

Assignment 1: Multithreading



Pedro Silva (93011) & João Soares (93078)
Master in Informatics Engineering
2021/2022

Problem 1 - Text processing in Portuguese: Main Ideas

- **Structures** to facilitate operations:
 - *ChunkText* - Structure of a chunk of text from a file.
 - *FileText* - Structure of File containing number of words, number of words starting with a vowel and number of words ending with a consonant.
- **Processes:**
 - **Main:**
 - Process Command Line Arguments (files and number of workers).
 - Initializes and creates threads Workers.
 - Reads successively each File and makes chunks out of them(*ChunkText*), saves these in the Shared Region(FIFO).
 - Waits for the termination of Workers.
 - Gets the results of the processing for each file.
 - **Workers:**
 - While there's enough work (chunks to process), get a *ChunkText* from the Shared Region, process it in order to obtain the number of words, number of words starting with a vowel and number of words ending with a consonant and save the results to the Shared Region.

Problem 1 - Text processing in Portuguese: Timing Results

- With Chunk Size : 20.
- With Chunk FIFO Size : 10000.
- As the volume of text to be processed increases, the time taken to calculate statistics also increases.

| File/ n° Workers | 1 | 2 | 4 | 8 |
|------------------|------------|------------|------------|------------|
| text0.txt | 0.000919 s | 0.001235 s | 0.001734 s | 0.002793 s |
| text1.txt | 0.002900 s | 0.004435 s | 0.006519 s | 0.009885 s |
| text2.txt | 0.008065 s | 0.012972 s | 0.017347 s | 0.020531 s |
| text3.txt | 0.004322 s | 0.013355 s | 0.006409 s | 0.023940 s |
| text4.txt | 0.006976 s | 0.013715 s | 0.016126 s | 0.018699 s |
| All | 0.016343 s | 0.019315 s | 0.033676 s | 0.077688 s |

Problem 2 - Determinant of a Square Matrix : Main Ideas

- **Structures** to facilitate operations:
 - *MatrixResult* - Structure of the Matrix processed Result
 - *FileMatrices* - File.
 - *Matrix* - Matrix to Process.
- **Processes:**
 - **Main:**
 - Process Command Line Arguments (files and number of workers).
 - Saves the list of *FileMatrices* to process in the Shared Region.
 - Initializes and creates threads Workers.
 - Reads successively the Files and creates matrices (*Matrix*) to save them in the Shared Region (FIFO).
 - Waits for the termination of Workers.
 - Prints the Results (*MatrixResult*) of the processment of the matrices.
 - **Workers:**
 - While there's enough work (matrices to process), gets a *Matrix* from the Shared Region, processes the determinant of the matrix and finally, saves the result in the Shared Region.

Problem 2 - Determinant of a Square Matrix : Timing Results

- With FIFO size : 128
- As the matrix order increases, the time to calculate the determinant also increases, so files with higher matrices order benefit to a great extent from using more threads (noted in the table beside with the elapsed time values).
- In the files with lower order matrices, the processing time is low, which makes workers available quickly and they can almost get the matrices as they are saved in the Shared Region by main which makes less beneficial the use of more threads.

| File/ n° Workers | 1 | 2 | 4 | 8 |
|------------------|------------|------------|------------|------------|
| mat128_32.bin | 0.041060 s | 0.040731 s | 0.040219 s | 0.041645 s |
| mat128_64.bin | 0.041715 s | 0.042725 s | 0.042853 s | 0.046194 s |
| mat128_128.bin | 0.068185 s | 0.042254 s | 0.046941 s | 0.045758 s |
| mat128_256.bin | 0.395748 s | 0.210990 s | 0.136858 s | 0.125298 s |
| mat512_32.bin | 0.085685 s | 0.075720 s | 0.081752 s | 0.091691 s |
| mat512_64.bin | 0.088171 s | 0.078154 s | 0.081079 s | 0.092932 s |
| mat512_128.bin | 0.229501 s | 0.133168 s | 0.112251 s | 0.106548 s |
| mat512_256.bin | 1.569689 s | 0.843133 s | 0.510857 s | 0.478045 s |