HW 2—Problem 2

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Estimation of parallel computation time:

Serial Dot Product:

There are K multiplications taking M time and $K-1$ additions taking A time, so the total time is:

$$KM + (K-1)A$$

Parallel Dot Product

The master sends the entire sub-problem to process 1 in one message, then sends the entire sub-problem to process 2 in one more message. After process 1 is done, it replies, and after process 2 is done, it replies, for a total of 4 messages. Process 1 and process 2 each have $K/2$ multiplications and $(K-1)/2$ additions. Therefore, each process will take $2T + \frac{K}{2}M + \frac{K-1}{2}A$ to receive the problem, calculate the partial dot product, and return the solution. Because the messages will be staggered (that is, P1 will receive the problem first, and start computing while P2 is receiving the problem), the total time is:

$$3T + \frac{K}{2}M + \frac{K-1}{2}A$$

The parallel algorithm is faster than the serial algorithm if $3T < \frac{K}{2}M + \frac{K-1}{2}A$

This is because otherwise, $3T \geq \frac{K}{2}M + \frac{K-1}{2}A$, which implies that $3T + \frac{K}{2}M + \frac{K-1}{2}A \geq KM + (K-1)A$, which is the runtime of the serial program, which means the parallel program take the same time or be slower than the serial program.

Socket Programming

See zip file “will0101_problem_2.zip” (master.py, worker.py, python_output.png)

MPI Programming

See zip file “will0101_problem_2.zip” (dot_prod.c , dot_prod.sbatch, dot_prod_31181535_stdout.txt)