HPC4M assignment 5

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Exercise 2

I implemented a code that adapts the number of subdivisions M according to the number of processros `nproc`. In particular, for horizontal and vertical strips

$$M = M - \mathrm{mod}(M - 1, \texttt{nproc}),$$

for squares

$$n = \mathrm{int}(\mathrm{sqrt}(\texttt{nproc})), \quad M = M - \mathrm{mod}(M - 1, n).$$

I performed tests with a starting value $M = 2306$ and final time $T = 1$.

The next tables present the results for horizontal strips, vertical strips, squares, in terms of computational time, speed and parallel efficiency. The computational time of the serial code is 745.1 seconds. For small values of `nproc`, the speed up and efficiency seem to not follow the expected behaviour. For larger `nproc` instead, the speed up is smaller that `nproc` and the efficiency is smaller that 1. For the last instance with `nproc` $= 46$, there is a jump in the computational time. This may be because the size of the domain assigned to each processor becomes sufficiently small to fit into a different part of memory. All the times reported do not include the time required to write the results to file.

We also show a plot of the weak scaling for horizontal stips; in this case, we changed the problem dimension according to $M \approx 384\sqrt{\texttt{nproc}}$, so that for 36 processors M was the same as in the previous tests.

Figure 1: Speed up against number of processors for horizontal strips

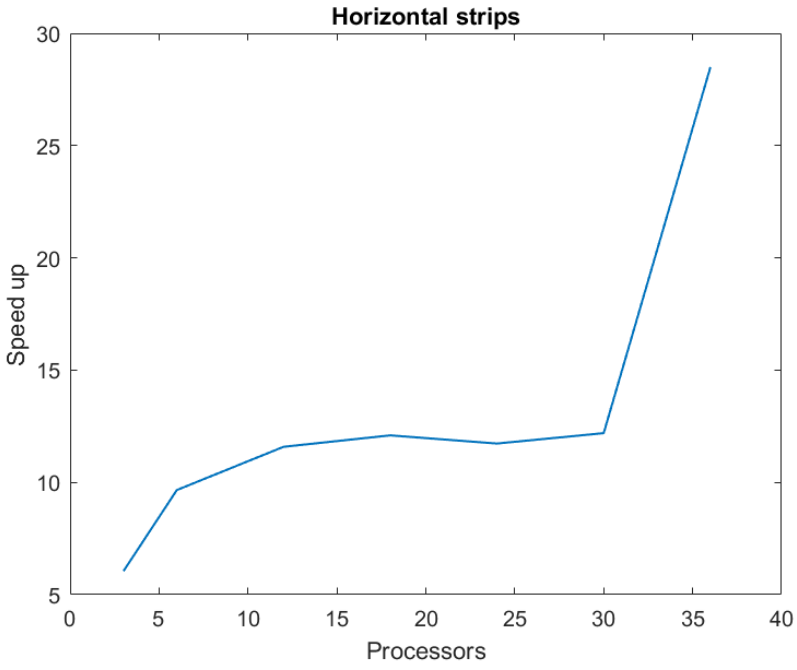

Figure 2: Speed up against number of processors for vertical strips

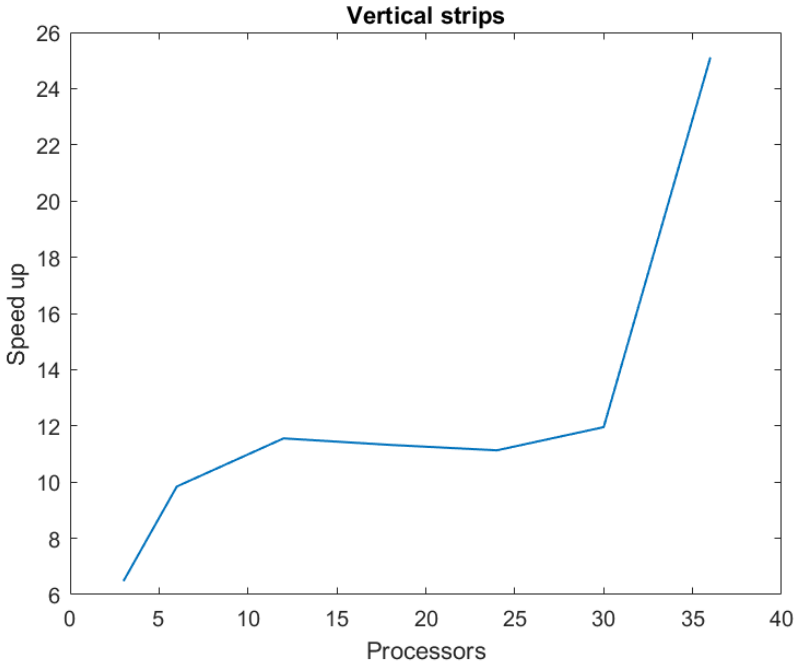

Figure 3: Speed up against number of processors for squares

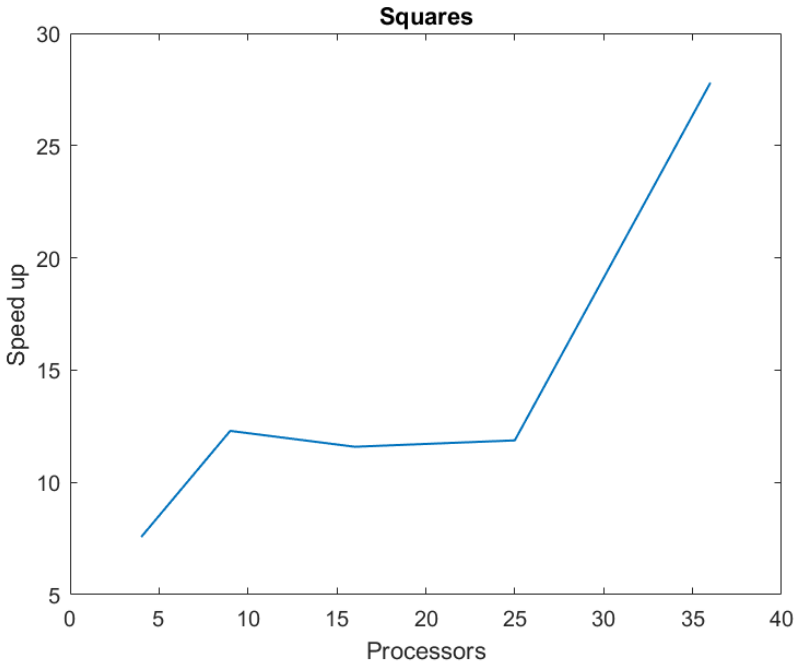

Figure 4: Weak scaling for horizontal strips

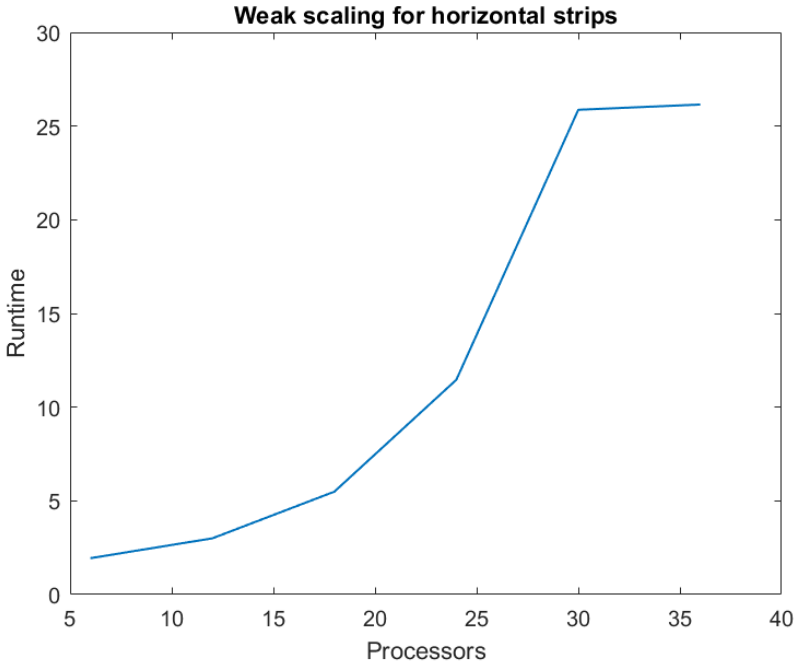

Table 1: Results with horizontal strips.

`nproc`	time	speed up	efficiency
3	123.22	6.05	2.02
6	77.14	9.66	1.61
12	64.32	11.58	0.97
18	61.61	12.09	0.67
24	63.52	11.73	0.49
30	61.11	12.19	0.41
36	26.15	28.49	0.79

Table 2: Results with vertical strips.

`nproc`	time	speed up	efficiency
3	115.01	6.48	2.16
6	75.69	9.84	1.64
12	64.48	11.55	0.96
18	65.80	11.32	0.63
24	66.94	11.13	0.46
30	62.32	11.96	0.40
36	29.67	25.11	0.70

Table 3: Results with squares.

`nproc`	time	speed up	efficiency
4	98.44	7.57	1.89
9	60.61	12.29	1.37
16	64.31	11.59	0.72
25	62.77	11.87	0.47
36	26.80	27.80	0.77