ID5130: Parallel Scientific Computing

Assignment 3 - OpenACC

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Question 1 - LU Decomposition

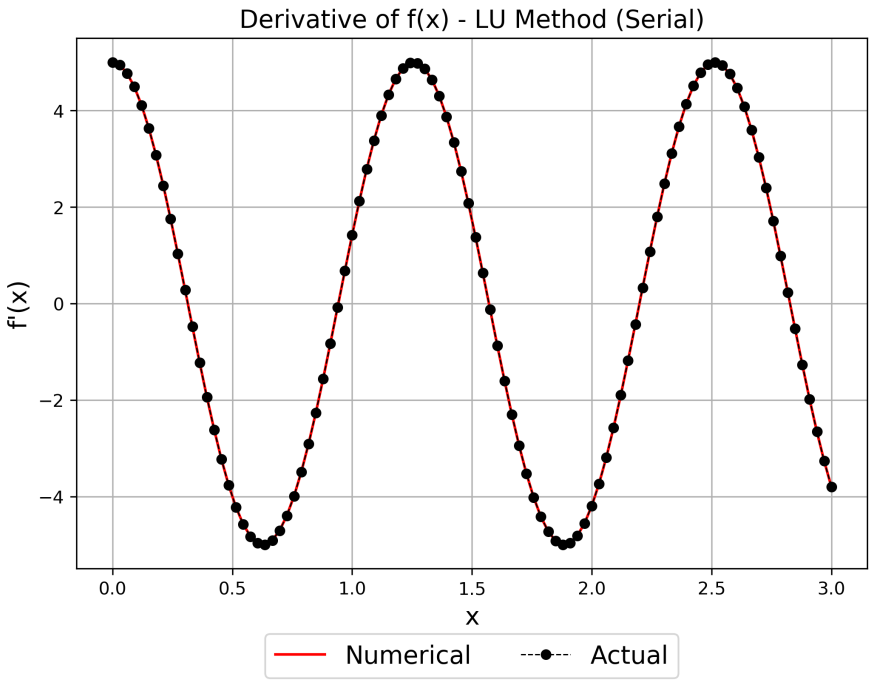

Figure 1: Analytical vs. Numerical Solution for Serial Code ($N = 100$)

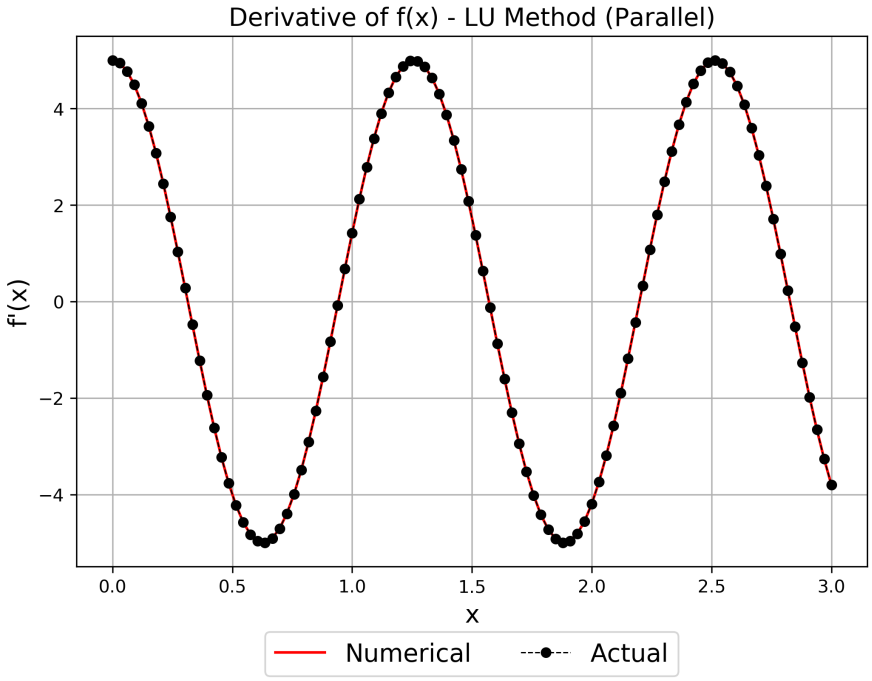

Figure 2: Analytical vs. Numerical Solution for Parallel Code ($N = 100$, $N_g = 10$)

