DEPARTMENT OF COMPUTER SCIENCE

COLORADOSCHOOLOFMINES.
EARTH • ENERGY • ENVIRONMENT

CSCI 341: Computer Organization
HW 10: CPU Performance and Basics of Processor Design
Due: November 7th | Points: 50

Name: _____

Although calculators are allowed, you **must show your work** to get partial/full credit to demonstrate that you understand the process of doing the problem. It's not just about getting the correct answer.

It's fine to handwrite and scan your work, just keep it legible. Make sure your name is on the pages submitted to Gradescope.

1	What common measure do you use to measure average CPU response time and how is response time related to throughput? (2 points)

2.1	Suppose I have designed a computer that will run Program A as a proof-of-concept. Given below is some information about the types of instructions in a given Program A, as well as my computer's hardware specs. Show your work for each of the questions below.
	
	    a) Calculate the theoretical average CPI for the program when it runs on my computer (5 points)
	    b) Calculate the CPU Time taken to execute my program (5 points)
	
	The two tables on the next page are used for this problem and the next two problems.

	Program A
Total Inst.	10^8
R-Type Inst.	60%
Load Inst.	20%
Store Inst.	17.5%
Branch Inst.	2.5%

	My Computer
Clock Rate	10 MHz
	CPI
R-Type Inst.	1
Load Inst.	4
Store Inst.	4
Branch	3

2.2	Suppose my rival suddenly comes up with a better computer that he claims can run program A faster than my computer. Given below are the specifications from his computer. Does it execute Program A faster? If so, calculate the speedup. (8 points)

	His Computer
Clock Rate	100 MHz
	CPI
R-Type Inst.	2
Load Inst.	5
Store Inst.	5
Branch	2

2.3	Suppose after months of work to get back at my rival, I get my original computer to execute branching instructions instantaneously. Ignoring the fact that I have revolutionized all of computer engineering, does the execution time of Program A improve by much (*do not perform any calculations*)?
	If not, how could I improve the execution time of Program A if I cannot improve the other instruction types' CPI? (6 points)

3	Draw the Instruction Fetch stage for the single-cycle datapath we have constructed. You might notice that a constant value is given to the ALU. Why do we always send in this value for the ALU? (7 points)

4	What functional (state/sequential) units are used in the whole execution of R-type instructions and what purpose does each unit serve in the datapath? (8 points)
5	Would the single-cycle datapath for an instruction like "add" work for an instruction like "addi?" Justify your answer (5 points)
6	What is the primary purpose of a clock on a CPU? (4 points)