Parallel Programming Exercise 8 – 10

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(If you and your team member contribute equally, you can use (co-first author), after each name.)

1 Problem and Proposed Approach

(Brief your problem, and give your idea or concept of how you design your program.)

Problem: 利用 checkerboard block decomposition 實作 matrix-vector multiplication。

Proposed Approach:先將 vector 分散到 first row，由 first row broadcast 到其他 column，算好值後再利用 reduction 合併答案。

2 Theoretical Analysis Model

(Try to give the time complexity of the algorithm, and analyze your program with iso-efficiency metrics)

Sequential algorithm complexity： $\Theta(n^2)$

Parallel computational complexity： $\Theta(n^2/p)$

Parallel communication complexity： $\Theta(n \log p / \sqrt{p})$

Parallel overhead：$To(n, p) = \Theta(np \log p / \sqrt{p})$

Iso-efficiency relation：$n >= C\sqrt{p} \log p$

M(n)=n^2

$M(C\sqrt{p} \log p)/p = C^2 p \log^2 p/p = C^2 \log^2 p$

3 Performance Benchmark

(Give your idea or concept of how you design your program.)

The time to perform calculate：χ

The time to perform sending：λ

Sequential execution time：$n^2\chi$

Parallel：

The computation time for each process: $(\lceil n/\sqrt{p} \rceil)^2 \chi$

Redistribution of b requires time：$\sqrt{p}(\lambda+8\lceil n/\sqrt{p} \rceil/\beta)$

Columnwise broadcast requires time：$\sqrt{p}(\lambda+8\lceil n/\sqrt{p} \rceil/\beta)$

Parallel execution time：$(\lceil n/\sqrt{p} \rceil)^2 \chi + \sqrt{p}(\lambda+8\lceil n/\sqrt{p} \rceil/\beta)$

Table 1. The execution time

Processors	1	2	3	4	5	6	7	8
Real execution time	0.288328	0.144052	0.098903	0.074405	0.05953	0.049791	0.042718	0.037545
Estimate execution time	0.28	0.14	0.093333	0.07	0.056	0.046667	0.04	0.035
Speedup		2.001555	2.91526	3.875116	4.843407	5.790765	6.749567	7.679531
Karp-flatt metrics		-0.000777	0.014534	0.010742	0.008083	0.007226	0.006184	0.005961

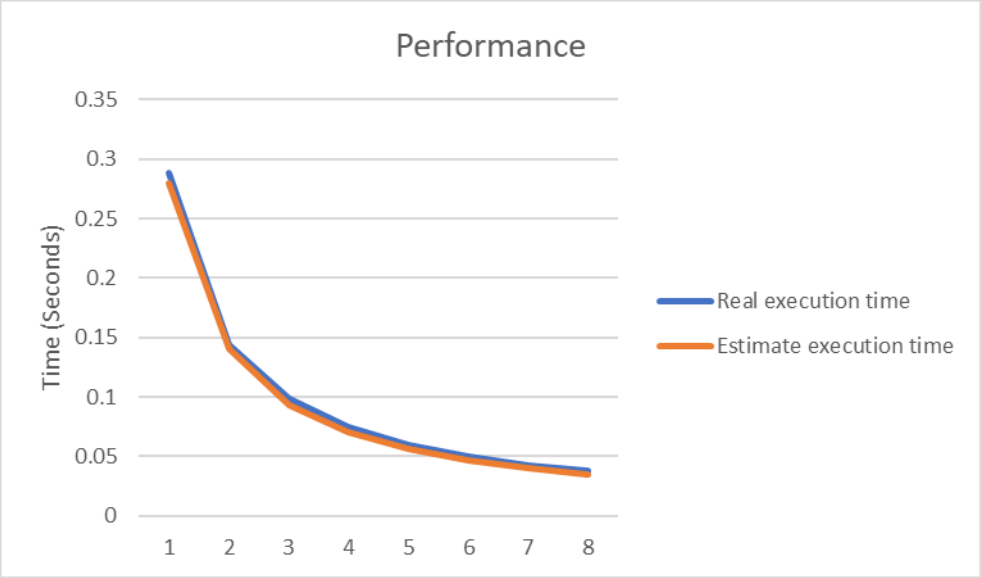

Figure 1. The performance of diagram

4 Conclusion and Discussion

(Discuss the following issues of your program

1. What is the speedup respect to the number of processors used?
2. How can you improve your program further more
3. How does the communication and cache affect the performance of your program?
4. How does the Karp-Flatt metrics and Iso-efficiency metrics reveal?

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從 speedup 的數據來看，當 processor 增加，speedup 的數據也會增加，本問題適合用平行計算。

從 Iso-efficiency metrics 顯示出這個程式有很好的 Scalability。

Appendix(optional):

(If something else you want to append in this file, like picture of life game)