

ELG7187 Problems

Performance Evaluation in Parallel Systems

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Questions

1. List at least 2 applications for performance monitors in multiprocessing systems.
2. What are the general trends in performance monitors in multiprocessing systems?
3. List and describe at least three variations of performance monitors.
4. What is the main bottleneck in SMP systems, according to Hennessy?
5. Name and describe the methods of accessing the performance monitoring data.

Problems

1. Draw schematically the architecture of a hardware performance counter. Describe each component.
2. Draw schematically the PMU(performance monitoring unit) unit employed in the IBM BlueGene computer. Describe each component.
3. *Adapted from "Computer Architecture: A Quantative Approach"* Your company has just bought a new dual Pentium processor, and you have been tasked with optimizing your software for this processor. You will run two applications on this dual Pentium, but the resource requirements are not equal. The first application needs 80% of the resources, and the other only 20% of the resources. a. Given that 40% of the first application is parallelizable, how much speedup would you achieve with that application if run in isolation? b. Given that 99% of the second application is parallelizable, how much speedup would this application observe if run in isolation? c. Given that 40% of the first application is parallelizable, how much overall system speedup would you observe if you parallelized it? d. Given that 99% of the second application is parallelizable, how much overall system speedup would you get?
4. *Adapted from "Computer Architecture: A Quantative Approach"* Imagine that your company is trying to decide between a single-processor system and a dual-processor system. Figure 1 gives the performance on two sets of benchmarks a memory benchmark and a processor benchmark. You know that your application will spend 40% of its time on memory-centric computations, and 60% of its time on processor-centric computations. a. Calculate the weighted execution time of the benchmarks. b. How much speedup do you anticipate getting if you move from using a Pentium 4 570 to an Athlon 64 X2 4800+ on a CPU-intensive application suite? c. At what ratio of memory to processor computation would the performance of the Pentium 4 570 be equal to the Pentium D 820?
5. Repeat the last problem, with the addition that all memory-centric operations have an overhead of 3 time units.

| Chip | # of cores | Clock frequency (MHz) | Memory performance | Dhrystone performance |
|--------------------|------------|-----------------------|--------------------|-----------------------|
| Athlon 64 X2 4800+ | 2 | 2,400 | 3,423 | 20,718 |
| Pentium EE 840 | 2 | 2,200 | 3,228 | 18,893 |
| Pentium D 820 | 2 | 3,000 | 3,000 | 15,220 |
| Athlon 64 X2 3800+ | 2 | 3,200 | 2,941 | 17,129 |
| Pentium 4 | 1 | 2,800 | 2,731 | 7,621 |
| Athlon 64 3000+ | 1 | 1,800 | 2,953 | 7,628 |
| Pentium 4 570 | 1 | 2,800 | 3,501 | 11,210 |
| Processor X | 1 | 3,000 | 7,000 | 5,000 |

Figure 1: