Designing and Building Applications for Extreme Scale Systems
CS598 Spring 2016

Homework 1. Matrix-matrix multiply performance

Objectives

1. Gain experience running programs and checking performance
2. Use performance models to gain insight into the behavior of code.

Tasks

Measure the elapsed time for a single matrix-matrix product, and compute the performance in Millions of floating-point operations per second (MFLOP/s).

Run the code, available on line in either C or Fortran, for the following problem sizes:

N = 100, 200, 400, 800, 1000, 1200, 1400, 1600, 2000

Provide a table with the measured performance for each value of N.

Estimate the performance in the following two ways:

1. Use the measured time for N=100 to compute a value for c in the formula Time = $2cN^3$. With that value of c, use that same formula to compute what time this formula would predict for the other values of N.
2. Using any information that you can find on the clock speed of the system that you are using, compute c as 1/frequency. For example, if the clock frequency for the processor is 2.6GHz, c = 1 / (2.6×10^9) = 0.38×10^{-9}. Again using the formula T = $2cN^3$, compute the time that this formula predicts for each value of N.

To present your results, use a table such as the one below (the first two lines provide the values of c used for the 2 rightmost columns, and must be included in your submission).

C for #1 =
C for #2 =

N	Measured Performance MFLOP/s	Measured Time (seconds)	Formula Time c for #1 (using N=100)	Formula Time c for #2 (using clock speed)
100				
200				
400				
800				
1000				

1200				
1400				
1600				
2000				

Submission

A PDF file containing the performance table and proper plots reflecting all the necessary performance trends (measured time, measured performance in MFLOP/s, and formula time).

Notes

Run on any system that you like. You may use your laptop; however, this is a good opportunity to checkout any computational cluster that may be available for the class.

Questions (but you don't need to turn in)

1. How well does the formula work?
2. How close is c computed from the clock speed? Is there an integer k > 1 such that c/k is a better predictor for your machine? Why might c/k be a better value for the formula?
3. Graph the measured performance. Are there obvious sudden changes in performance? What might you do to efficiently find the value of N where the performance has a sudden change?