Computer Architecture
Fall, 2018
Week 2
2018.09.17

[group2]

1. 將程式執行比喻成一輛車從台北開車到高雄，請問下列方法是增加 throughput 還是 加快 response time 呢
   1. 將速限由 120 提高至 300
   2. 實施高承載,限制單位時間車流量

Ans:

1. 將速限由 120 提高至 300
答：加快 response time

加快 response time & throughput

2.實施高承載,限制單位時間車流量
答：降低 throughput

[group5]

2. 在機器中加入更多的 processor 為什麼只會提高 throughput 而不會減少 response time?

Ans:

throughput 是單位時間內完成的總任務數，故增加 processor 可以分擔任務承載，提高完成的任務數量；而 response time 指的是執行一個任務所需要花費的時間，所以增加相同運算能力的 processor 也不會加速執行該項任務的速度，response time 不會減少。

[group7]

3. 對於 CPU time 來說，clock period 變小是否會導致效能一定變好？

Ans:

不一定，因為 clock period 變小雖然會導致 clock rate 下降，但同時亦會使 clock cycles 增加，此時要看何者變化的幅度較大才能決定是否讓效能更好。

[group9]

4. 通常量測電腦 execution time 時會分為 Elapsed time 和 CPU time 兩種。大家常說電腦使用固態硬碟(SSD)通會有比較好的執行效能，請問測量固態硬碟所帶來的效能改善應該使用上述兩種時間中的何者?並試描述它如何增加電腦的執行效能?(如何減少 execution time)

Ans:

Elapsed time ; 在 CPU 效能相同下，SSD 減少 I/O 的等待時間

[group1]

5. Consider three difference processors P1, P2, and P3 executing the same instruction set. P1 has a 3GHz clock rate and a CPI of 1.5. P2 has a 2.5GHz clock rate and a CPI of 1.0. P3 has a 4GHz clock rate and a CPI of 2.2.
   Q: If the processors each execute a program in 10 seconds, find the number of cycles and the number of instructions.

Ans:

Cycles:

P1: 3GHz * 10 = 3 * 10 ^ 10 cycles

P2: 2.5GHz * 10 = 2.5 * 10 ^ 10 cycles

P3: 4GHz * 10 = 4 * 10 ^ 10 cycles

Number of instructions:

P1: 3GHz * 10 / 1.5 = 2 * 10 ^ 10 instructions

P1: 2.5GHz * 10 / 1.0 = 2.5 * 10 ^ 10 instructions

P1: 4GHz * 10 / 2.2 = 1.82 * 10 ^ 10 instructions

[group4]

6. Suppose we have two implementations of the same instruction set architecture. Machine A has a clock cycle time of 1 ns and a CPI of 2.5 for some program, and machine B has a clock cycle time of 2 ns and a CPI of 1.5 for the same program. Which machine is faster for this program, and by how much ?

Ans:

faster:

CPU time＝Instruction count×CPI×clock cycle time

＝IC×CPI×clock cycle time

Machine A：CPU time＝IC×2.5×1ns＝IC×2.5 ns

Machine B：CPU time＝IC×1.5×2ns＝IC×3 ns

故 Machine A 較快。

by this much:

CPU Time B / CPU Time A = IC x 3 / IC x 2.5 = 1.2

[group8]

7. If we put Program C whose instruction count is 1600 into Machine X, which clock rate is 2 GHz. What execution time we should get?

Program C

Type of Instruction	CPI	%
A	2	75
B	6	25

Ans:

Execution time = (IC * average clock cycle) / clock rate
= 1600 * (0.75*2 + 0.25*6) / (2*10^9)
= 2400 * 10^-9 s
= 2400 ns

[group1]

8. Assume a program has 50 FP instructions, 80 L/S instructions, and 16 branch instructions. The CPI for each type of instruction is 1, 4, and 2, respectively. Assume that the processor has a 2GHz clock rate.
Q: Could we only improve the CPI of FP instructions to reduce the execution time by a factor of 2? Please explain your reasons.

Ans:

A: Can't be two times faster

[group10]

9. 小明去光華商場組電腦，假設同樣預算為使效能提高老闆提供兩種 instruction types of enhancement 供其選擇一種，依據 Amdahl's Law 試計算哪種方法較划算。
Load enhancement 1: 占整體執行時間 10%，執行速度提升 20 倍
Store enhancement 2: 占整體執行時間 80%，執行速度提升 1.6 倍??

$$\text{(Amdahl's Law speedup}=\frac{1}{(1-\textit{整體執行時間比})+\frac{\textit{整體時間比}}{\textit{執行速度提升}}})$$

Ans:

方法一: 整體效能提升: 1/(0.9+0.1/20)=1.105 倍
方法二: 整體效能提升: 1/(0.2+0.8/1.6)=1.43 倍
故一樣預算下選擇 Store enhancement 更能提升效能。

[group4]

10. 題目一：CPU 的效能高低，很重要的一點在於當初電腦在被設計時的 instruction（ 指令）有關，其中有

1.Instruction count

2.CPI(Cycle per instruction)

3.Clock rate

三個評估電腦效能的指標

以下五個面向，分別有(1)program (2)complier (3)instruction set (4)organization (5)tech

請問各面向會不會去影響到電腦的 1.Instruction count 2.CPI(Cycle per instruction) 3.Clock rate？，請完成以下表格，將有相關的欄位劃上 x

	Instruction Count	CPI	Clock Rate
Program			
Compiler			
Instruction Set			
Organization			
Technology			

Ans:

	Instruction Count	CPI	Clock Rate
Program	X	X	
Compiler	X	X	
Instruction Set	X	X	X
Organization		X	X
Technology			X