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CSD 211: Computer Organization and Architecture

Tutorial Sheet 1

Question 1. A program contains 1000 instructions. Out of that 25% instructions requires 4 clock cycles, 40% instructions requires 5 clock cycles and remaining require 3 clock cycles for execution. Find the total time required to execute the program running in a 1 Ghz machine. **(2 marks)**

Question 2. For the following processor, obtain the performance. Clock rate = 800Mhz, Number of instructions executed is 1000 and Average number of steps needed per machine instructions is 20. **(1 marks)**

Question 3. For the same program, two different compilers are used. The table below shows the execution time of the two different compiled programs.**(4 marks)**

	Compiler A		Compiler B	
	#instructions	Execution Time	#instructions	Execution Time
Program 1	1.00 E+09	1s	1.20 E+09	1.4s
Program 2	1.00 E+09	0.8s	1.20 E+09	0.7s

a) Find the average CPI for each program given that the processor has a clock cycle time of 1ns.
b) Assume the average CPIs found in part (a), but that the compiled programs run on two different processors. If the execution times on the two processors are the same, how much faster is the clock of the processor running compiler A's code versus the clock of the processor running compiler B's code?
c) A new compiler is developed that uses only 600 million instructions and has an average CPI of 1.1. What is the speed-up of using this new compiler versus using Compiler A or B on the original processor of part (a)?

Consider two different implementations, P1 and P2, of the same instruction set. There are five classes of instructions (A,B,C,D and E) in the instruction set. P1 has a clock rate of 4GHz, and P2 has a clock rate of 6GHz. The average number of cycles for each instruction class for P1 and P2 are listed in the following table.

	Class	CPI on P1	CPI on P2
a.	A	1	2
	B	2	2
	C	3	2
	D	4	4
	E	5	4

and

	Class	CPI on P1	CPI on P2
b.	A	1	2
	B	1	2
	C	1	2
	D	4	4
	E	5	4

d) Assume that peak performance is defined as the fastest rate that a computer can execute any instruction sequence. What are the peak performances of P1 and P2 expresses in instructions per second? e) if the number of instructions executed in a certain program is divided equally among the classes of instructions in

Question 4. (a)Program execution time T is to be examined for a certain high-level language program. The program can be run on a RISC or a CISC machine computer. Both computers use pipelined instruction execution, but pipelining in the RISC machine is more effective that in the CISC machine. Specifically, the effective value of S in T expression for the RISC machine is 1.2, but it is only 1.5 for the CISC machine. Both machines have same clock rate R. What is the largest allowable value for N, the number of instructions executed on the CISC machine, expressed as a percentage of the N value for the RISC machine, if time for execution on the CISC machine is to be longer than on the RISC machine? Repeat (a) if the clock rate R for the RISC machine is 15 percent higher than that for the CISC machine. **(2 marks)**

Question 5. (a)Suppose that execution time for a program is proportional to instrcution fetch time. Assume that fetching an instruction from the cache takes 1 time unit, but fecthing it from the main memory takes 10 time units. Also, assume that a requested instruction is found in the cache with probablity 0.96. Finally, assume that if an instruction is not found in the cache it must first be fetched from the main memory into the cache and then fetched from the cahe to be executed. Compute the ratio of program execution time without the cache to program execution time with the cache. This ratio is called the speedup resulting from the presence of the cache. (b) If the size of the cache is doubled, assume that the probablity of not finding a requested instruction there is cut in half. Repeat part(a) for a doubled cache size. **(2 marks)**

Question 6. We want to compare the computers R1 and R2, which differ that R1 has the machine instructions for the floating-point operations, while R2 has not (FP operations are implemented in the software using several non-FPinstructions). Both computers have a clock frequency of 400 MHz. In both we perform the same program, which has the following mixture of commands:**(6 marks)**
a) Calculate the MIPS for the computers R1 and R2.
b) Calculate the CPU program execution time on the computers R1 and R2, if there are 12000 instructions in the program?
c) At what mixture of instructions in the program will both computers R1 and R2 be equally fast?

Type the command	**Dynamic Share of instructions in program(Pi)**	**Instruction duration (Number of clock period CPIi)**	
		R1	**R2**
FP addition	16%	6	20
FP multiplication	10%	8	32
FP division	8%	10	66
Non - FP instructions	66%	3	3

Question 7. We want to speed up computer performance with an additional unit for calculating in floating point format. This unit is 20 times faster than the same operations without unit. What percentage of a total computer time must this unit be active to achieve an overall increase in computer speed for 2.5 times? **(3 marks)**