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JUC 17

CDA3101
Assignment 1
Computer Measurements

Objectives: Learn how to apply various measurements associated with a computer.

Put all answers on this sheet. Show your work (this is required for full credit and helpful for partial credit).

1. Consider a computer system, where each processor can independently perform a separate task. Given that the *response time* on a computer system for a single task is 12 seconds, how long would it take to perform 18 tasks on this system when it has four processors? What would be the *throughput* per second for 18 tasks? (20 points)

$$\frac{1}{12} = \frac{4}{12} = \frac{1}{3} \cdot \frac{18}{1} = \frac{18}{3} = 65$$

DOING 3 TASKS EVERY 1 SECONDS

2. Machine A can perform 3 tasks in 6 seconds. Machine B can perform 2 tasks in 5 seconds. Which machine can perform a task faster? How much faster is this machine than the other. (20 points)

$$\frac{3}{6} = \frac{15}{30} \quad \frac{2}{5} = \frac{12}{30} \quad \frac{A}{B} = \frac{15}{12} = 1.25$$

A IS 1.25 TIMES FASTER

3. Given that a program on a machine requires an average of 3 cycles per instruction, the machine has a 2 GHz clock rate, and the program executes a total of 40,000,000,000 instructions, what is the CPU time in seconds required by this program? (20 points)

$$CPI = 3$$

$$CPU\ TIME = INST.\ COUNT \cdot CPI \cdot CLOCK\ CYCLE\ TIME$$

$$CLOCK\ RATE = 2.0\ GHz$$

$$INST.\ COUNT = 40,000,000,000 = 4.0E10$$

$$CPU\ TIME = ?$$

$$CLOCK\ RATE = \frac{1}{CYCLE\ TIME}$$

$$CPU = \frac{INST.\ COUNT \cdot CPI}{CLOCK\ RATE}$$

SI UNIT
IS Hz

$$GHz = 10^9 Hz$$

$$2.0 \times 10^9$$

$$2.0E9$$

$$CPU = \frac{4.0E10 \cdot 3}{2.0E9}$$

$$CPU = 60\ s$$

4. How many gibibytes is 0.32 Tib? (10 points)

$$\begin{aligned} \text{Tib} &= 2^{40} & \text{GB} &= 10^9 \\ .32 \times 2^{40} \\ \hline &= 351.8437209 \text{ GB} \end{aligned}$$

5. The portion of time a program spends performing floating-point operations is 25%. A new floating-point co-processor would perform floating-point operations five times as fast. Given that the execution time of a program required 40 seconds without the new floating-point co-processor, what would you expect the execution time of the program to be in seconds with the new floating-point co-processor? (20 points)

$$\begin{aligned} .25 \cdot 40 &= \frac{10}{5} = 2 \text{ sec} & 40 - 10 &= 30 \\ & & \underline{+ 2} & \\ & & 32 \text{ SECS} & \end{aligned}$$

6. Suppose the clock period is 250 picoseconds. What is the clock rate in gigahertz (GHz)? (10 points)

$$\begin{aligned} \text{ps} &= 10^{-12} \\ \text{GHz} &= 10^9 \\ \hline &10^{-3} \end{aligned} \quad 250 \text{ ps} = \frac{10^3}{250} = 4.0 \text{ GHz}$$