ES3 EE3400 06/03/2025

1. Gathering the statistics of instruction usage.
A. Select 3 programs on your computer ls, gcc, firefox/chrome, ffmpeg. You can download these programs or use their equivalents in your system.
Disassemble them using the program called objdump, e.g.
$ objdump --no-leading-addr -d /bin/ls > ls.s
Write a python program to create a histogram of all the instructions in the generated assembly files. Plot them in a bar graph.
B. For the top 10 instructions in the list from (A) and from the table shown at https://www.agner.org/optimize/instruction_tables.pdf, find out the total time taken for the sequential execution of the programs. Can you use this information to say which program is faster or slower?

2. We have seen one of the FSM that can be used for making branch prediction decisions. How many other such FSMs exist? Can you produce them by a python program?

3. This is from H&P, Comp. Arch & Design, RISC-V edition, 2020
4.10 When processor designers consider a possible improvement to the processor datapath, the decision usually depends on the cost/performance trade-off. In the following three problems, assume that we are beginning with the datapath from Figure 4.25, the latencies from Exercise 4.7, and the following costs:

I-mem: Reg File: Mux: ALU: Adder: D-Mem: Single Reg: Sign extend: Single Gate: Control
1000: 200: 10: 100: 30: 2000: 5: 100: 1: 500

Suppose doubling the number of general purpose registers from 32 to 64 would reduce the number of lw and sw instructions executed by 12%, but increase the latency of the register file from 150ps to 160ps and double the cost from 200 to 400. Use the following instruction mix:

R-type/I-type: lw : sw : beq
52% : 25% : 11% : 12%

4.10.1 [5] <§4.4> What is the speedup achieved by adding this improvement?

4.10.2 [10] <§4.4> Compare the change in performance to the change in cost.

4.10.3 [10] <§4.4> Given the cost/performance ratios you just calculated, describe a situation where it makes sense to add more registers and describe a situation where it doesn't make sense to add more registers.