

Operating systems lab 2

Multithreaded matrix

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Code organization:

Program is written in only one file , code is separated in to different method. Methods of reading matrices dimensions from txt file, reading matrices from txt file, solving through one thread, solving through rows (thread per row), solving through element (thread per element), and two methods for creating threads (one invokes solving by rows and solving by elements)

Code main functions:

1- readrowcol(FILE *f,int *row,int *col)

function to read row and column dimensions from file

2- void readmatrix(int **array,FILE * f,int row,int col)

function to copy file contents to 2d array ,array to be copied in , file to be read ,row ,column

void readmatrix(int **array,FILE * f,int row,int col)

3- void SolveForMatrix(int **a,int **b,int **c)

Function to solve in one thread

4- void *SolveForRow(void *object)

Function to solve matrix by rows , a thread for each row

5- void *SolveForElement(void *object)

Function to solve matrix by each elemnt , a thread for each element

6- void RowThreads(int **a,int **b,int **c)

creating Threads for solving by rows

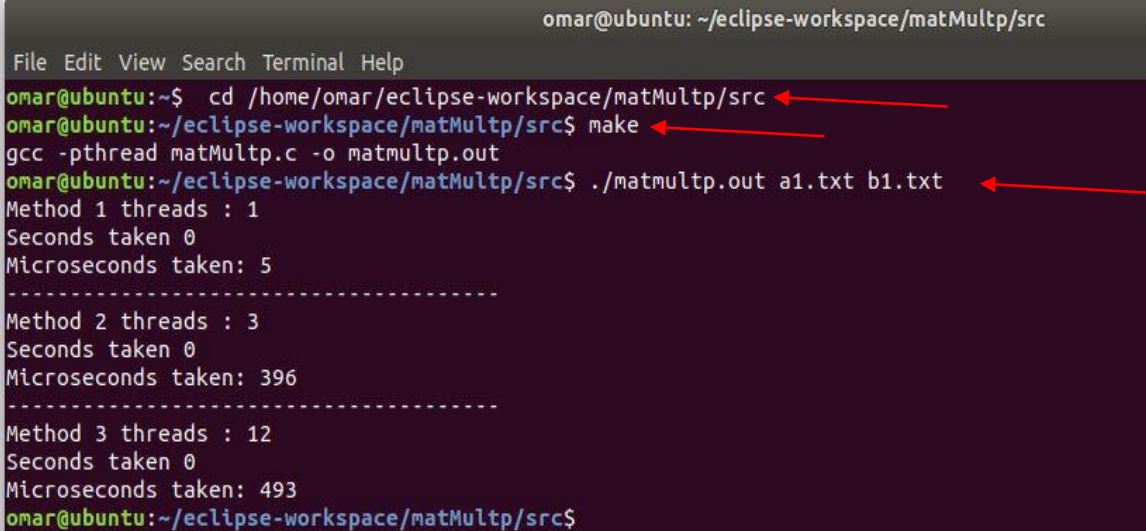
7- void ElementsThreads(int **a,int **b,int **c)

Creating Threads for solving by each element

8- void WriteOutput(int **c, char *filepath)

Writes output array to a distinct file

How to compile and run your code.



```
omar@ubuntu: ~/eclipse-workspace/matMultp/src
File Edit View Search Terminal Help
omar@ubuntu:~$ cd /home/omar/eclipse-workspace/matMultp/src
omar@ubuntu:~/eclipse-workspace/matMultp/src$ make
gcc -pthread matMultp.c -o matmultp.out
omar@ubuntu:~/eclipse-workspace/matMultp/src$ ./matmultp.out a1.txt b1.txt
Method 1 threads : 1
Seconds taken 0
Microseconds taken: 5
-----
Method 2 threads : 3
Seconds taken 0
Microseconds taken: 396
-----
Method 3 threads : 12
Seconds taken 0
Microseconds taken: 493
omar@ubuntu:~/eclipse-workspace/matMultp/src$
```

