Homework

Wave

ME 471/571, Spring 2019 **submission due: Mar 31st**

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Unfortunately, in my first try the problem size was small and I had to repeat the computation with a bigger problem, however the R1 was down on Thursday and Friday and that is why I am submitting this now. And also, I couldn't submit jobs for number of CPUs greater than 80! Probably due to recent problem with R1.

For the serial process the original wave.c algorithm was used and then the code was modified for parallel processing. Below are the description of files:

Wave.c: MPI wave algorithm

run_wave.qsub: submission file

Makefile

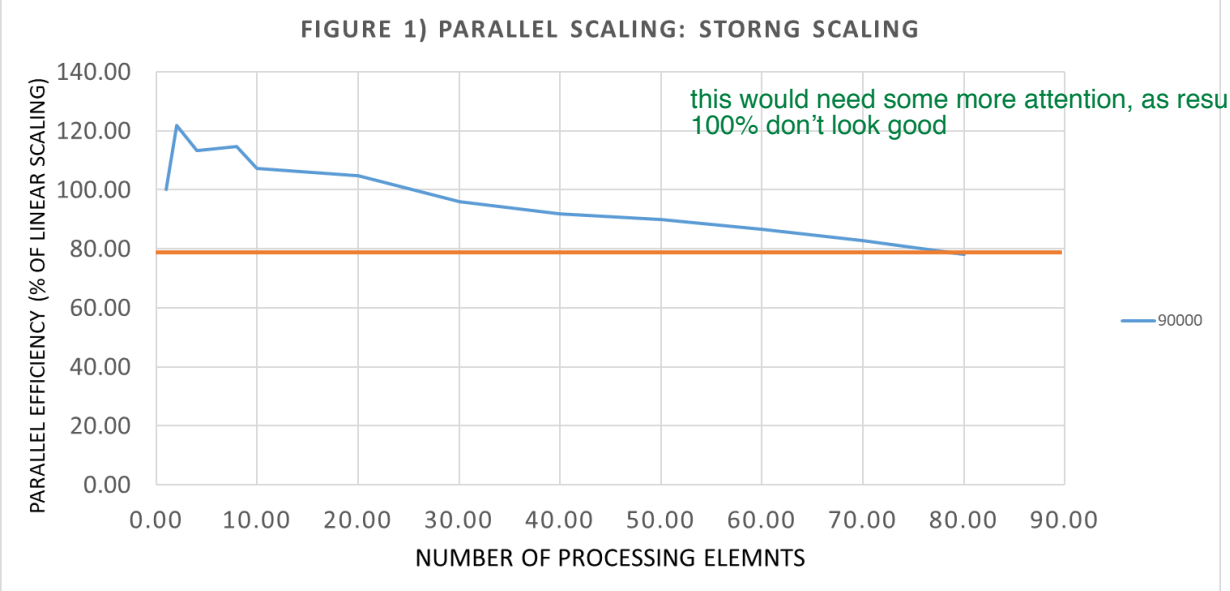
For strong scaling a fix problem size was considered and the results are in table 1, as it can be seen from Figure1 only the 80 cores have a parallel efficiency below 80%. However, I the cpu core that was used to compute the single process was unexpectedly slower at that moment which resulted in increased efficiency above 100% for the first processes. According to the result 80 processors would be the optimum number for this code.

I don't see any proof that you are computing a correct result. Is your U_ERROR actually computed? I imagine that for 90000 points there will be error at machine precision.
To make a compelling proof, you should either plot the result compared with exact solution, or comment on what the error means (and express it in scientific notation, i.e. 0.123e-14 - right now 0.00 does not tell me much, the error could be 0.0001).

Table1) strong scaling results

NPROC	NPTS	U_ERROR	WTIME_GLOBAL
1.00	90000.00	0.00	2647.30
2.00	90000.00	0.00	1086.01
4.00	90000.00	0.00	583.43
8.00	90000.00	0.00	288.83
10.00	90000.00	0.00	247.03
20.00	90000.00	0.00	126.40
30.00	90000.00	0.00	91.84
40.00	90000.00	0.00	71.97
50.00	90000.00	0.00	58.89
60.00	90000.00	0.00	50.91
70.00	90000.00	0.00	45.71
80.00	90000.00	0.00	42.34

Even better, you should do a convergence study, so show me the error for increasing number of elements, starting at some low numbers (e.g. 10 or 20). This would show the behavior of your numerics really well, and should there be any errors in implementation, expose them immediately. This was not a requirement for this assignment, but I comment on it here as a general advice for your research work.



