MATH 440A/540A Parallel Scientific Computing
Homework – Exercise Sheet 4

1. Determine the correct time unit (such as microsecond) that it takes for a single processor core to do a floating point operation if it does
(i) 1 MFLOPS; (ii) 1 GFLOPS; (iii) 1 TFLOPS; (iv) 1 PFLOPS.

2. Consider a two-level memory system with a 2 GHz processor. In the system, let cache access time be 2 cycles per word, main memory access time be 100 cycles per word, and let the cache-hits rate be 99%.

   Consider a code that involves computing only a matrix C_N that is a product of two $N \times N$ matrices A_N and B_N. (That is, $C_N = A_N B_N$.) What is the maximum number of FLOPS possible for this code on the system.

3. Write a sequential program (in any language of your choice) to compute the sum $S_N = \sum_{i=1}^{N} a_i$. Test the program by taking $a_i = (-1)^{i+1}/(2i-1), i = 1, \cdots, N$, and tabulating the values of S_N and $S_N - \pi/4$ for various values of N. What is your conclusion?

4. Determine the performance of the test in Q.3 on a single core as a function of N, by tabulating the CPU time (that is, $T(N)$) for various values of N. On the system, what are the approximate critical values of N below which the measure CPU time is uncertain? Plot the function T and determine an approximate mathematical/theoretical model for the problem. In your report, give details of the system you are using.

5. Consider Q3. Determine the performance on a single processing core for computing the entries $a_i, i = 1, \cdots, N$ and the associated sum S_N, separately. Determine if there is any relationship between computing these two terms and write down your conclusions.