Assignment 1 – Report

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1 Experiment

The task is to compute in parallel the two-dimensional integral

$$I_{2D} = \int_0^2 \left(\int_0^2 (x + \sin(y) + 1) dx \right) dy$$

By the midpoint rule,

$$\int_0^2 \left(\int_0^2 (x + \sin(y) + 1) dx \right) dy \approx h_y \sum_{i=0}^{n} \left(\int_0^2 (x + \sin(y_i) + 1) dx \right)$$

$$= h_x h_y \sum_{i=0}^{n} \left(\sum_{j=0}^{n} (x_j + \sin(y_i) + 1) \right)$$

$$= h_x h_y \sum_{i=0}^{n} \left(\sum_{j=0}^{n} ((j - 0.5)h_x + \sin((i - 0.5)h_y) + 1) \right)$$

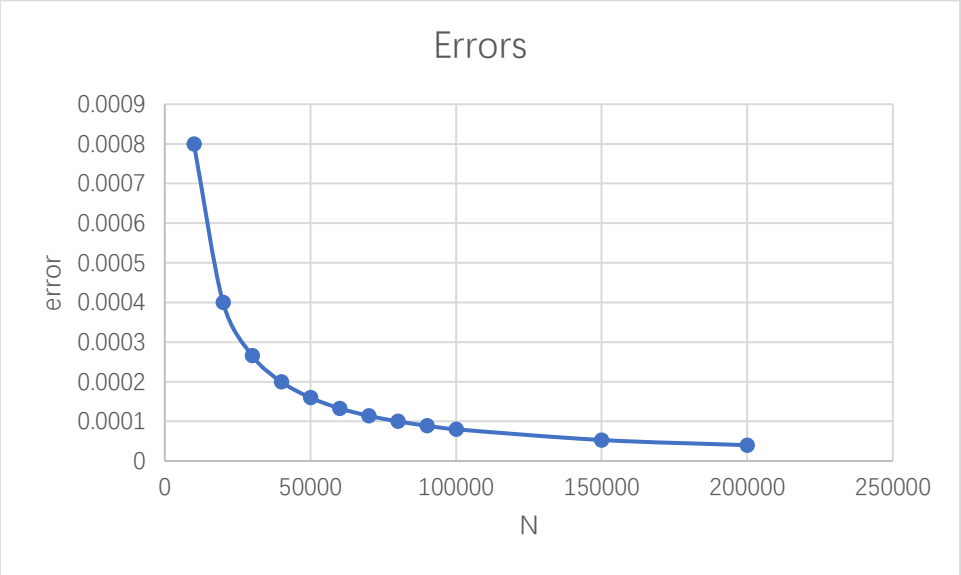
In the solution, by given *p* processes, we divide the processes into a *p*×1 mesh and assign a strip of the computational domain to each of them to compute a partial sum, and then collect the local sums into one process, which will know the answer.

2 Results

(1) Correctness

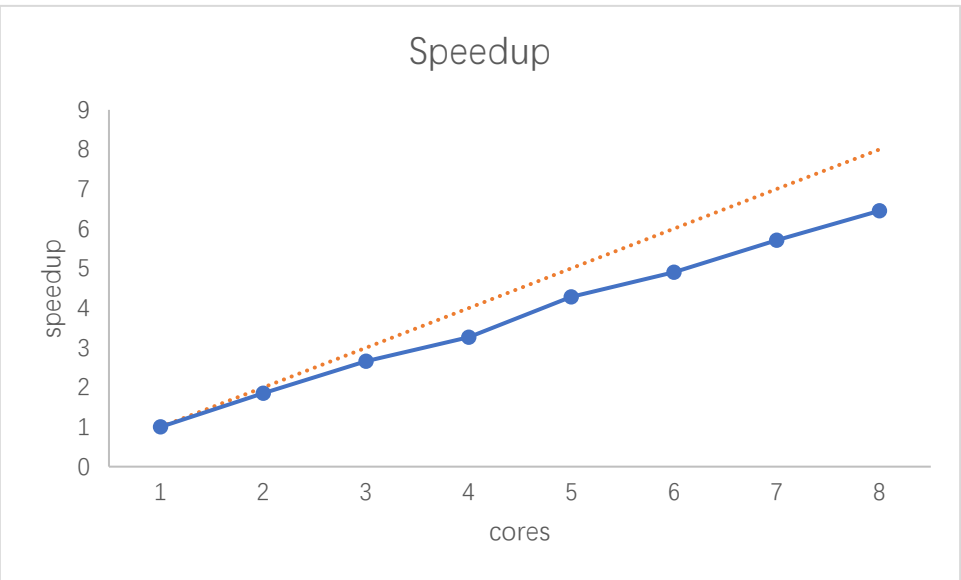
N	I
100	10.911941
1000	10.840290
10000	10.833094
20000	10.832694
30000	10.832560
40000	10.832494
50000	10.832454
60000	10.832427
70000	10.832408
80000	10.832394
90000	10.832383
100000	10.832374
150000	10.832347
200000	10.832334

The exact answer is $I_{2D} = 10 - 2\cos(2) \approx 10.832293673094284$



(2) Fixed size problem

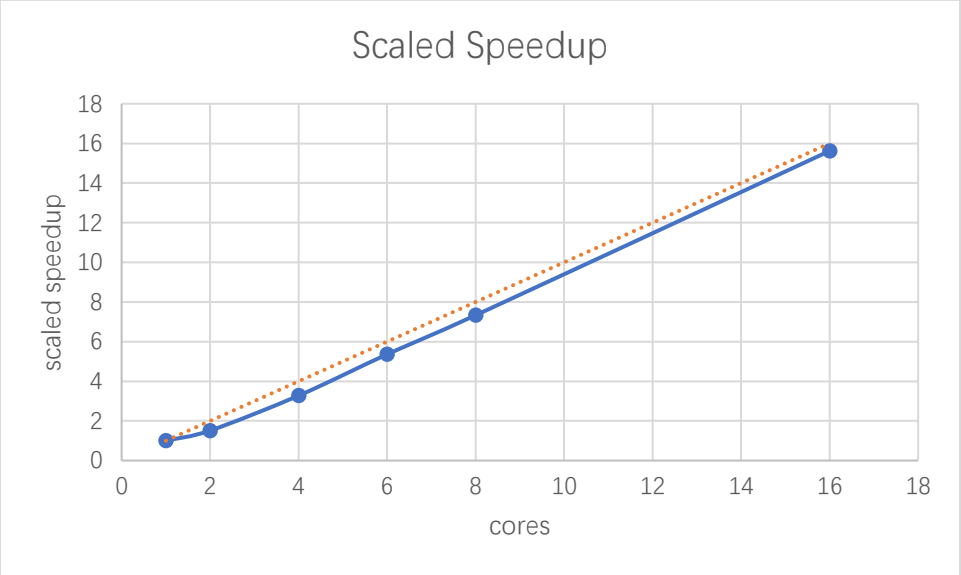
cores	time(s)
1	414.498705
2	223.899529
3	155.683489
4	127.034036
5	96.723770
6	84.521891
7	72.567787
8	64.234766



(Intel(R) Xeon(R) CPU E5520 @ 2.27GHz, N = 100000)

(3) Scaled size problem

N	cores	time
10000	1	3.885584
20000	2	7.991117
40000	4	16.103248
60000	6	30.405434
80000	8	40.678325
160000	16	153.709824



(Intel(R) Xeon(R) CPU E5520 @ 2.27GHz)

3 Conclusion

The results shows that the solution has great accuracy with good parallel performance.