CPTG445 HW 1

1. Assume a color display using 8 bits for each of the primary colors (red, green, blue) per pixel and a frame size of 1280 x 1024.

   a) What is the minimum size in bytes of the frame buffer o store a frame?

   b) How long would it take, at a minimum, for the frame to be sent over a 100 Mbit/s network?

   Answer

   1.4

   a. 1280 × 1024 pixels = 1,310,720 pixels => 1,310,720 × 3 = 3,932,160 bytes/frame.

   b. 3,932,160 bytes × (8 bits/byte) /100E6 bits/second = 0.31 seconds

2. Consider two different implementations of the same instruction set architecture. The instructions can be divided into four classes according to their CPI (class A, B, C, and D). P1 with a clock rate of 2.5 GHz and CPIs of 1, 2, 3, and 3, and P2 with a clock rate of 3 GHz and CPIs of 2, 2, 2, and 2.

   a) Given a program with a dynamic instruction count of 1.0 x 10^6 instructions divided into classes as follows: 10% class A, 20% class B, 50% class C, and 20% class D, which is faster: P1 or P2?

   b) What is the global CPI for each implementation?

   c) Find the clock cycles required in both cases.

   Answer

   1.6

   a. Class A: 10^5 instr. Class B: 2×10^5 instr. Class C: 5×10^5 instr. Class D: 2×10^5 instr.

   Time = No. instr. × CPI/clock rate

   Total time P1 = $(10^5 + 2 \times 10^5 \times 2 + 5 \times 10^5 \times 3 + 2 \times 10^5 \times 3)/(2.5 \times 10^9) = 10.4 \times 10^{-4}$ s

   Total time P2 = $(10^5 \times 2 + 2 \times 10^5 \times 2 + 5 \times 10^5 \times 2 + 2 \times 10^5 \times 2)/(3 \times 10^9) = 6.66 \times 10^{-4}$ s

   CPI(P1) = $10.4 \times 10^{-4} \times 2.5 \times 10^9/10^6 = 2.6$

   CPI(P2) = $6.66 \times 10^{-4} \times 3 \times 10^9/10^6 = 2.0$

   b. clock cycles(P1) = $10^5 \times 1 + 2 \times 10^5 \times 2 + 5 \times 10^5 \times 3 + 2 \times 10^5 \times 3 = 26 \times 10^5$

   clock cycles(P2) = $10^5 \times 2 + 2 \times 10^5 \times 2 + 5 \times 10^5 \times 2 + 2 \times 10^5 \times 2 = 20 \times 10^5$

3. Consider a computer running a program that requires 250 s, with 70 s spent executing Floating Point (FP) instructions, 85 s executing Load/Store (L/S) instructions, 40 s spent executing branch (BR) instructions, and 55 s spent executing Integer (INT) instructions.

   a) By how much is the total time reduced if the time for FP instructions is reduced by 20%?

   b) By how much is the time for INT instructions reduced if the total time is reduced by 20%?

   c) Can the total time be reduced by 20% by reducing only the time for branch instructions?

Answer

1.13

1.13.1 $T_{fp} = 70 \times 0.8 = 56$ s. $T_{new} = 56+85+55+40 = 236$ s. Reduction: 5.6%

1.13.2 $T_{new} = 250 \times 0.8 = 200$ s, $T_{fp}+T_{l/s}+T_{branch} = 165$ s, $T_{int} = 35$ s. Reduction time INT: 58.8%

1.13.3 $T_{new} = 250 \times 0.8 = 200$ s, $T_{fp}+T_{int}+T_{l/s} = 210$ s. NO