Performance

Measuring the performance of a computer

Latency (response time) - is the time between the stand and completion of an event
Throughput (bandwidth) - is the total amount of work done in a given period of time

1. Replacing your processor with a faster one will:
    - increase throughput and decrease latency
2. Adding additional processors to a system
    - Only throughput will increase

> *Performance is the inverse of time*

$$Performance = \frac{1}{ExecutionTime}$$

$$Performance(x) > Performance(y)$$

Term	Definition
Elapsed Time|total wall clock time needed for task
CPU Time|time cpu spends actually working on the program
User CPU Time|CPU time spent in the program itself
System CPU Time|CPU time spend in the OS, performing tasks
Clock Cycle|the basic discrete time of a processor clock
Clock Period|the length of each clock cycle
Clock Rate|inverse of the clock period

> *Elapsed Time VS. the CPU Time may show I/O inefficenys, due to confusion of the user*

Term	Definition
Bit	Binary digit
Nibble	Four bits
Byte	Eight bits
Word	four bytes(32 bits)
Kibibyte (KiB)	2^10 (1024) bytes

$$CPUExecutionTime = CPUClockCycles * ClockPeriod$$

$$CPUClockCycles = Instructions * AverageClockCyclesPerInstruction$$

- The average number of clock cycles per instruction is often abbreviated as CPI. The above equation can be rearranged to give the following

$$CPI = \frac{CPUClockCycles}{InstructionCount}$$

Computer A: Clock cycle time 250ps and 2.0 CPI
Computer B: Clock cycle time 500ps and 1.2 CPI
Which Is Faster?

$$ComputerA(250 * 2.0) < ComputerB(500 * 1.2)$$

From this we can gather the basic equation

$$CPUTime = InstructionCount * CPI * ClockPeriod$$

Or

$$CPUTime = \frac{InstructionCount * CPI}{ClockRate}$$

Component	Unit Of Measure
CPU Execution Time	Seconds (for the program)
Instruction Count	Instructions Executed
Clock Cycles Per Instruction	Avg Number of Clock Cycles
Clock Cycle Time (Clock Period)	Seconds Per Clock Cycle

- No one of these factors makes a CPU ***FASTER*** so we must look at all factors in determining the speed of a computer

Amdahl's Law

Amdahl's Law states that the performance improvement to be gained from some faster mode of execution is lmited by the time the faster mode can be used

$$ImprovedExecutionTime = \frac{AffectedExecutionTime}{AmountOfImprovement} + UnaffectedExecutionTime$$

Energy Efficient Processors

- Extend battery life for mobile systems
- Reduce heat dissipation for general purpose processors
- Energy cost for increasing

Enhanced capability available to users led to new classes of computers. This led to the dominance of microprocessor-based computers. Allowing programmers to trade performance

for productivity. Nature of applications is changing because of this fact.

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