Chapter 1

Performance – More Examples

CPU Time Example

Exercise:

A program takes 10 seconds to run on a 2 GHz CPU. The same program on another CPU would take 20% extra clock cycles, yet it finishes in 6 seconds. What is the other CPU clock rate?

CPU-1:

$$10 \text{ sec} = \frac{\text{CPU clock cycles}}{2 \times 10^9} \quad \rightarrow \text{CPU1 clock cycles} = 20 \times 10^9$$

$$\text{CPU2 clock cycles} = 1.2 \times 20 \times 10^9 = 24 \times 10^9$$

$$6 \text{ sec} = \frac{24 \times 10^9}{\text{Clock Rate}} \quad \rightarrow \text{CPU2 clock rate} = 4 \times 10^9 \text{ Hz}$$

CPI Example

Op	Freq	CPI_i	Freq x CPI_i			
ALU	50%	1	.5	.5	.5	.25
Load	20%	5	1.0	.4	1.0	1.0
Store	10%	3	.3	.3	.3	.3
Branch	20%	2	.4	.4	.2	.4
			$\Sigma =$ 2.2	1.6	2.0	1.95

- How much faster would the machine be if a better data cache reduced the average load time to 2 cycles?

  CPU time new = 1.6 x IC x CC so 2.2/1.6 means 37.5% faster

- How does this compare with using branch prediction to shave a cycle off the branch time?

  CPU time new = 2.0 x IC x CC so 2.2/2.0 means 10% faster

- What if two ALU instructions could be executed at once?

  CPU time new = 1.95 x IC x CC so 2.2/1.95 means 12.8% faster