- 1- Open ubuntu terminal
- 2- Write: cd c file path
- 3- Write: make
- 4- Write: ./matmultp.out matrix1_path matrix2_path outputmatrixfilepath

Sample runs

Test 1:

```
omar@ubuntu: ~/eclipse-workspace/matMultp/src
File Edit View Search Terminal Help
omar@ubuntu:~$ cd /home/omar/eclipse-workspace/matMultp/src
omar@ubuntu:~/eclipse-workspace/matMultp/src$ make
gcc -pthread matMultp.c -o matmultp.out
omar@ubuntu:~/eclipse-workspace/matMultp/src$ ./matmultp.out
Method 1 threads : 1
Seconds taken 0
Microseconds taken: 28
-----
Method 2 threads : 10
Seconds taken 0
Microseconds taken: 944
-----
Method 3 threads : 100
Seconds taken 0
Microseconds taken: 2532
omar@ubuntu:~/eclipse-workspace/matMultp/src$
```

```
Open  c.out  Save  ~/eclipse-workspace/matMultp/src
row=10 col=10
415    430    445    460    475    490    505    520    535    550
940    980    1020   1060   1100   1140   1180   1220   1260   1300
1465   1530   1595   1660   1725   1790   1855   1920   1985   2050
1990   2080   2170   2260   2350   2440   2530   2620   2710   2800
2515   2630   2745   2860   2975   3090   3205   3320   3435   3550
3040   3180   3320   3460   3600   3740   3880   4020   4160   4300
3565   3730   3895   4060   4225   4390   4555   4720   4885   5050
4090   4280   4470   4660   4850   5040   5230   5420   5610   5800
4615   4830   5045   5260   5475   5690   5905   6120   6335   6550
5140   5380   5620   5860   6100   6340   6580   6820   7060   7300

Plain Text  Tab Width: 8  Ln 1, Col 1  INS
```

Test 2

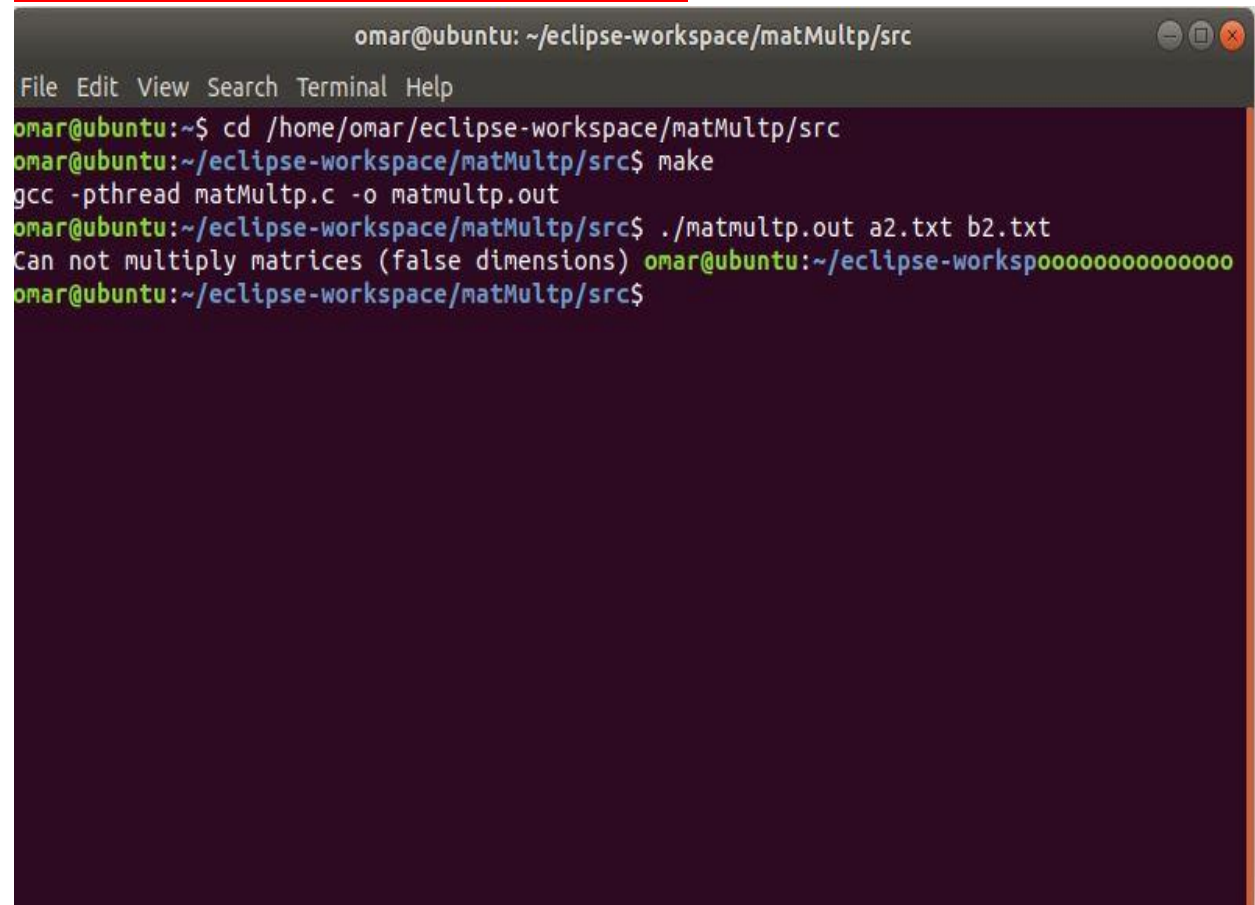
```
omar@ubuntu: ~/eclipse-workspace/matMultp/src
File Edit View Search Terminal Help
omar@ubuntu:~$ cd /home/omar/eclipse-workspace/matMultp/src
omar@ubuntu:~/eclipse-workspace/matMultp/src$ make
gcc -pthread matMultp.c -o matmultp.out
omar@ubuntu:~/eclipse-workspace/matMultp/src$ ./matmultp.out a1.txt b1.txt
Method 1 threads : 1
Seconds taken 0
Microseconds taken: 27
-----
Method 2 threads : 3
Seconds taken 0
Microseconds taken: 338
-----
Method 3 threads : 12
Seconds taken 0
Microseconds taken: 583
omar@ubuntu:~/eclipse-workspace/matMultp/src$
```

```
c.out
~/eclipse-workspace/matMultp/src
Open [icon] Save [icon]
row=3 col=4
-1      10      -15     -28
-3      -10     15      -36
5       -2       -9     -20

Plain Text Tab Width: 8 Ln 1, Col 1 INS
```

Test 3

Wrong input matrices dimensions



```
omar@ubuntu: ~/eclipse-workspace/matMultp/src
File Edit View Search Terminal Help
omar@ubuntu:~$ cd /home/omar/eclipse-workspace/matMultp/src
omar@ubuntu:~/eclipse-workspace/matMultp/src$ make
gcc -pthread matMultp.c -o matmultp.out
omar@ubuntu:~/eclipse-workspace/matMultp/src$ ./matmultp.out a2.txt b2.txt
Can not multiply matrices (false dimensions) omar@ubuntu:~/eclipse-workspooooooooooooooooo
omar@ubuntu:~/eclipse-workspace/matMultp/src$
```

A comparison between the three methods of matrix multiplication.

Method	Method1	Method2	Method3
Number of threads	1	Number of rows of first matrix	Number of elements in output matrix
Execution time	$O(n^3)$	$O(n^3)$	$O(n^3)$

All execution time is the same but when a method creates more threads it takes much time, because each threads waits the other thread to finish (threads are joined) to handle synchronization.