Project 0 - Simple OpenMP Experiment

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1. **Tell what machine you ran this on**

   - rabbit machine (@rabbit.engr.oregonstate.edu) from OSU (Oregon State University) server was used to implement the project0.

2. **What performance results did you get?**

   - I picked 123,456 (123K) as the size of an array to do the arithmetic on. The performance results I got are below.

	1-thread	4-thread
Peak Performance	277.48 (MegaMults/sec)	597.66 (MegaMults/sec)

3. **What was your 1-thread-to-4-thread speedup?**

   - Speedup (S) is equal to the equation that execution time with one thread is divided by execution time with four threads, or performance with four threads is divided by performance with one thread. These equations are below.

$$S = \left(\frac{Execution\ time\ with\ one\ thread}{Execution\ time\ with\ four\ threads}\right) = \left(\frac{Performance\ with\ four\ threads}{Performance\ with\ one\ thread}\right)$$

Thus, $S = \left(\frac{597.66}{277.48}\right) \approx 2.2$

4. **Your 1-thread-to-4-thread speedup should be less than 4.0. Why do you think it is this way?**

   - Before conducting the experiment, we expect that the performance of increase in the number of threads is directly linear. The performance of 4-threads would be 4 times than that of 1-thread. However, the results of the experiment show that the performance was not linear. There are several reasons why this happened. One of the cases is when multiple threads compete for shared resources such as memory, contention can occur, leading to decrease the performance. Furthermore, in the

program, factors such as load imbalance among threads, false sharing can contribute to reduced speedup. In addition, overhead, including the cost of creating and managing threads and synchronization between threads, can dminish the expected speedup.

5. **What was your Parallel Fraction, F_p? (Hint: it should be less than 1.0, but not much less.)**

   - To calculate Parallel Fraction, we need to use the equation provided by instructor. The equation of Parallel Fraction (F_p) is below.

$$F_p = \left(\frac{4.}{3.}\right) \times \left(1. - \left(\frac{1.}{S}\right)\right)$$

S is 1-thread-to-4-threads Speedup, which is 2.2. Therefore,

$$F_p = \left(\frac{4.}{3.}\right) \times \left(1. - \left(\frac{1.}{2.2}\right)\right) \approx 0.7$$