

Report for Pgm1

Problem Statement

Matrix multiplication can be quite resource intensive, especially when dealing with large matrices. Making use of multiple cores can help improve its performance. One way to specifically do this is by utilizing the OpenMP API for C. For this task, OpenMP directives will be useful in improving upon an existing matrix multiplication function.

Approach to Solution

The OpenMP API is the main tool utilized to assist in finding a solution to the problem. Additionally, SLURM (Simple Linux Utility for Resource Management) and access to a Linux server on a supercomputer through an SSH may be essential. Since it is apparent that the matrix multiplication is heavily reliant on loops, the decision to use a pragma directive (from the OpenMP API) that specialized on parallelizing loops was made. Additionally, privatizing the variables within the nested loops and making use of the reduction clause for OpenMP allowed for more optimizations of the matrix multiplication function.

Solution Description

In this task, the code written by Dr. Goodrum was modified merely with the OpenMP API, and any additional code added to it was mainly done on the `matmul` function along with comments added all throughout the C source file.

When logged into a remotely hosted Linux server on a supercomputer through an SSH (with `bridges.psc.edu` being the recommended remote host), it is important to have the `matmul.c` and `matmul.sh` files in the current directory. When they are there, go into interact mode by typing in “interact” and pressing enter. From there, executing the bash script with the SLURM-specific command `sbatch` should be done with the command `sbatch matmul.sh`. A slurm file should be produced in the current directory from executing this bash script, and the content of that file will display the statistics of the program that ran.

```
[namang@br018 ~]$ interact
A command prompt will appear when your session begins
"Ctrl+d" or "exit" will end your session

[namang@r001 ~]$ sbatch matmul.sh
Submitted batch job 2279773
[namang@r001 ~]$ ls
a.out  matmul.c  matmul.sh  slurm-2279773.out
[namang@r001 ~]$ cat slurm-2279773.out
L = 1000, M = 1000, N = 1000, elapsed = 0.925378, flops = 2.16128e+09
```

The execution of the bash script and the results after multiplying two 1000x1000 matrices.

With these statistics, it is made apparent that the optimizations made to the matrix multiplication function worked measurably. What would normally take more than five seconds to compute the result of multiplying two 1000 by 1000 sized matrices now takes less than a second with 2 gigaflops, signifying great improvement and success in resolving the problem.