COMP4300 Computer Architecture
Fall 2023
Homework 1
Due Monday Sept 25, 11:59pm

1. (15 points) Suppose that a given optimization results in an OVERALL speedup of 1.5 over the original design. If the optimization speeds up loads and stores, which collectively accounted for 75% of the execution time BEFORE the optimization, by what factor were loads and stores sped up by the optimization?

2. (15 points) If, in problem one, the described optimization could make loads and stores take no time at all (not realistic, just for the sake of argument), what would the overall speedup to the execution time be?

3. (30 points) Suppose that in problem one, the fraction of time taken for loads and stores AFTER optimization is 25%, and overall speedup is 1.5, what would the fraction of time taken by loads and stores BEFORE optimization? What would the speedup to loads and stores be?

4. (30 points) For a PDP-8, generate assembly code and binary to multiply the number in hex address 0x200 by 4, and store the result in address 0x201. The program should start in address 0x100. You can assume the number in 0x200 is positive and less than 0x100. You will need to consult the Internet for the PDP-8 mnemonics and instruction formats. Note in particular that the PDP-8 has no multiply instruction. Be sure to give the address of each instruction.

5. (10 points) If a given processor has a dynamic instruction count that is 20% ALU instructions, 40% loads and stores, and 20% jumps, and if ALU Instructions take 1 cycle to execute, load or store take 5 cycles, jumps take 3 cycles, and on average all the other instructions not listed take 2.3 cycles, what is the average CPI for the processor?