

Lab 1: A Calculator ISA

Lab 1 is due Friday March 15. Your lab report and source code must be submitted by **10:10AM before the class**. The late policy applies to this lab project.

This lab is a **team project**. All team members are expected to work together on ALL parts of the lab. Get started early! The required format for lab reports can be found on the resource page.

Objective: The objective of this laboratory is to design an 8-bit calculator ISA, design a test benchmark, and mentally simulate your ISA.

Specification of the calculator: The calculator ISA must support the following operations. You may encode other functions in the ISA as you wish.

- Address four 8-bit registers.
- All registers should have value “0” before their first write.
- Load a 4-bit immediate number into a register. The immediate number should be sign-extended.
- Add/subtract between two registers and store the result in a third register.
- Display a register’s content to console.
- Compare two registers. If they are not equal, execute the next instruction. If equal, the instruction should support the choice of skipping either the next 1 or the next 2 instructions

Task 1: Design the ISA. Submit a design document that specifies the format of instructions and the semantics of each instruction.

Task 2: Design a benchmark, i.e., a program written ONLY in your ISA, to verify the functionality and correctness of your future implementation of the ISA as a BLACKBOX. The benchmark should meet the following requirements:

- (1) Use all operations at least once.
- (2) Each instruction in the benchmark influences the outcome. In other words, whether an instruction is correctly executed in an implementation of your ISA will lead to different outcomes of your benchmark.

Include a binary representation of your benchmark in your submission, e.g., “00110010” in the file. In the lab report, you should explain the design of your benchmark, in particular how it may test the correct implementation of each instruction. Mentally run your benchmark and tabulate possible outcomes for successes/failures.

What to Turn In

For this lab project, turn in your design documents and benchmarks. You should submit all documents to Canvas.

Each submission should include (1) an ISA design document for task 1; (2) the benchmarks you design in binary format, and (3) the documentation of your benchmark design and the explanation of why your benchmark can test an implementation of your ISA.

Peer evaluation: Please submit your peer evaluation (guideline is on Canvas) of your teammates, including scores and justification, directly to the TA.