1.14 Assume a program requires the execution of 50 \* 10^6 FP instructions, 110 \* 10^6 INT instructions, 80 \*10^6 L/S instructions, and 16 \* 10^6 branch instructions. The CPI for each type of instruction is 1,1,4,2. Assume that the processor has a 2GHz clock rate.

1.14.1 By how much must we improve the CPI of FP instructions if we want the program to run two times faster?

% of FP = 50 \* 10^6/(50+110+80+16) \* 10^6 = 50/256

% of INT = 110/256

% of L/S = 80/256

% of branch = 16/256

CPI original = 2

CPI new = 2/2 = 1

1 = FP \* 50/256 + 1 \* 110/256 + 4 \* 80/256 + 2 \* 16/256 256-562 = FP \* 50 or (256-562)/50 = FP

Improving the FP by two times is not possible because the equation gives a negative value

1.14.2 By how much must we improve the CPI of L/S instructions if we want the program to run two times faster?

CPI = 1

1 = 1 \* 50/256 + 1 \* 110/256 + L/S \* 80/256 + 2 \* 16/256 L/S = .725

We must improve the L/S instructions to .725 to run two times faster

1.14.3 By how much is the execution time of the program improve if the CPI of INT and FP instructions is reduced by 40% and the CPI of L/S and Branch is reduced by 30%?

INT improved to .6 because 40% of 1 is .6

FP improved to .6 because 40% of 1 is .6

LS improved by 30% : 70% \* 4 = 2.8

Branch improved by 30% : 70% \* 2 = 1.4

CPI = 50/256 \* .6 + 110/256 \* .6 + 80/256 \* 2.8 + 16/256 \* 1.4 = 1.33