



## Exercise

Given a hard disk with a Unix-like filesystem with the following specifications: the block size is 4KB, the block address length is 4 bytes and the i-nodes have a traditional structure (10 direct pointers, 1 single indirect pointer, 1 double indirect pointers and 1 triple indirect pointer).

Answer the following questions:

- a) What is the number of blocks (including both the data and address blocks) that have the following files:
  - File A with a size of 20 KBytes
  - File B with a size of 200 KBytes
  - File C with a size of 2000 KBytes
  - File D with a size of 20000 KBytes
- b) What is the maximum file size?

## Solution

In each address block 1024 block addresses can be allocated:  $4\text{KBytes} / 4 \text{ bytes} = 1024$  addresses

a. Number of blocks

- File A with a size of 20 KBytes  
A 20KB file will use 5 data blocks, using the first 5 direct pointers.

That is, it will use **5 blocks**

- File B with a size of 200 KBytes

A 200Kb file will use 50 data blocks. The first 10 will be addressed by the direct pointers. The remaining 40 will be pointed by the single indirect pointers (an extra block is needed).

That is, it will use 50 blocks + 1 block (related to the single indirect pointer) = **51 blocks**

- File C with a size of 2000 KBytes

A 2000KB file will use 500 data blocks. The first 10 will be addressed by the direct pointers. The remaining 490 will be pointed by the single indirect pointers (an extra block is needed).

That is, it will use 500 blocks + 1 block (related to the single indirect pointer) = **501 blocks**

- File D with a size of 20 000 Kbytes

A 20000KB file will use 5000 data blocks. The first 10 will be addressed by the direct pointers. The next 1024 blocks will be pointed by the single indirect pointers (an extra block is needed). The remaining 3966 blocks will be addressed using the double indirect pointers (using 1 block to keep the pointer block addresses (1024 address block) plus 4 blocks to point the 3966 data blocks).

That is: 5000 blocks + 1 block (single indirect) + 5 blocks (double indirect) = **5006 blocks**

c) What is the maximum possible file size?

The maximum number of blocks of a file is:

- 10 blocks addressed by direct pointers
- 1024 blocks addressed by single indirect pointers
- $1024 * 1024$  blocks addressed by double indirect pointers
- $1024 * 1024 * 1024$  blocks addressed by triple indirect pointers

The overall number of block is  $1\text{G} + 1\text{M} + 1\text{K} + 10$  blocks which is approximately **4 TBytes** (not considering 4GB, 4MB and 40KB because are much smaller than the first term).