1. (20 pts) Explain the dangers of utilizing only a subset of the performance equation as a performance metric. Use examples if necessary.

CPU time = Instruction_count x CPI x clock_cycle

Use this equation, and any answer is correct if reasonable.

For example, switch from complex instructions set to simple instructions set will cost the instruction_count increasing, but the CPI might be reduced.

2. (20 pts) Computer-A executes the MIPS ISA and computer-B executes the x86 ISA. On average, programs can execute as 1.5 times MIPS instructions asx86 instructions. Computer-A has an average CPI of 1.5 and computer-B an average CPI of 3. If computer-B runs at a 3GHz clock frequency, what frequency does computer-A have to run at to be at least as fast as computer B?(assuming that they run same number of instructions)?

If you assume they run same number of instructions:

IC_A*CPI_A/CR_A=IC_B*CPI_B/CR_B

1*1.5/CR_A=1*3/3GHz

CR_A=1.5GHz

OR: If you think A runs 1.5 times of MIPS instruction (since MIPS in more simple instruction, so compiler will generate more MISP instruction than X86 instruction suppose they run same source code.)

IC_A*CPI_A/CR_A=IC_B*CPI_B/CR_B

1.5*1.5/CR_A=1*3/3GHz

CR_A=2.25GHz

(IC: instruction count

CR: clock_rate)

3. (20 pts)

i.Calculate the CPI of this machine:

Type	CPI for type	Frequency	
Arith/Logic	4	40%	1.6
Load	5	30%	1.5
Store	3	10%	0.3
branch	3	20%	0.6

Total CPI=1.6+1.5+0.3+0.6=4.0

ii. If the clock frequency of this machine is 2.5 GHz, Calculate the average MIPS ratings. 一条指令执行所需时间

Average MIPS rating=CR/(CPI*10^6)

=2.5*10^9/(4.0*10^6)

=4*10^8/(4*10^6)

=625 (微秒)

4. (20pts)Which type of instruction is the bottleneck of (most impact on performance) this machine.

Type	CPI for type	Frequency
Load	4	30%
Store	6	10%
Add	2	40%
Mul	12	8%
Div	40	2%
Cond	4	8%
uncond	2	2%

Load	.3*4 = 1.2
Store	.1*6 = .6
Add	.4*2 = .8
Mul	.08*12 = .96

Div	.02*40 = .8
Cond	.08*4 = .32
uncond	.02*2 = .04
Total	4.72

Pick Load as the bottleneck because it has the most impact on performance.

5. (20 pts) Considering a computer running a program that requires 250 sec, with 80 sec spent in executing FP (floating point) instructions. By how much is the total time reduced if the time taken by the FP operations could be reduced by 40% (e.g., by employing a faster FP execution unit)?

The time reduced comes from 40% of FP instructions.

That is 80sec * 40% =32sec