Fall, 2022

Week 2

2021.09.19

組別：13 簽名：_____

[group2] CPU TIME = (# of clk cycles) × (T_{clk}) clk period 同

1. Fred previously designed two compilers, he wanted to compare them with the same computer to know which compiler performed better. CPU TIME ↓

Compiler Alpha: α: # of cycles = 4×2000 + 8×500 = 12000

Instuction Class	CPI	Instruction Count
A	4	2,000
B	8	500

Compiler Beta: β: # of cycles = 5×1400 + 6×800 = 11800

Instruction Class	CPI	Instruction Count
A'	5	1,400
B'	6	800

Question:

(a) Which compiler is more efficient in terms of this program? Beta

(b) The program compiled with Compiler Beta runs 0.2s faster than the one compiled with Compiler Alpha. What is the clock rate of the machine?

Sol: Hardware (computer): CPI . T_{clk}. ∵ same computer ⇒ same CPI . T_{clk}

compiler : IC . CPI. but diff compiler ⇒ CPI . IC 不同

(a) ∵ T_{clk} 同, T_{CPU} : 11800 < 12000 (α) ⇒ only T_{clk} 同

∴ Beta better #

(b) $T_\alpha - T_\beta = 0.2$ $T_{clk} = \frac{1}{1000}$

$12000\,T_{clk} - 11800\,T_{clk} = 0.2$ ∴ $f_{clk} = 1000$ Hz

$200\,T_{clk} = 0.2$ #

[group14]

2. Consider the following processors and their specifications. How many instructions can it process in 10 seconds? Which processor has the best performance?

Processor	Clock rate	CPI
P1	1 GHz	3
P2	2 GHz	2
P3	3 GHz	1

$$T_{CPU} = \frac{IC \times CPI}{f_{clk}}$$

$$IC = f_{clk} \cdot T_{CPU} / CPI$$

① P1 : $\frac{1}{3} \times 10^{10}$

P2 : $\frac{2}{3} \times 10^{10}$

P3 : 10^{10}

② P3 is the best.

[group1]

3. Please select the correct options. 2. 5. 6

F 1. Instruction Count for a program is determined by program, ~~CPI~~ and compiler.

T 2. Throughput is total work done per unit time.

F 3. Adding more processors can not only ~~shorten the response time~~ but enhance the throughput.

F 4. ~~Compiler~~ Assembler translates assembly language to binary machine language.

T 5. Compiler performance depends on Instruction count and CPI.

T 6. Elapsed time (Execute time) is a total respone time of processing, I/O, OS overhead, and Idle time, which also can determine the performance of system.

F 7. Given two computers, computer_A: Cycle Time=250ps, CPI=2.0; and computer_B: Cycle Time=500ps, CPI=1.2, we can conclude that ~~A is faster~~.

$$T_{CPU} = IC \times CPI \times T_{clk}$$

[group5]

4. Which of the following statements is correct? (Single Choice)

a. Suppose that Floating point instructions are improved with speedup = 10. Only 20% of actual instructions are Floating Point instructions. The overall speedup would be 3.

b. For a given program, its average cycles per instruction (CPI) is affected not only by the instruction set architecture, but also by the compiler used.

c. By changing the clock frequency of a processor from 1.5 GHz to 2 GHz, and also changing its supply voltage from 1 Volt to 1.25 Volt, the dynamic power consumption of this processor will theoretically increase by more than 3 times.

d. According to Amdahl's law, it is theoretically possible to achieve a 6X speedup on executing a program which is 87% parallelizable, by using a 16-core multiprocessor.

[group11]

5. A common performance figure is GFLOPS (billions of floating-point operations per second), defined as

$$GFLOPS = \frac{\text{No. FP operations}}{\text{CPU time}} \times 10_9$$

but this figure has the same problems as MIPS

By using the table below, calculate the GFLOPS of P1 running a particular program.

processor	Instruction count	Type of instructions		CPI		Clock rate
		Load/Store	Floating Point	Load/Store	Floating Point	
P1	$1*10^9$	40%	60%	1	2	4GHz

[group8]

6. What performance factor(s) below may be affected

(1) Instruction count (2) CPI (3) Cycle time T_{clk} (clk period)

(A) Algorithm : (1) . (2) (multiple choice)

(B) Program : (1) . (2) (multiple choice)

(C) Compiler : (1) . (2) (multiple choice)

(D) Computer organization : (2) . (3) (multiple choice)

Hardware

[group12]

7. The division operation of a certain program requires 8 cycles, and other operations require 4 cycles. Assuming that 60% of the operations of this program are division and 40% are other operations, CPI=?

CPI of Div = 8

CPI of others = 4

Avg. CPI = $8 \times 0.6 + 4 \times 0.4 = 6.4$

[group7]

8.

Detremine if each of the following statements is True or False and explain why.

F 1.CPU time increases when the clock rate increases

T 2.CPU time increases when the CPI increases

T 3.CPU time increases when the instruction count(IC) increases

$T_{CPU} = CPI \cdot IC \cdot T_{clk} = CPI \cdot IC / f_{clk}$

① F: when CPI, IC 不变, CPU time ↑ if f_{clk} ↓

② T: when IC, T_{clk} 不变, CPU time ↑ if CPI ↑

③ T: when CPI, T_{clk} 不变, CPU time ↑ if IC ↑.