Programming assignment #1

Multiplication of Two Matrices

Deadline : 23:59 Oct 18 , 2018

Objective

1. To understand how to design an algorithm.
2. To exercise the concept of recursion.
3. To learn how to use divide and conquer

Problem Definition

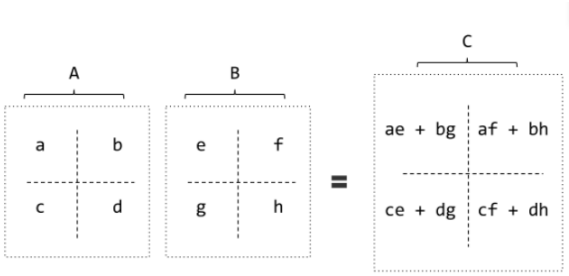
1. Using divide and conquer algorithm to multiply two given matrices, implement the program in C++
2. Compare the results of method 1 ,method 2 and schoolbook matrix multiplication.
3. Analyze the time complexity for the three algorithms .

Experiments

You need to multiply two given square matrices by **divide and conquer algorithm**. The faster your program runs,the more score you can get.

You **ONLY NEED TO HANG IN Method 2** in your program (hang in schoolbook matrix multiplication will get **zero point!!!**), but Method 1 ,Method 2 and schoolbook matrix multiplication in your report.

Method 1:



Method 2:

$$\begin{bmatrix} C_{11} & C_{12} \\ C_{21} & C_{22} \end{bmatrix} = \begin{bmatrix} A_{11} & A_{12} \\ A_{21} & A_{22} \end{bmatrix} \begin{bmatrix} B_{11} & B_{12} \\ B_{21} & B_{22} \end{bmatrix}$$

$$\begin{aligned} P_1 &= (A_{11} + A_{22})(B_{11} + B_{22}) \\ P_2 &= (A_{21} + A_{22})B_{11} \\ P_3 &= A_{11}(B_{12} - B_{22}) \\ P_4 &= A_{22}(B_{21} - B_{11}) \\ P_5 &= (A_{11} + A_{12})B_{22} \\ P_6 &= (A_{21} - A_{11})(B_{11} + B_{12}) \\ P_7 &= (A_{12} - A_{22})(B_{21} + B_{22}) \\ C_{11} &= P_1 + P_4 - P_5 + P_7 \\ C_{12} &= P_3 + P_5 \\ C_{21} &= P_2 + P_4 \\ C_{22} &= P_1 + P_3 - P_2 + P_6. \end{aligned}$$

I/O Format

Your program must be able to read an input file and write an output file. The I/O file names are arguments to your program; in other words, those file name can NOT be fixed. In command line, your program is invoked by:

```
./a.out   input_data   output_data
```

Input file example

```
4                       //size of matrices

26 14 31 37             //matrix 1
9 19 11 14
8 12 15 24
35 7 11 4

39 16 23 1              //matrix 2
1 35 29 17
34 18 15 24
1 32 38 18
```

output file example

```
2119 2648 2875 1674
758 1455 1455 848
858 1586 1669 1004
1750 1131 1325 490
```

Program Submission

1. Please use C/C++ language and your program must be written in only one source file.
2. Your source file must be named as "Student_ID_number_hw1.cpp" and please make sure that all characters of the filename are in **lower case**. For example, if your student number is 9711592, the name of your program file should be "9711592_hw1.cpp".
3. Upload your report and program to the E3 by deadline.
4. Don't cout any words on terminal.

Report

1. No more than 3 pages.
2. Your report must contain:
   a. The flow chart or the pseudo code of you program.
   b. The experimental results and analysis between the three methods.
3. The report file name must be "Student_ID_number_hw1.doc(x)" or "Student_ID_number_hw1.pdf" and please make sure that all characters of the filename are in lower case. For example, if your student number is 9711592, the name of your program file should be "9711592_hw1.pdf".

Grading

You need to submit both your source code and report. Remember the submission rules mentioned above, or you will get zero point !.

- Report 30 %
- Case0 10 %
- Correctness of Case1 16 %
- Performance of Case1 4 %
- Correctness of hidden cases 24 %
- Performance of hidden cases 16 %

Ps. The size of case0 and case1 won't be changed, but the content will be changed.