Homework#1 Solutions

2.4 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.

2.6 MIPS = millions of instruction executions per second. FLOPS = floatingpoint operations per second.

2.1 *CPI* = 1.5; MIPS rate (for 200 MHz processor) = 133.3; MIPS rate (for 400 MHz processor) = 266.6.

2.2 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.

2.3 **a.** We can express the MIPs rate as: [(MIPS rate)/10^6] = I_c/T. So that: $I_c = T \times$ [(MIPS rate)/10^6]. The ratio of the instruction count of the RS/6000 to the VAX is [x × 18]/[12x × 1] = 1.5.

b. For the Vax, *CPI* = (5 MHz)/(1 MIPS) = 5.
For the RS/6000, *CPI* = 25/18 = 1.39.