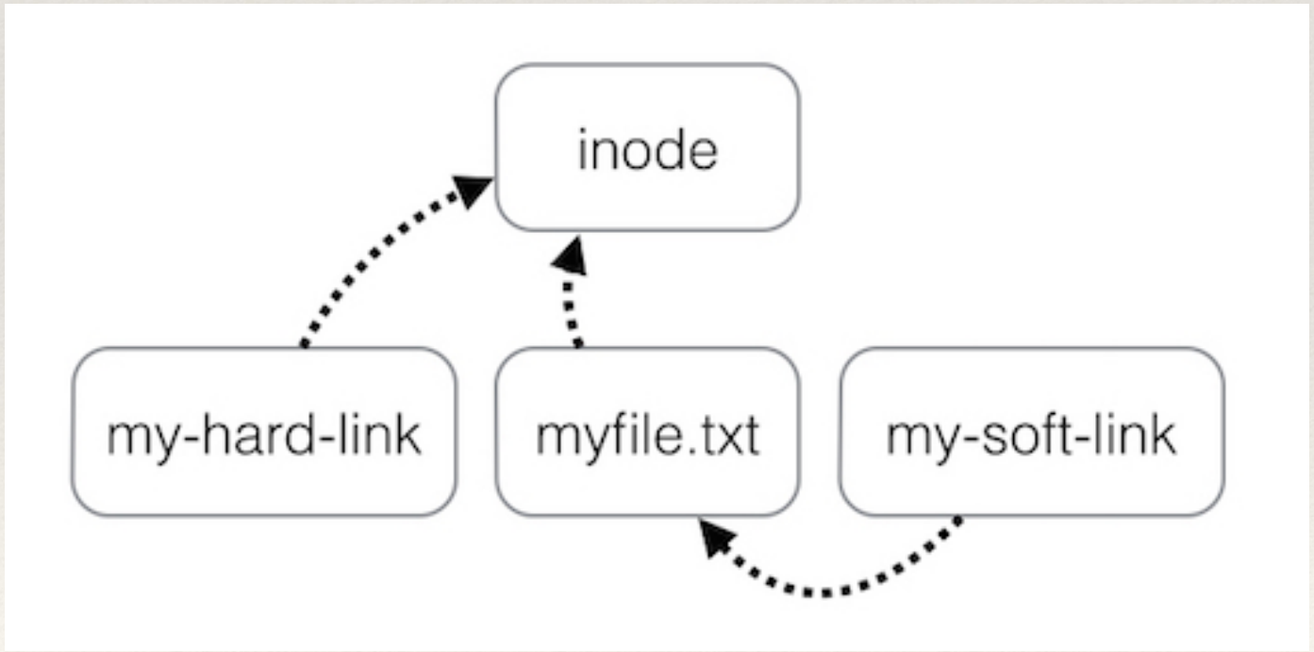
- Exercise: Assume an i-node could hold up to
  - 12 direct block pointers
  - 1 indirect block pointer
  - 1 double indirect block pointer
  - 1 triple indirect block pointer.
  - Block size is 4KB and each pointer occupies 4 bytes. What is the maximum size of a file represented by an i-node?

i-node

- 1 blocks contains 4x1024 / 4 = 1024 direct block pointers.
- A file could occupy up to 12 + 2^10 + 2^20 + 2^30 blocks
- Maximum file size = (12 + 2^10 + 2^20 + 2^30) x 4KB = 48KB + 4MB + 4GB + 4TB

Soft link vs Hard link

- Hard link is a directory entry that associates a name with a file on a filesystem.
- Soft link (symbolic link) is the "nickname" for any file that contains a reference to another file or directory in the form of an absolute or relative path.



Soft link vs Hard link

- Exercise: distinguish soft link and hard link through running the following commands.
  - $ echo hello world > hello
  - $ ln hello world
  - $ ln –s hello hw
  - $ rm hello
  - $ cat world
  - $ cat hw

End

Thanks!