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Personal Assignment. Review Questions Ch. 2 (textbook page 75)

2.1 List and briefly define some of the techniques used in contemporary processors to increase speed. (page 47-48)

Pipelining: Processor moves data or instructions into a conceptual pipe with all stages of the pipe processing simultaneously (like an assembly line to make cars).

Branch Prediction: Processor looks ahead in the instruction code fetched from memory and tries to guess which way a branch or group of instructions will go.

Superscalar Execution: This is the ability to issue more than one instruction in every processor clock cycle (multiple parallel pipelines used).

Data Flow Analysis: Processor analyze which instruction are dependent on each other's result, or data, to create an optimized schedule of instructions.

Speculative Execution: Using branch prediction and data flow analysis, processors can execute instructions before they appear in the program execution by holding results in temporary locations.

2.2 Explain the concept of performance balance.

Adjusting the organization and architecture to make up for the downsides of various components.

2.3 Explain the differences among multicore systems, MICs, and GPGPUs.

Multicore Systems &
Many Integrated Cores (MICs) places multiple processors on the same chip.

General Purpose GPUs (GPGPUs) utilizes how GPUs process, and implements the GPU to support the general purpose processors.

2.4 Briefly characterize Amdahl's law.

Has to do with potential speedup of programs using multiple processors compared to one.

- Speed = (Time in single processor) / (Time in multiple processors).

- Speed = 1 / (1 - f(1-1/N))

-Explains that software has to adapt to parallel execution to use the full power of parallel processing.

-Using more cores eventually doesn't improve much speed.

2.5 Briefly characterize Little's law.

Is fundamental and simple relation with broad range of applications.

-Average number of items in a Qing system = (Average rate items arrive) * (Time item spends in system).

-can be applied to almost any system thats statistically in steady state, and if theres no leakage.

-uses Qing theory terminology and applied to Qing systems.

-server is the Qing systems central element, which provides services for items which requires the be served.

-the item is served quickly, if the server is idle. If server is busy, the item should wait in the Q.

-the Q for servers vary based on single or multiple cores.

-the item departs server once it is served and completed.

2.6 Define MIPS and FLOPS.

Millions of Instructions Per Second (MIPS) is a common measure of performance for a processor, is the rate at which instructions are executed.
MIPS rate = (Instruction count) / (Total execution time x 10^6) = (Constant frequency) / (Avg cycles per instruction x 10^6)

Millions of Floating-point Operations Per Second (MFLOPS) is another common performance measure that deals only with floating-point instructions.
MFLOPS rate = (Number of executed floating point operations in a program) / (Execution time x 10^6)

2.7 List and define three methods for calculating a mean value of a set of data values.

Arithmetic
- arithmetic mean (AM) is an appropriate measure if the sum of all the measurements is a meaningful and interesting value.
- AM is a good candidate for comparing the execution time performance of several systems.
- AM used for a time based variable, such as program execution time, and has the important property that it is directly proportional to the total time. (if total time doubles, mean value doubles)

Geometric
-GM gives consistent results regardless of which system is used as a reference, when measuring the relative performance of machines.

Harmonic
-HM is inversely proportional to the total execution time, which is a desired property.

2.8 List the desirable characteristics of a benchmark program.

1) it is written in a high level language, making it portable across diff machines.

2) it is representative of a particular kind of programming domain or paradigm, such as systems , numerical , or commercial programming.

3) it can be measured easily.

4) it has wide distribution.

2.9 What are the SPEC benchmarks?

Standard Performance Evaluation Corporation (SPEC) maintains a collection of benchmark suites which is a collection of programs defined in a high level language, that together attempt to provide a representative of a computer in particular application or system programming area.

2.10 What are the differences among base metric, peak metric, speed metric, and rate metric?

Base Metric: these are required for all reported results and have strict guidelines for compilation.

Peak Metric: This enables users to attempt to optimize system performance by optimizing the compiler output.

Speed Metric: This is simply a measurement of the time it takes to execute a compiled benchmark. The speed metric is used for comparing the ability of a computer to complete single tasks.

Rate Metric: This is a measurement of how many tasks a computer can accomplish in a certain amount of time called the throughput, capacity, or rate measure. The rate metric allows the system under test to execute simultaneous tasks to take advantage of multiple processors.