

GTU Department of Computer Engineering
CSE 344 - Spring 2022
Homework #2 Report

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1. How I Solved This Problem?

I firstly tried writing simple programs using the new functions we have learned. After I figured out how these functions work, I started developing the program.

At first, I implemented input validity checking. Then, I read file. For every 30 bytes read, which means 10 3d integer coordinates, I passed the read text to a child process. I also passed the output file path and the identifying number of the current process to be created as well. In child processes, I first tried to calculate and print the matrix that has been past from parent to child directly to the output file. After printing is done, I coordinated parent and child processes and made parent wait for all childs to finish their jobs.

After the output file is created completely, I read and parsed the output file in parent process. Then, I printed all the matrices in their creation order. After that, I made necessary Frobenius norm calculations and printed the last result of closest matrices.

Finally, I researched what is covariance matrix and calculated this matrix in child process. I modified the necessary parts of the code to finalize the program. I tested the program with different input file contents.

2. My Design Decisions

To create a child process, I first tried the `execve()` function but it didn't work for some reason. I believe it was about its third parameter, which is environment variables. Then I converted to `execvp()` function and sent the data as command line arguments.

While sending the coordinates to child processes, I also sent information about the number of the current child process to be created. In other words, number i is sent to i th child process. In output file, the format is that every line includes one matrix, starting with the number i and every coordinate is separated by one single whitespace.

The stdout example in the homework PDF confused me a little. Because it looks as if there are more than three triplets of coordinates in covariance matrix there, like $(x,y,z),(x,y,z)\dots(x,y,z)$. That \dots part confused me because according to the definition, covariance matrix is supposed to be 3×3 in this homework's scenario. I decided to do it in $(x,y,z),(x,y,z),(x,y,z)$ anyway

3. Achived and Failed Requirements

Requirements that are related to the class topics, which are file read/write/lock, child process creation and signal handling are working fine.

I am not sure about the validity of the matrix calculation outputs because although I tested my example matrix in online calculators, even they were inconsistent and were giving different results. So I can't say if my output is correct mathematically. But it is in correct format for sure.

One example test:

Input data(without newline):

```
"123456789012345678901234567890qwertyuopiQWERTYUOPlqwertyuopiasdfghjklIASDFG
HJKLlasdfghjklizxcvbnm.,-ZXCVCBNM.,-zxcvbnm.,-123456789012345678901234567---
aaaaaabaaaabaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaa"
```

Command:

```
$ ./processP -i input.dat -o out.dat
```

Output file:

```
out.dat
1 3 -435.060 268.040 -72.060 540.840 -72.060 998.840 1484.840 -435.060 540.840
2 2 -343.140 399.160 215.360 602.060 215.360 1481.560 1571.560 -343.140 602.060
3 6 -0.160 0.840 -0.160 -0.160 0.160 0.840 0.840 -0.160 -0.160
4 1 -17.000 39.000 -4.000 -8.000 -4.000 29.000 31.000 -17.000 -8.000
5 4 -579.740 4666.761 1789.260 665.760 1789.260 3588.760 2524.760 -579.740 665.760
6 5 -20.960 30.640 -10.160 -9.760 -10.160 25.040 31.440 -20.960 -9.760
7
```

Stdout output:

```
Process P reading input.dat
Created R_1 with (-17.000,39.000,-4.000),(-8.000,-4.000,29.000),(31.000,-17.000,-8.000)
Created R_2 with (-343.140,399.160,215.360),(602.060,215.360,1481.560),(1571.560,-343.140,602.060)
Created R_3 with (-435.060,268.040,-72.060),(540.840,-72.060,998.840),(1484.840,-435.060,540.840)
Created R_4 with (-579.740,4666.761,1789.260),(665.760,1789.260,3588.760),(2524.760,-579.740,665.760)
Created R_5 with (-20.960,30.640,-10.160),(-9.760,-10.160,25.040),(31.440,-20.960,-9.760)
Created R_6 with (-0.160,0.840,-0.160),(-0.160,-0.160,0.840),(0.840,-0.160,-0.160)
Reached EOF, collecting outputs from out.dat
The closest 2 matrices are R_1 and R_5, and their distance is 1.839835.
```

```
==4544==
==4544== HEAP SUMMARY:
==4544==    in use at exit: 0 bytes in 0 blocks
==4544==   total heap usage: 1 allocs, 1 frees, 1,024 bytes allocated
==4544==
==4544== All heap blocks were freed -- no leaks are possible
==4544==
==4544== For counts of detected and suppressed errors, rerun with: -v
==4544== ERROR SUMMARY: 0 errors from 0 contexts (suppressed: 0 from 0)
```

Valgrind Result: