CMPEN 331 – Computer Organization and Design,
Chapter 1 Review Questions

Solve the following problems from the text book:

1- List and briefly define one of the techniques used in contemporary processors to increased speed.

Pipelining: The execution of an instruction involves multiple stages of operation, including fetching the instruction, decoding the opcode, fetching operands, performing a calculation, and so on.

2- Briefly characterize Amdahl's law.

Amdahl's law deals with the potential speedup of a program using multiple processors compared to a single processor. The law indicates the amount of speedup as a function of the fraction of code that can be executed in parallel.

3- List the desirable characteristics of a bench mark program.

a. It is written in a high-level language, making it portable across different machines.
b. It is representative of a particular kind of programming domain or paradigm, such as systems programming, numerical programming, or commercial programming.
c. It can be measured easily.
d. It has wide distribution.

4- What are the SPEC benchmarks?

This is a collection of benchmark suites is defined and maintained by the Standard Performance Evaluation Corporation (SPEC).

5- Consider two different machines, with two different instruction sets, both of which have a clock rate of 200 MHz. The following measurements are recorded on the two machines running a given set of bench mark programs.

Instruction type	Instruction Count (millions)	Cycles per Instruction
Machine A		
ALU	8	1
Load and store	4	3
Branch	2	4
Others	4	3
Machine B		
ALU	10	1
Load and store	8	2
Branch	2	4
Others	4	3

a) Determine the effective CPI, MIPS rate, and execution time for each machine.
b) Comment on the result.

a)

$$CPI_A = \frac{\sum CPI_i \times I_i}{I_c} = \frac{(8\times1+4\times3+2\times4+4\times3)\times10^6}{(8+4+2+4)\times10^6} \approx 2.22$$

$$MIPS_A = \frac{f}{CPI_A \times 10^6} = \frac{200\times10^6}{2.22\times10^6} = 90$$

$$CPU_A = \frac{I_c \times CPI_A}{f} = \frac{18\times10^6\times2.2}{200\times10^6} = 0.2 \text{ s}$$

$$CPI_B = \frac{\sum CPI_i \times I_i}{I_c} = \frac{(10\times1+8\times2+2\times4+4\times3)\times10^6}{(10+8+2+4)\times10^6} \approx 1.92$$

$$MIPS_B = \frac{f}{CPI_B \times 10^6} = \frac{200\times10^6}{1.92\times10^6} = 104$$

$$CPU_B = \frac{I_c \times CPI_B}{f} = \frac{24\times10^6\times1.92}{200\times10^6} = 0.23 \text{ s}$$

b) Although machine B has a higher MIPS than machine A, it requires a longer CPU time to execute the same set of benchmark programs.