HPC Project 4

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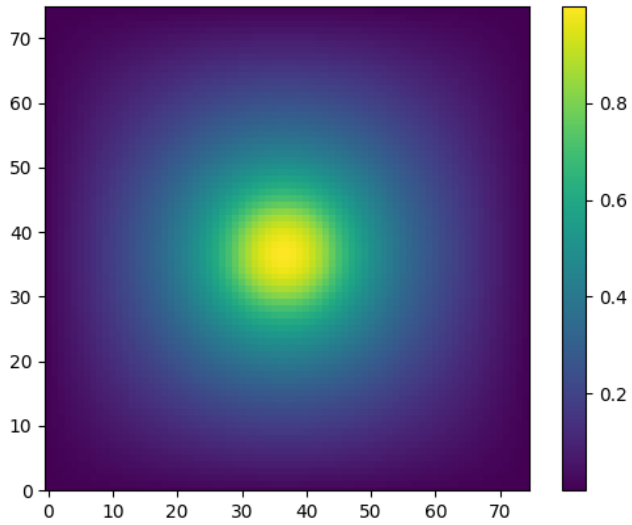
1. Serial Experimentation

Run a simulation of 75*75 domain.

1.1 Resources used

Mehtod	Memory(MB)	Time(sec)
Dense	241.61	8.52
Sparse(OTF)	0.21	0.02

1.2 Example plotting



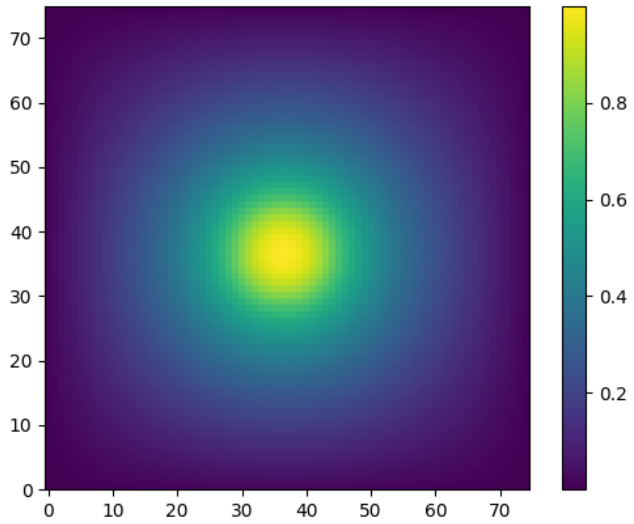
1.3 Estimations

Dense memory method will consume a memory of O(N*N), while OTF method only need O(N).(Approximately)
If we scale the problem size ot 10000 * 10000:
Dense memory will increase to around 2 * 10^10 GB.
Sparse memory will be 4 GB.

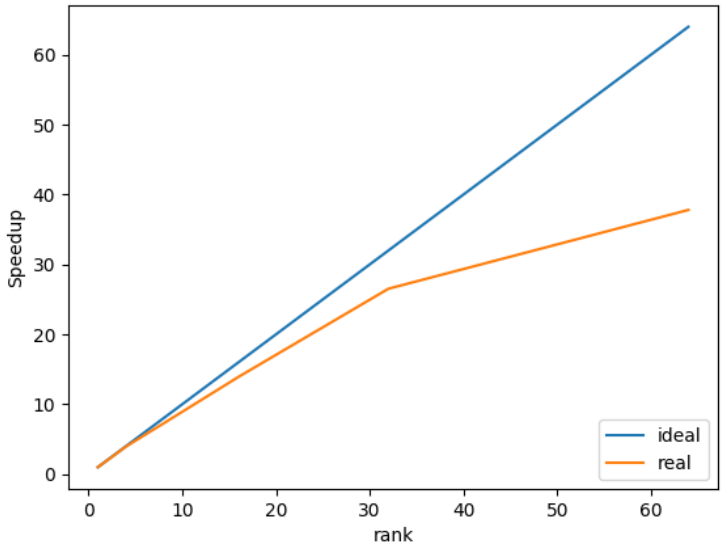
2. Parallel Experimentation

2.1 Example plotting

Here is the result of `mpirun -n 4 ./main 75 parallel` :

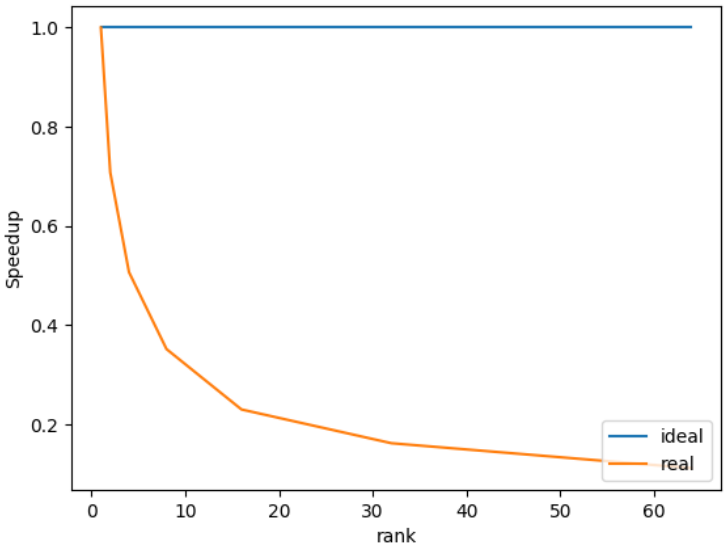


2.2 Strong Scaling



With rank increasing, array size of each rank decreases. However, the ghost cells in each rank does not change, which reduces the parallel efficiency.

2.3 Weak Scaling



There are probably 2 reasons:

1. The same in strong scaling. Communication overheads increase relatively.

2. Iteration times increases when problem size increases. If we define a new "speedup" based on "running time per iteration step", we can get a more "ideal" scaling curve: