HomeWork 1

Monday, February 5, 2024 6:22 PM

1.5: A. IPS (Instructions per second)

IPS = Clock Rate / (CPI · 10^9) Clock Rate ~ hertz

P1 = 3GHz / (1.5)(10^9) = 3,000,000,000 / 1500000,000 = 2 IPS

P2 = 2,500,000,000 / 1,000,000,000 = 2.5 IPS

P3 = 4,000,000,000 / 2,200,000,000 = 1.818 IPS

Through our calculations P2 has the highest performance due to its IPS

B. Number of Cycles = Clock Rate · Execution Time

Number of Instructions = CPI · Number of Cycles

P1: 30 billion cycles

NOI = 30 billion · 1.5 = 45 billion instructions

P2: 25 billion cycles

NOI = 25 billion · 1 = 25 billion instructions

P3: 40 billion cycles

NOI = 40 billion · 2.2 = 88 billion instructions

C. New Execution Time = Old execution time · (1 − Time reduction percentage)

New CPI = Old CPI · (1 + CPI Increase percentage)

New Clock Rate = (Number of instructions · Old CPI) / (NET · 10^9)

NET = 10 (0.7) = 7 seconds

New CPI = 1.5 · (1.2) = 1.8

NOI = 45 billion

NCR = 45 billion · 1.5 / (7 · 10^9) = 1.93 GHz

Through our calculations we know we need a clock rate of 1.93 GHz to achieve the time reduction.

1.13.1: P1 Clock Rate: 4 GHz CPI = 0.9 Number of Instructions: $5 \cdot 10^9$

P2 Clock Rate: 3 GHz CPI = 0.75 ↓ : $1 \cdot 10^9$

Execution Time P1 = $5 \cdot 10^9 \cdot \frac{0.9}{4{,}000{,}000{,}000}$ = 1.125 s

P2 = $1 \cdot 10^9 \cdot \frac{0.75}{3{,}000{,}000{,}000}$ = 0.25 s

As shown above P2 Executes faster even though P1 has a larger clock rate. Both clock rate and CPI matter for execution time

1.13.2: Execution Time ; P1: $1 \cdot 10^9 \cdot \frac{0.9}{4 \times 10^9} = 1 \cdot \frac{0.9}{4} = 0.225 \cdot 1 = 0.225$ s

Number of Instructions (P2): $0.225 \cdot \frac{3 \cdot 10^9}{0.75} = \boxed{0.9 \times 10^9}$ is the amount of Instructions that P2 executes during P1's execution of its Instructions

1.13.3: MIPS = $\frac{\text{Clock Rate}}{\text{CPI} \cdot 10^6}$

MIPS P1 = $\frac{4 \cdot 10^9}{0.9 \cdot 10^6} = 4.44 \times 10^3$

P2 = $\frac{3 \cdot 10^9}{0.75 \cdot 10^6} = 4 \cdot 10^3$

Even though Processor 1 has a larger MIPS we Calculated earlier that processor 2 is faster So we can actually see an inverse relationship.

P2 has a higher performance therefore the statement is proven false.

1.13.4: Number of floating point instructions = $0.4 \cdot 5 \cdot 10^9 = 2 \cdot 10^9$

Execution Time of P1 = 1.125

NFPI P2 = $1 \cdot 10^9 \cdot 0.4 = 0.4 \cdot 10^9$

ET P2 = 0.25 s

MFLOPS(P1) = $\frac{2 \cdot 10^9}{1.125 \cdot 10^6} = \boxed{1.777 \cdot 10^3}$

MFLOPS(P2) = $\frac{0.4 \cdot 10^9}{0.25 \cdot 10^6} = \boxed{1.6 \cdot 10^3}$

$$\frac{1.125 \cdot 10^6}{} = \boxed{}$$

$$MFLOPS(P2) = \frac{0.4 \cdot 10^9}{0.25 \cdot 10^6} = \boxed{1.6 \cdot 10^3}$$

3. A. Amdhals law $= \frac{1}{(1-y)+\frac{y}{n}}$

for A $y = 0.6$
$N = 2$

$$\text{Speedup} = \frac{1}{(1-0.6)+\frac{0.6}{2}} = \frac{1}{(0.4)+0.3} = \frac{1}{0.7} = \boxed{1.43}$$ Speedup for the application

B. $y = 0.95$
$N = 2$

$$\frac{1}{0.05+\frac{0.95}{2}} = \frac{1}{0.05+0.475} = 1.90$$ Speed up for the application

C. Speed up Overall $= \frac{1}{(0.75 \cdot \text{Speedup}_1 + 0.25 \cdot \text{Speedup}_2)}$

$$\text{Speedup}_2 = \frac{1}{1-0+\frac{0}{2}} = 1$$

$$\text{Speedup}_{overall} = \frac{1}{(0.75 \cdot 1.43) + 0.25} = \frac{1}{1.07+0.25} = \frac{1}{1.32} = \boxed{0.76}$$ overall system speedup

D. $\text{Speedup}_1 = 1.43$ $\text{Speedup}_2 = 1.90$

$$\text{Overall System Speedup} = \frac{1}{(0.75 \cdot \text{Speed}_1) + (0.25 \cdot \text{Speed}_2)}$$

$$= \frac{1}{(0.75 \cdot 1.43) + (0.25 \cdot 1.90)}$$

$$= \frac{1}{1.545}$$

$$= \boxed{0.65}$$ overall system speedup