CS M151B Homework 1

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Problem 1.2

a) $\boxed{\text{Performance via Pipelining}}$

b) $\boxed{\text{Dependability via Redundancy}}$

c) $\boxed{\text{Performance via Prediction}}$

d) $\boxed{\text{Performance via Parallelism}}$

e) $\boxed{\text{Make the Common Case Fast}}$

f) $\boxed{\text{Hierarchy of Memories}}$

g) $\boxed{\text{Use Abstraction to Simplify Design}}$

Problem 1.7

	A	B	C	D
P1 (2.5 GHz)	1	2	3	3
P2 (3 GHz)	2	2	2	2
Weights	10%	20%	50%	20%

a) What is the global CPI for each implementation?

$$\text{CPI}_{P1} = W_A\text{CPI}_{A1} + W_B\text{CPI}_{B1} + W_C\text{CPI}_{C1} + W_D\text{CPI}_{D1}$$

$$\text{CPI}_{P1} = (0.1 \times 1) + (0.2 \times 2) + (0.5 \times 3) + (0.2 \times 3)$$

$$\boxed{\text{CPI}_{P1} = 2.6}$$

$$\text{CPI}_{P2} = W_A\text{CPI}_{A2} + W_B\text{CPI}_{B2} + W_C\text{CPI}_{C2} + W_D\text{CPI}_{D2}$$

$$\text{CPI}_{P2} = (0.1 \times 2) + (0.2 \times 2) + (0.5 \times 2) + (0.2 \times 2)$$

$$\boxed{\text{CPI}_{P2} = 2}$$

b) Find the clock cycles required in both cases.

$$\#\ \text{Clock Cycles}_{P_1} = \text{CPI}_{P1} \times \text{Instruction Count}$$

$$\#\ \text{Clock Cycles}_{P_1} = 2.6 \times 1.0 \times 10^6$$

$$\boxed{\#\ \text{Clock Cycles}_{P_1} = 2.6 \times 10^6}$$

$$\#\ \text{Clock Cycles}_{P_2} = \text{CPI}_{P2} \times \text{Instruction Count}$$

$$\#\ \text{Clock Cycles}_{P_2} = 2 \times 1.0 \times 10^6$$

$$\boxed{\#\ \text{Clock Cycles}_{P_2} = 2 \times 10^6}$$

$$\text{Execution Time} = \text{Instruction Count} \times \text{CPI} \times \text{Cycle Time}$$

$$\text{ET}_{P1} = 1.0 \times 10^6 \times 2.6 \times \frac{1}{2.5 \times 10^9} = 1.04\text{ms}$$

$$\text{ET}_{P2} = 1.0 \times 10^6 \times 2 \times \frac{1}{3 \times 10^9} = 0.67\text{ms}$$

$$\boxed{\text{P2 is faster}}$$

Problem 1.8

a) Find the average CPI for each program given that the processor has a clock cycle time of 1ns.

$$\text{Execution Time} = \text{Instruction Count} \times \text{CPI} \times \text{Cycle Time}$$

$$1.1 = 1.0 \times 10^9 \times \text{CPI}_A \times 1 \times 10^{-9}$$

$$\boxed{\text{CPI}_A = 1.1}$$

$$1.5 = 1.2 \times 10^9 \times \text{CPI}_B \times 1 \times 10^{-9}$$

$$\boxed{\text{CPI}_A = 1.25}$$

b) Assume the compiled programs run on two different processors. If the execution times on the two processors are the same, how much faster is the clock of the processor running compiler A's code versus the clock of the processor running compiler B's code?

$$\text{IC}_A \times \text{CPI}_A \times \text{CT}_A = \text{IC}_B \times \text{CPI}_B \times \text{CT}_B$$

$$1.0 \times 10^9 \times 1.1 \times \text{CT}_A = 1.2 \times 10^9 \times 1.25 \times \text{CT}_B$$

$$\frac{\text{CT}_B}{\text{CT}_A} = 0.73$$

$$\boxed{\frac{f_B}{f_A} = 1.36}$$

c) A new compiler is developed that uses only 6.0E8 instructions and has an average CPI of 1.1. What is the speedup of using this new compiler versus using compiler A or B on the original processor?

$$\text{Execution Time} = \text{Instruction Count} \times \text{CPI} \times \text{Cycle Time}$$

$$\text{ET}_C = 6.0 \times 10^8 \times 1.1 \times 1.0 \times 10^{-9}$$

$$\text{ET}_C = 0.66\text{s}$$

$$\boxed{\frac{\text{ET}_A}{\text{ET}_C} = \frac{1.1}{0.66} = 1.67}$$

$$\boxed{\frac{\text{ET}_B}{\text{ET}_C} = \frac{1.5}{0.66} = 2.27}$$