HPC cluster computing

Qingxian Lu(14723697), Ingrid Marie Wølneberg(14580934),Yongqing Liang(14115603)

January 2023

1 Task 1

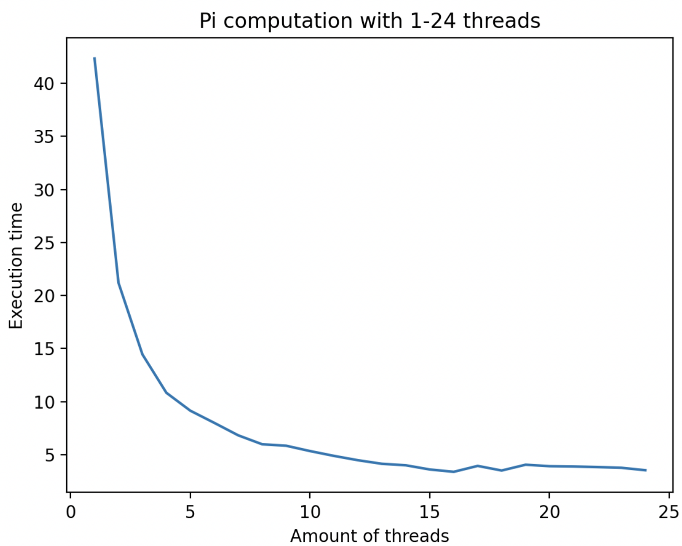

Figure 1: Pi computation with different amount of threads

Since we know the average Lisa node has 16 processors it makes sense that when the amount of threads goes over 16 the execution time stops decreasing because there are no more processors to run the extra threads in parallel. Only 16 can run in parallel at a time.

2 Task 2

In this task, we set $thread = 16$, which means that all the parallelism is used (since the average Lisa node has 16 processors), so the amount of computation rises in proportion to the time required as the purple line shown in figure 2. Besides, the grey lines shown in figure 2 illustrates that the estimated Pi is getting closer to the real value of Pi as the amount of computations rises.

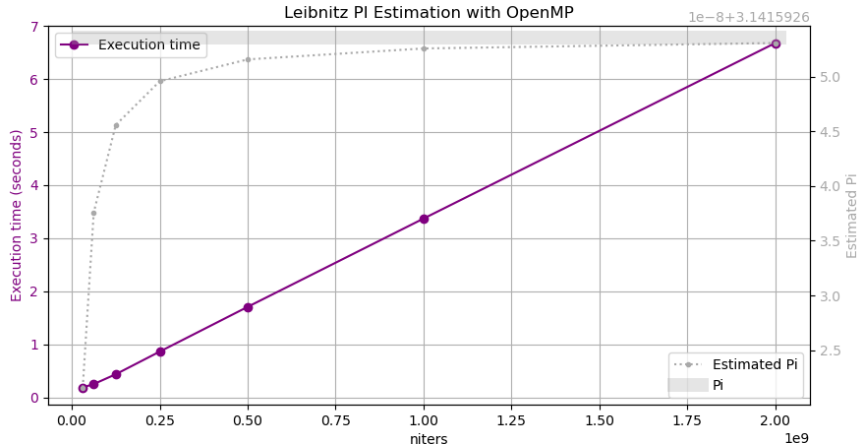

Figure 2: Pi computation with different amount of iterations

3 Task 3

In task3, we used $\{niter, thread\} = \{2000000000, 16\}$ as a reference and equivalently scaled $\{niter, thread\}$, where $thread$ ranges from 1 to 24. From Figure 3, when the number of processors is less than or equal to 16, the running time increases slowly, as expected, due to that the base overhead for calling more processors is increased. As the number of processors increases from 16 to 17, there is a dramatic increase in runtime, due to the fact that a worknode has 16 processors and if it is increased to 17, the amount of computation has increased, but the processing power of the parallel system has not.

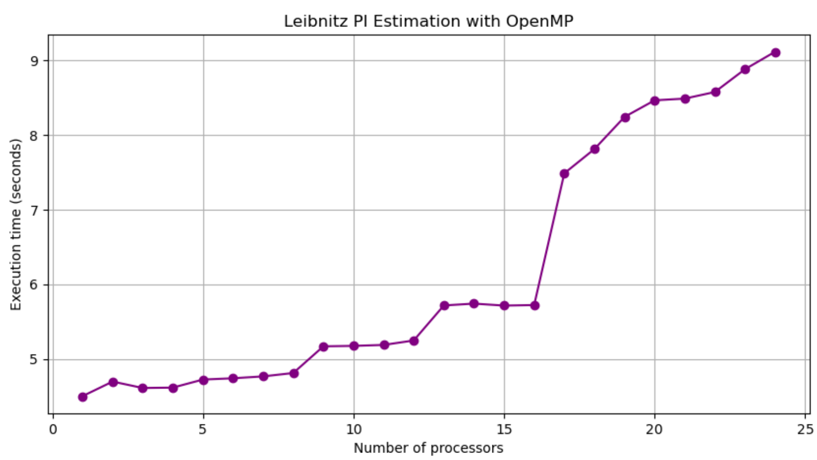

Figure 3: Pi computation with different amount of processors

The following analysis of the efficiency of each processor, which may be more intuitive, shows the same pattern. According to the definition of weak scaling, both the number of processors and the problem size are increased. The essence is that we expect each processor to handle the same amount of work. To measure the parallel scaling performance we computed the efficiency of each processor:

$$\text{Efficiency } = t(1)/t(N)$$

$t(1)$: the amount of time to complete a work unit with 1 processor.
$t(N)$: the amount of time to complete N of the same work units with N processors.

From Figure 4, we can see that the ideal efficiency of weak scaling is 1, since the workload per processor is the same theoretically. The actual efficiency decreases as the workload/number of processors increases. The weak scaling is an ideal assumption. In fact, the actual efficiency is really hard to approach 1.

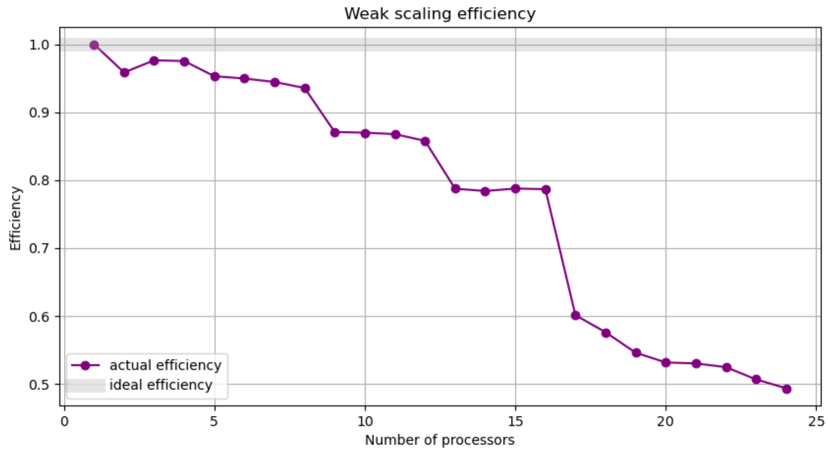

Figure 4: Weak scaling