

Feedback to HW8

Aurora

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In this solution, denote **Int1** with i_1 and **Int2** with i_2 .

1 Harolds Personal Files

1.1 Least blocks

Fetch inode of root dir →
→ Fetch inode of 1st dir
→ Fetch inode of 2nd dir
...
→ Fetch inode of i_1 mod 3
→ Fetch inode of file →

Total blocks = $(i_1 \text{ mod } 3) + 1$

1.2 Most blocks

Total blocks = $(i_1 \text{ mod } 3) + 1$

2 Fat Fast File

2.1 Largest file v

$12 + i_1 \text{ mod } 3$ direct pointer
File size:



$$(12 + i_1 \text{ mod } 3) + (8 + (i_2 \text{ mod } 4)) \cdot 16$$

2.2 Max file size supported

$12 + i_1 \text{ mod } 3$ direct pointer: $12 + i_1 \text{ mod } 3$ blocks;

2 indirect pointer: $2 \cdot (8 + (i_2 \text{ mod } 4)) \cdot 1024/8 = 2^8 \cdot (8 + (i_2 \text{ mod } 4))$ blocks

2 double indirect pointer: $2 \cdot ((8 + (i_2 \text{ mod } 4)) \cdot 1024/8)^2 = 2^{15} \cdot (8 + (i_2 \text{ mod } 4))^2$ blocks

2 triple indirect pointer: $2 \cdot ((8 + (i_2 \text{ mod } 4)) \cdot 1024/8)^3 = 2^{22} \cdot (8 + (i_2 \text{ mod } 4))^3$ blocks

1 quadruple indirect pointer: $((8 + (i_2 \text{ mod } 4)) \cdot 1024/8)^4 = 2^{28} \cdot (8 + (i_2 \text{ mod } 4))^4$ blocks

Total number of blocks:

$$12 + i_1 \text{ mod } 3 + 2^8 \cdot (8 + (i_2 \text{ mod } 4)) + 2^{15} \cdot (8 + (i_2 \text{ mod } 4))^2 \\ + 2^{22} \cdot (8 + (i_2 \text{ mod } 4))^3 + 2^{28} \cdot (8 + (i_2 \text{ mod } 4))^4$$

"within %1": $((8 + (i_2 \text{ mod } 4)) \cdot 1024/8)^4 = 2^{28} \cdot (8 + (i_2 \text{ mod } 4))^4$ blocks

Total size of file: $2^{28} \cdot (8 + (i_2 \bmod 4))^5 \text{ KB} = 256 \cdot (8 + (i_2 \bmod 4))^5 \text{ GB}$

Approximation:

- $i_2 \bmod 4 = 0: 2^8 \cdot 8^5 = 8 \text{ PB}$
- $i_2 \bmod 4 = 1: 2^8 \cdot 9^5 = 14.4 \text{ PB}$
- $i_2 \bmod 4 = 2: 2^8 \cdot 10^5 = 24.4 \text{ PB}$
- $i_2 \bmod 4 = 3: 2^8 \cdot 11^5 = 39.3 \text{ PB}$

3 Wasted Space

3.1 Internal fragmentation

folder name	#entries
animal	3
felidae	1

Exp. $i_2 = 2$, then block size is 20K bytes.
Then fragmentation of folder:

fragmentation of folder:

Fragmentation of file:



Total fragmentation: (bytes)

$$81712 + 8192 = 89904$$

3.2 Internal fragmentation with double block size

Exp. $i_2 = 2$, then block size is 20K bytes.

Then fragmentation of folder:

$$\begin{aligned}
 \text{fragFolder} &= \sum_{\text{folders}} (10 \cdot 1024) \text{B} - \text{number of entries in folder} \cdot 16\text{B} \\
 &= 8 \cdot 20 \cdot 1024 - 16 \cdot (3 + 1 + 2 + 2 + 1 + 2 + 1 + 1) \\
 &= 163632\text{B}
 \end{aligned}$$

Fragmentation of file:

$$\begin{aligned}\text{fragFile} &= \sum_{\text{files}} \text{internal fragmentation of each file} \\ &= 8\text{K} + 10\text{K} + 0 + 10\text{K} + 0 + 0 \\ &= 28672\text{B}\end{aligned}$$

Total fragmentation: (bytes)

$$163632 + 28672 = 192304$$

