CS 575 Spr 2015 HW2
due Sun. Mar 8 @ 11:59 pm

Speedup & Efficiency: Version 0.1

Problem 1: [20 pts: 4×5]

A: What is the maximum fraction of execution time that can be spent in performing inherently sequential operations, if a parallel application is to achieve a speedup of 50 over its sequential version?

B: A programmer wrote a parallel program that achieves a speedup of 9 on 10 processors. What is the maximum fraction of the computation that may consist of inherently sequential operations?

C: A parallel program takes 242 seconds to execute on a 16-processor machine. Benchmarking later reveals that 9 seconds were spent on initialization and file I/O, while all the processors were busy doing useful work during the remaining 233 seconds. What is the scaled speedup achieved by the program.

D: Programmer B benchmarks a parallel program and finds that 95% of the time of a program running on 40 processors is spent in perfectly parallel code. Predict a bound on the speedup of the program.

Problem 2: [24 pts: 6×4]

The execution times of six parallel programs, I. . . VI, were measured on 1,. . . , 8 processors, as reported in the speedup table below.

# Proc	Speedup					
	I	II	III	IV	V	VI
1	1.00	1.00	1.00	1.00	1.00	1.00
2	1.67	1.89	1.89	1.96	1.74	1.94
3	2.14	2.63	2.68	2.88	2.30	2.82
4	2.50	3.23	3.39	3.67	2.74	3.65
5	2.78	3.68	4.03	4.46	3.09	4.42
6	3.00	4.00	4.62	5.22	3.38	5.15
7	3.18	4.22	5.15	5.93	3.62	5.84
8	3.33	4.35	5.63	6.25	3.81	6.50

For each of the six programs, which of the following statements *best describes* the likely performance on 16 processors. Justify your answers using the Karp Flatt metric.

A: The speedup achieved on 16 processors will probably be at least 40% higher than the speedup achieved on eight processors.

B: The speedup achieved on 16 processors will probably be less than 40% higher than the speedup achieved on eight processors due to the large serial component of the computations.

C: The speedup achieved on 16 processors will probably be less than 40% higher than the speedup achieved on eight processors due to the increase in overhead as processors are added.

Problem 3: [35 pts: 7×3+7×2]

Let $W \geq f(p)$ be the iso-efficiency relation of a parallel system, and let $M(W)$ be the amount of memory required to solve a problem that does W work. First, rank the following parallel programs/systems, from worst to best based on the iso-efficiency function. Next, rank them based on the per-procesor scalability function (C is some constant, each instance of C is not necessarily the same).

A: $f(p) = Cp$, and $M(W) = W^2$

B: $f(p) = Cp \log p$, and $M(W) = W^2$

C: $f(p) = C\sqrt{p} \log p$, and $M(W) = W^2$

D: $f(p) = C\sqrt{p}$, and $M(W) = W^2$

E: $f(p) = Cp$, and $M(W) = W$

F: $f(p) = p^C$, for $1 < C < 2$ and $M(W) = W$

G: $f(p) = p^C$, for $C > 2$ and $M(W) = W$

Problem 4-6: [21 pts: 3×6+3]

Do problems 5.5, 5.6 sand 5.7 of the textbook. Next, compare and discuss your three answers [3 pts].