Parallel Programming Exercise 6 – 13

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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: M x N 的方格中的每一個都有一個細胞，細胞有兩種狀態死細胞和活細胞，如果一個死細胞周圍有三個活細胞，下一代會轉成活細胞，如果一個活細胞周圍有小於三個或大於三個活細胞，下一代會轉成死細胞，總共經過 J 代，每 K 代輸出一次結果。

Proposed Approach:每個 processor 負責計算第 in/p 到 (i+1)n/p-1 row，計算好之後，因為每個細胞要參考八個方位鄰居，因此要第一列傳給前一個 process，最後一列傳給下一個 process，再計算下一代。要輸出的時候，讓每一個 process 把負責計算的 rows 傳給 process 0，process 0 負責輸出。

2 Theoretical Analysis Model

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

Sequential algorithm complexity：Θ(JMN)

Parallel computational complexity：Θ(JMN/p)

Parallel communication complexity：Θ(J)

Parallel overhead：To(n, p) =Θ(Jp)

Iso-efficiency relation：p>=Cp

M(n)=n^2

M(Cp)/p= (Cp)^2 /p= C^2 p= C_2 p

3 Performance Benchmark

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

The time to perform calculate a cell：χ

Sequential execution time：JMNχ

Parallel：

The computation time for each process: χ (JN$\lceil$M /p$\rceil$)

Every iteration a process need to send a 1D-array at most 2+ $\lceil M /p\rceil$ times.

Send a 1D-array requires time：λ

Parallel execution time： χ $(JN\lceil M /p\rceil)+ \lambda J(2+ \lceil M /p\rceil)$

Table 1. The execution time

Processors	1	2	3	4	5	6	7	8
Real execution time	21.414555	15.79338	12.416672	10.743042	10.989637	9.716124	9.509998	8.73947
Estimate execution time	22	11	7.333333	5.5	4.4	3.666666	3.142857	2.75
Speedup		1.355919	1.724661	1.993341	1.948613	2.204022	2.251793	2.450326
Karp-flatt metrics		0.475013	0.369735	0.335560	0.391481	0.344459	0.351438	0.323553

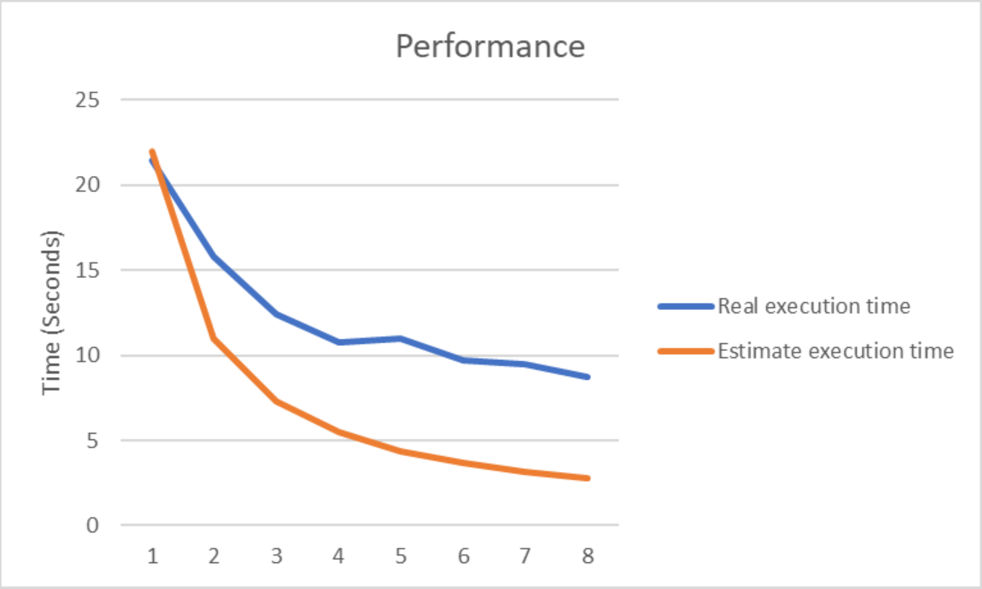

Figure 1. The performance of diagram

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，但受到資料傳輸大小影響，能夠提升的空間有限。

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

Appendix(optional):

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