Wenjing Guo · 50/50

good!

Mid-term Examination
HPC1 Fall 2012
Date: Tuesday, November 6

UB: wenjingg

50026284

15/15 **Problem 1:** Compare and contrast shared memory and message passing programming models, giving at least four attributes for each.

shared memory: 1) relatively ~~very~~ simple over sequential code if just have one aglorithm
(like openMP)
2) scalable on big problem size but less so than MPI
3) incrementation implementation speedup
4) not identical to each vendor ok.
5) Imp? openmp

message passing program: 1) general model that can be applicable on many platforms.

2) can get high performance

3) allow us ~~to~~ get full control of the data location and data flow

4) not for data parallelizing less suitable

5) ~~very~~ more complex over sequential code ~~even~~ just one aglorithm.

35/35 **Problem 2:** A sequential program depends on data of size N and has performance of $\mathcal{O}(N^2)$. It also takes $\tau_i + N$ time units to execute the serial portion of the code (input, output, setup, etc.). The program's parallelizable portion executes in $100N^2$ time units.

a. Derive an expression for the parallel speedup, $S(N, P)$, in terms of N and the number of processors, P.

b. Similarly express the parallel efficiency, $\mathcal{E}(N, P)$, assuming $\tau_i << N$.

c. Express in terms of P the maximum speedup for this program for $N = 10^5$, again assuming $\tau_i << N$. For what value of P does the parallel efficiency drop to 50%?

d. Now suppose that $\tau_i = N^2$. For what value of P does the parallel efficiency now drop to 50%?

10/10 a) $$S(N,P) = \frac{T_s}{T_P} = \frac{(\tau_i + N) + (100N^2)}{(\tau_i + N) + (100N^2)/P}$$

$$= \frac{P}{1 + (P-1)\frac{\tau_i + N}{\tau_i + N + 100N^2}}$$

if $\tau_i << N$

10/10 b) $$\mathcal{E}(N,P) = \frac{S(N,P)}{P} = \frac{1}{1 + (P-1)\frac{\tau_i + N}{\tau_i + N + 100N^2}} \approx \frac{1}{1 + (P-1)\frac{1}{1 + 100N}}$$

10/10 c) $$S(N,P) \approx \frac{P}{1 + (P-1)\frac{1}{1+100N}} = \frac{P}{1 + (P-1)\frac{1}{1 + 100 \cdot 10^5}} \le P.$$

$$\mathcal{E}(N,P) = \frac{1}{1 + (P-1)\frac{1}{100 \cdot 10^5}} \approx 50\%.$$

$$P = 10^7 \times 2$$

5/5 d) $\tau_i = N^2$

$$\mathcal{E}(N,P) = \frac{1}{1 + (P-1)\frac{N^2 + N}{N^2 + N + 100N^2}} = \frac{1}{1 + (P-1)\frac{N+1}{101N+1}} = 0.5$$

$N = 10^5$, $P = 102$

problem 1). shared memory: share the same adress space.

message passing programming: Use seperate adress space, and task cannot access to other data without sending messages

shared memory (openmp)	message passing programming
1. shared memory adress space	1. seperate memory adress space
2. simpler over sequential code if with one aglorithm	2. very complex over sequential code even just with one aglorithm
3. use incrementation speedup (openmp).	3. can achieve a large parallel performance
4. thread model for data paralleling	4. not for data paralleling most for task paralleling.
5. Scalable on big problem size ✗ less so than MPI	5. ok allow us to get full control of data location and data flow.
6. implementation not identical to each vendor. (openmp)	6. general model that is applicable on many platforms.
	7. easy to get speedup ✗ not really
	8. get higher performance, we need to re-eiginer the code.

Wenjing Guo.

wenjingg