CS 21 - Computer Organization and Assembly Language Programming

Lecture 14

Measuring CPU Performance

University of the Philippines - Diliman
College of Engineering
Department of Computer Science

Outline

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Single-cycle vs Multi-cycle processors

- Single cycle processor - one cycle, one instruction processed
  - ADVANTAGE: simple design
  - DISADVANTAGE: may be slow

Single-cycle vs Multi-cycle processors

- Single cycle processor - one cycle, one instruction processed
  - ADVANTAGE: simple design
  - DISADVANTAGE: may be slow
- Multicycle processor - different instructions take different number if cycles to complete
  - ADVANTAGE: simpler programs, faster execution
  - DISADVANTAGE: complex design

Outline

CPU Execution Time

- CPU execution time - time spent by the CPU in the execution of the program(unit is in *seconds*)
- CPU clock cycles - number of clock cycles spent by the the CPU in program execution (unit is in *cycles*)
- Clock cycle Time - period of a clock cycle (unit is in *seconds per cycle*)

Relationship between the three:

$$CPUExecutionTime = CPUclockcycles * Clockcycletime$$

$$CPUExecutionTime = \frac{CPUclockcycles}{Clockrate}$$

Improving CPU Execution Time

Two ways of improving CPU Execution Time

- decrease clock cycle time/increase the clock rate
- decrease the CPU clock cycles

CPU Clock Cycles

$$CPUClockCycles = numberofinstructions * CPI$$

CPI = Cycles per Instruction

Dependencies

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- Number of instructions - algorithm/program
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- CPI - ISA, circuit/hardware technology
  - What is the CPI of a single-cycle processor?

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I have a program with 100 instructions, and I'm going to run it in a single-cycle processor with 500MHz clock. What is the CPU Execution Time for my Program?

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$$CPUClockCycles = 100cycles$$

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CPU Execution Time = .0000002 seconds

Problem 2

I have a program with 100 instructions, and I'm going to run it in a multi-cycle processor with 500MHz clock.

Register-register instructions take a single cycle; jump and branch instructions take 3 cycles; memory-access instructions take 10 cycles.

My program is composed of 70% register-register instructions, 23% jump and branch, and 7%memory-access.

What is the CPU Execution Time for my program?