Renmin University of China

Advanced Parallel Computing 2022 Fall Semester

Lab 1: OpenMP Version Matrix-Matrix Multiplication

Deadline: November 4, 2022

1. Target

This course assignment familiarizes students with the OpenMP programming model by writing the OpenMP version of matrix-matrix multiplication (SGEMM). Everyone is encouraged to try different optimization strategies.

2. Problem Description

In mathematics, matrix multiplication multiplies two matrices together to produce another matrix. Matrix multiplication is widely used in practical applications and implemented by different programming languages. The Basic Linear Algebra Subprograms (BLAS) standard, developed in 1979, describes basic linear algebra operations, including matrix multiplication. BLAS is divided into three levels, and matrix-matrix operations belong to the third level. In the following formula, a and b are constants, and A, B, and C are matrices.

$$C = aAB + bC$$

See obe for the program example code, and execute the "make" command to compile the program. Execute "bash run.sh" to execute the program. The catalog only provides the code for small-scale matrices,

and the large-scale matrix code needs to be implemented by yourself. Please use a multi-core server. If you have any questions, please contact the teaching assistant. Require:

- Measure the processing speed (GFLOPS/sec) of different scale matrices according to the memory size, and give the calculation formula.
- Please calculate the theoretical peak value of the system. If the theoretical peak value is not reached, try to give the reason.

1. Optimization Tips

- Consider the influence of thread storage and access methods and OpenMP's thread scheduling policy.
- To test larger-scale matrices, use malloc etc. to allocate space on the Heap.
- Two-dimensional arrays can be represented by one-dimensional arrays.

2. Score

- Correctness（30%）

Please ensure that the program execution result is correct, the same as the serial operation result. Deviations are allowed.

- Report writing（30%）

The number of pages is limited to 2 pages, that is, the front and back sides of a sheet of paper are printed. Explain clearly in the limited space.

- Experimental results（40%）

The performance is evaluated by analyzing the experimental results given. If it doesn't make sense we'll check the code.

3. Submission

Submit the experiment report and code to UniCourse+, compress it in zip format, and specify how to run it in the report. The lab report can be up to 2 pages. Write your name and student number clearly. It needs to include problem description, method (how to solve the problem/algorithm), experiment (experimental environment, result analysis, experimental code path and how to run the program), conclusion and other parts, and screenshots of program operation.

4. Reminder

- Do not log in to other people's accounts.
- Do not copy other people's work
- Welcome to discuss issues in the WeChat group
- UniCourse+ internet site：http://obe.ruc.edu.cn/