Advanced Topics

Chapter 19

Assessing Performance

Topics

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- Measures of Computational Power
- Integer and Floating Point Computation
- Application Specific Instruction Counts
- Standardized Benchmarks
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Introduction

- This chapter covers
  - a broad view of performance
  - Amdahl's law

Measures of Computational Power

- How can be measure computational power?
- What makes one computer system perform better than another?
- How to measure performance ??

Because a computer is designed to perform a wide variety of tasks, and because no architecture is optimal for all tasks, therefore the performance of the system depends on the task being performed

Measures of Computational Power

- Vendors take advantage of above and give measures for tasks performed best by their architecture

  A variety of performance measures exist because there is no single measure that suffices for situations

Integer and Floating Point Computation

- MIPS: Millions of instructions per second
- FLOPS: Floating point operations per second

Because some instructions take substantially longer to execute than others, the average time required to execute an instruction only provides a crude approximation of performance. The actual time required depends on which instructions are executed

Application Specific Instruction Counts

- How to assess performance more accurately?: assess performance for a particular application

- A more general assessment: use a large set of programs to obtain relative weights for each type of instruction. Use relative weights to assess performance of a given architecture.

  An instruction mix consists of a set of instructions along with relative weights that have been obtained by counting instruction execution in example programs. An architect can use an instruction mix to assess how a proposed architecture will perform

Standardized Benchmarks

- What instruction mix should be used to compare the performance of two architectures ?
  - find a set of "typical" applications, also called benchmarks

- Benchmarks: programs that provide a standard workload against which a computer can be measured.

Standardized Benchmarks

- SPEC: Standard Performance Evaluation Corporation
  - independent, non-profit organization
  - to "establish, maintain and endorse a standardized set of relevant benchmarks that can be applied to the newest generation of high-performance computers.

Boundary Between Hardware and Software

- Special purpose hardware performs function much faster than software.
- To optimize performance, move operations with most CPU time from software to hardware

- Choosing items to optimize
  - where to use high-speed hardware, conventional hardware, and software.
  - Amdahl says don’t waste resources on functions rarely used, optimize those that are most often used

Amdahl's Law and Parallel Systems

- Performance improvement that can be realized from faster hardware is limited to the fraction of time the faster technology can be used.

- Applied to parallel systems
  - why speedup N is not achieved ?
  - because optimizations limited to amount of time the processors are being used.

Summary

- Simplisitic measures: FLOPS, MIPS
- Weighted average are more accurate
- Benchmarks are programs that are run to assess performance
- Amdahl's law selects functions to be optimized, those that account for most time