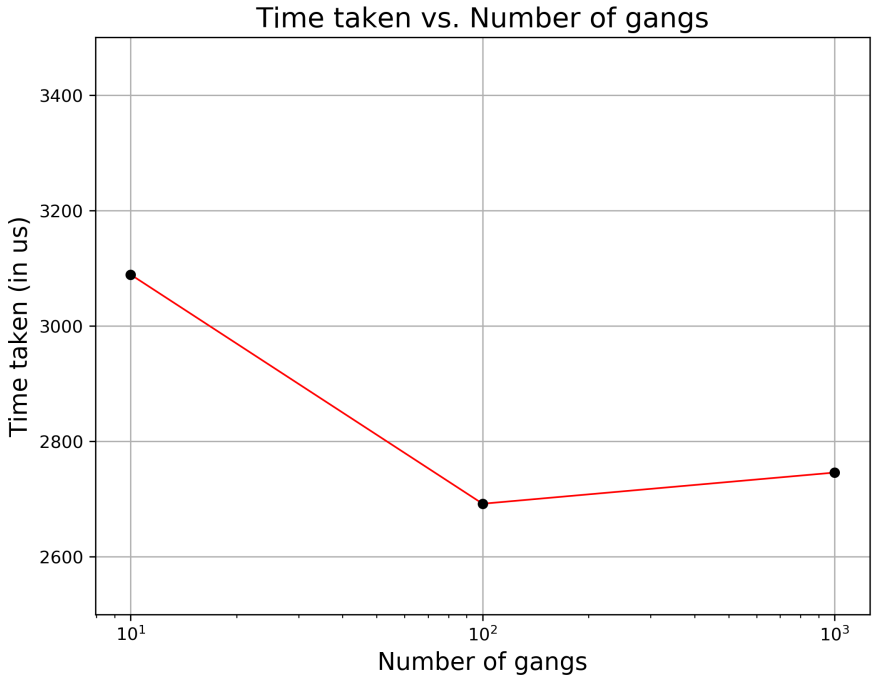

Figure 3: Time taken vs. Number of gangs for $N = 1000$

Figs. 1 & 2 compare the analytical and numerical results generated by serial and parallel code for $N = 100$ and 10 gangs. It can be seen that both the numerical plots are matching with the analytical ones, which means that the code is correct. Fig. 3 shows the time the parallel code takes for different numbers of gangs for $N = 1000$. For $N_g = 100$, we get the most improvement, while for higher N_g, the overheads are taking over the improvement gained.

Question 2 - Cholesky Decomposition

```
abhijeet@raft-fujitsu-ws:~/ID5130_Local/ID5130-PSC/Assignments/3_OpenACC$ ./outfile.exe
L =
1.0000 0      0      0      0      0      0      0      0      0
0.0100 0.9999 0      0      0      0      0      0      0      0
0.0200 0.0298 0.9994 0      0      0      0      0      0      0
0.0300 0.0397 0.0482 0.9976 0      0      0      0      0      0
0.0400 0.0496 0.0578 0.0642 0.9942 0      0      0      0      0
0.0500 0.0595 0.0673 0.0731 0.0769 0.9890 0      0      0      0
0.0600 0.0694 0.0768 0.0819 0.0850 0.0861 0.9820 0      0      0
0.0700 0.0793 0.0863 0.0908 0.0930 0.0932 0.0920 0.9733 0      0
0.0800 0.0892 0.0958 0.0997 0.1010 0.1003 0.0980 0.0948 0.9632 0
0.0900 0.0991 0.1053 0.1085 0.1091 0.1074 0.1041 0.0998 0.0951 0.9518
abhijeet@raft-fujitsu-ws:~/ID5130_Local/ID5130-PSC/Assignments/3_OpenACC$ ./a.out
L =
1.0000 0      0      0      0      0      0      0      0      0
0.0100 0.9999 0      0      0      0      0      0      0      0
0.0200 0.0298 0.9994 0      0      0      0      0      0      0
0.0300 0.0397 0.0482 0.9976 0      0      0      0      0      0
0.0400 0.0496 0.0578 0.0642 0.9942 0      0      0      0      0
0.0500 0.0595 0.0673 0.0731 0.0769 0.9890 0      0      0      0
0.0600 0.0694 0.0768 0.0819 0.0850 0.0861 0.9820 0      0      0
0.0700 0.0793 0.0863 0.0908 0.0930 0.0932 0.0920 0.9733 0      0
0.0800 0.0892 0.0958 0.0997 0.1010 0.1003 0.0980 0.0948 0.9632 0
0.0900 0.0991 0.1053 0.1085 0.1091 0.1074 0.1041 0.0998 0.0951 0.9518
abhijeet@raft-fujitsu-ws:~/ID5130_Local/ID5130-PSC/Assignments/3_OpenACC$
```

Figure 4: Comparison of serial (top) and parallel (bottom) outputs ($N = 10$)

Fig. 4 shows the L matrix generated by the serial and parallel code. The top matrix is the one generated by the serial code. It can be seen that both are the same, ensuring the correctness of the parallel code. Fig. 5 shows the time the serial and parallel codes take. It is observed that the parallel code has much improvement compared to the serial code.

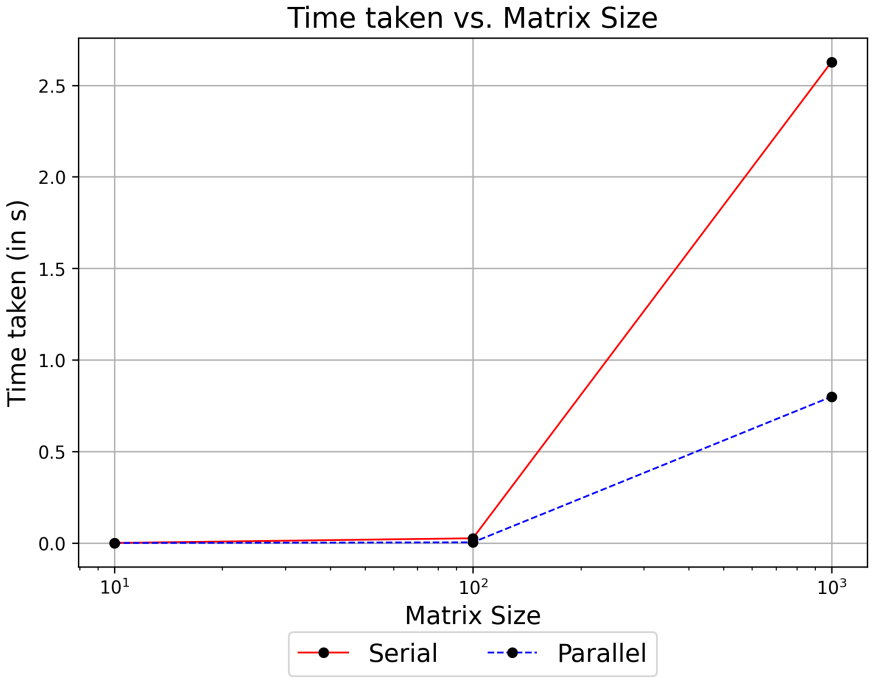

Figure 5: Time taken vs. Matrix size