Parallel Programming Exercise 5 – 11

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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

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題目：計算 $\sum_{k=0}^{n}\frac{1}{k}$, n = 1000000, to 100 digits of precision.

作法：將 n 個數字平均拆給各個 processors 作運算，如果單純用 double 的話，沒辦法算到 100 位，所以我用「大數除法」來做運算，將 digit 存在 array 裡面，模擬長除法的流程以計算出商。

Ans:
14.392726722865723631381127493188587676644800137443116534184334581295850751799535682981759472191007083

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

2 Theoretical Analysis Model

n is the number of sequence.
d is the number of digits.
p is the number of processors.

Sequential time complexity: $O(n*d)$

Parallel time complexity: $O(\frac{n}{p}*d+logp)$

Scalability function:

$$n*d<C*p*logp$$

$$n<C*p*logp*\frac{1}{d}$$

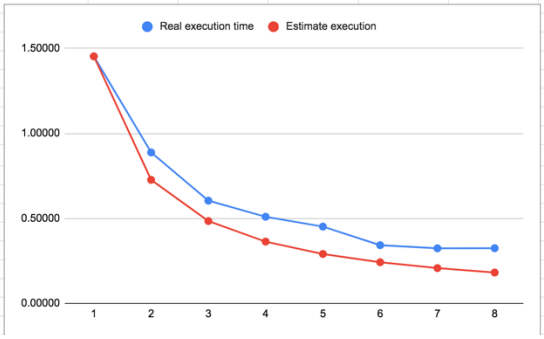
$$\frac{M(f(p))}{p}=C*logp*1/d$$

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

3 Performance Benchmark

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

Processors	1	2	3	4	5	6	7	8
Real execution time	1.45370	0.88830	0.60440	0.50980	0.45170	0.34250	0.32410	0.32480
Estimate execution time	1.45370	0.72685	0.48457	0.36343	0.29074	0.24228	0.20767	0.18171
Speedup	X	1.63650	2.40520	2.85151	3.21829	4.24438	4.48534	4.47568
Karp-flatt metrics	X	0.22212	0.12365	0.13426	0.13841	0.08273	0.09344	0.11249



4 Conclusion and Discussion

1. The speedup increases with the number of processors.
2. 原本我是讓 array 中的一個 item 存 6 個 digits，如果把它調成更多個可以更快。
3. Seq part 佔的比例比較大，communication 相對來說不大。
4. K 隨 p 而下降，代表 seq part 佔不小的比例，根據 Part2 算的 scalability function 可知這個 model 有良好的 scalability。

(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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Appendix(optional):

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