High Performance Computing and Big Data - Cluster Computing

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1 Execution Time & Number of Threads

The first question describes a strong scaling problem which increases the number of processors with fixed problem size. As we can observe from Fig. 1, as the number of threads increases, the execution time decreases. However, when the number of processors is more than 16, the execution time increases. Considering the fact that an average node of Lisa has 16 processors, those exceptions can be explained as follows.

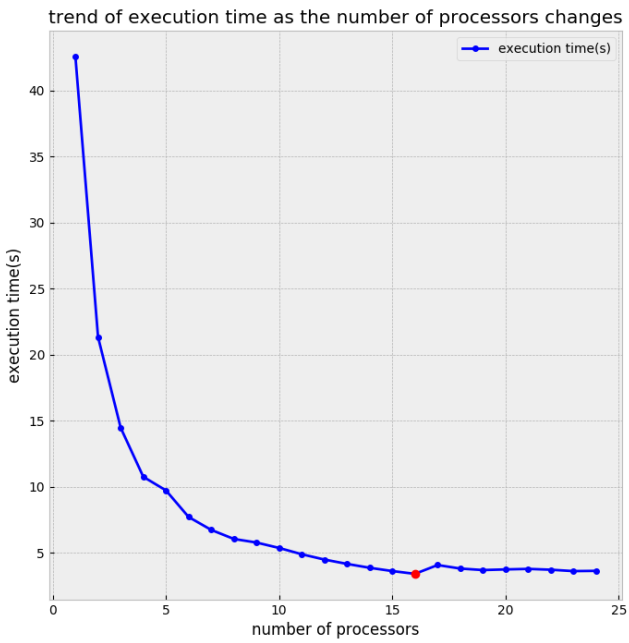

Fig. 1. The trend of execution time as the number of threads changes but the total problem size is fixed.

First of all, when the predefined number of threads is greater than the number of available cores, some cores will be assigned with more than one thread and the execution time of those cores increases. Second, as the number of threads increases, the communication time between threads also increases. When the additional time is greater than the reduced time (i.e., the reduced execution time of each thread), the execution time increases in general.

2 Execution Time & Numbers in the Leibniz series

The second question increases the problem size (i.e., the numbers in the Leibniz series) in proportion. In Fig. 2, it's obvious that the execution time also increases proportionately, which means that the task is evenly distributed to every thread.

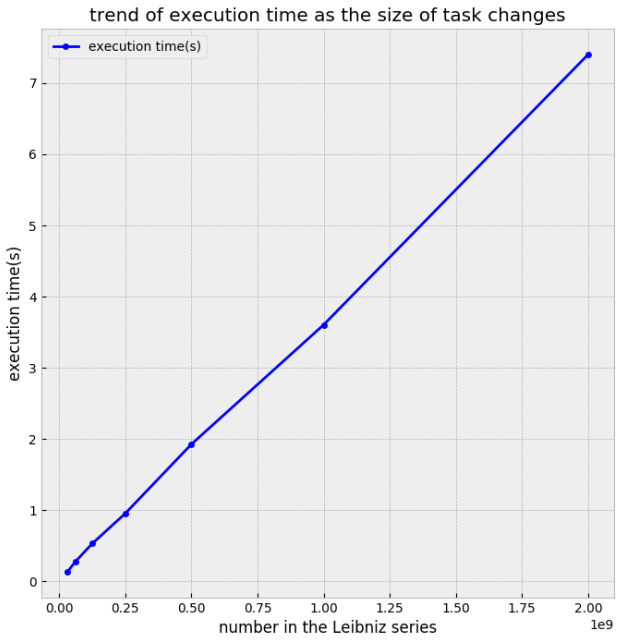

Fig. 2. The trend of execution time as the number in the Leibniz series increases but the number of threads remains the same.

3 Weak Scaling

In order to explore the weak scaling of the pi-computation problem, we collect and visualized the changes of execution time when the number of threads increases while the problem size of per thread remains the same. As shown in Fig. 3, although the task size of each thread is the same, the total execution time rises. One of possible reasons for this phenomenon is the increase of communication time.

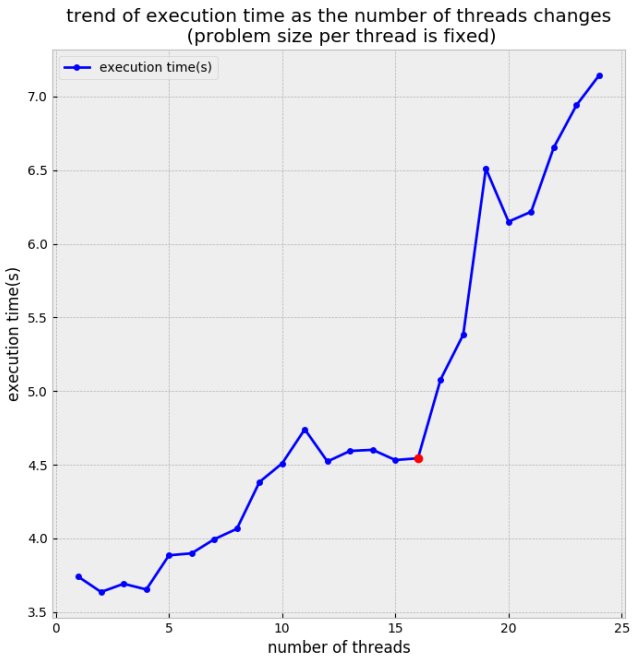

Fig. 3. The trend of execution time as the number of threads changes but the problem size per thread is fixed.