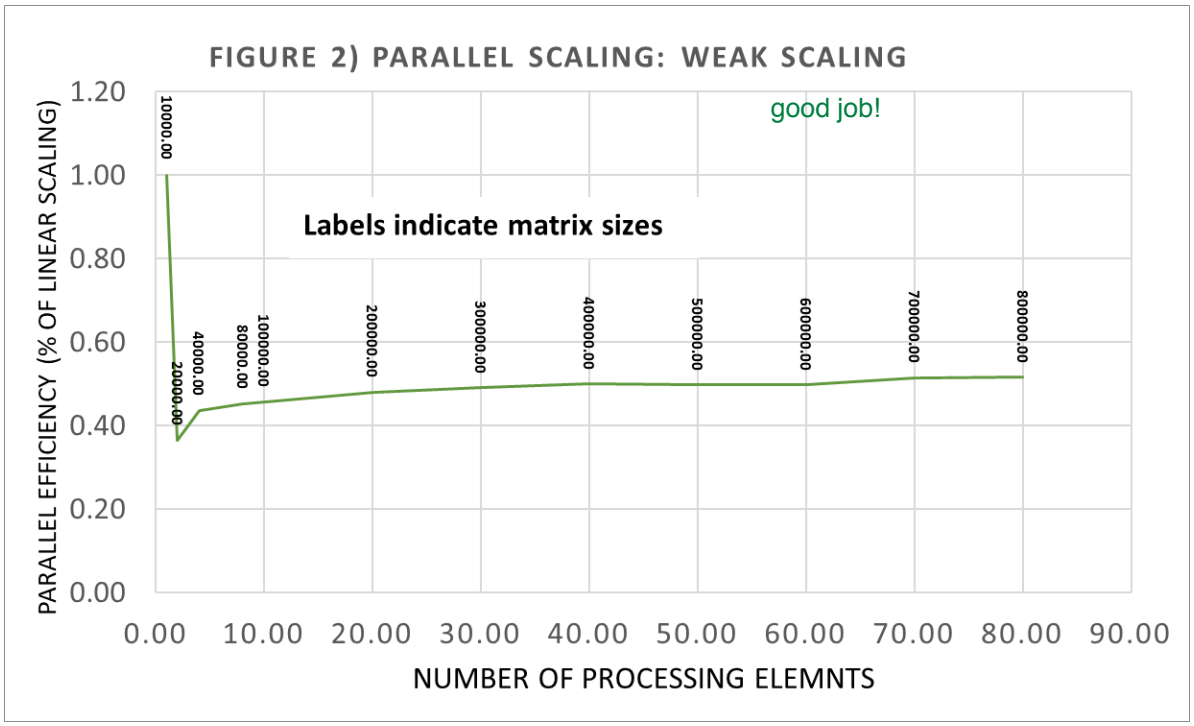
this would need some more attention, as results so much over 100% don't look good

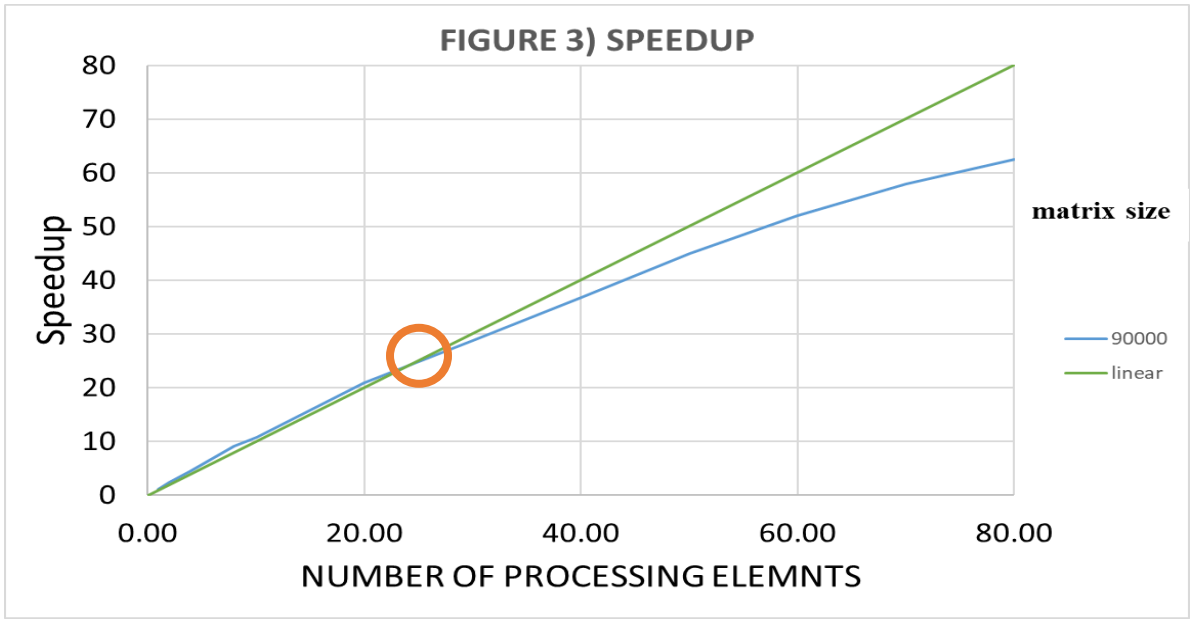
The week scaling was setup in away that problem size would be the product of number of CPUs and a constant size of 10000. Results indicated that for week scaling parallel efficiency starts from 36% with 2 CPUs and goes up to 50-52% and stays in that range so it is not a good code for week scaling and doesn't provide a large boost in efficiency when the CPUs increase as the

size of problem increases. Figure 3 on the other hand, that the speedup of this algorithm for problem size of 90000 is identical to the ideal parallel process up to 30 processors and after that there is a deviation from the ideal parallel process.

Table 2) week scaling results

NPROC	NPTS	U_ERROR	WTIME_GLOBAL
1.00	10000.00	0.00	568.39
2.00	20000.00	0.00	207.36
4.00	40000.00	0.00	247.87
8.00	80000.00	0.00	256.84
10.00	100000.00	0.00	259.73
20.00	200000.00	0.00	273.23
30.00	300000.00	0.00	278.86
40.00	400000.00	0.00	284.28
50.00	500000.00	0.00	282.70
60.00	600000.00	0.00	282.47
70.00	700000.00	0.00	292.77
80.00	800000.00	0.00	293.10





Finally, a plot of wave equation vs predicted is shown in figure 4.

Ok, I see it now :)