

CMSC313 Project 3

Due 5/6 11:59pm

Design a simple processor with the following requirements:

- Contain 16 registers (each of them are 8 bit wide)
- Be able to load any of the 16 registers with an immediate 8-bit value (i.e., move 8-bit immediate value to register)
- Be able to add any two registers ($\text{src1} + \text{src2}$) and have the result stored back to src1
- Be able to subtract any two registers ($\text{src1} - \text{src2}$) and have the result stored back to src1
- Be able to leave all register values unchanged (NOP: No Operation)

Suggested steps:

- Identify the total number of instructions that are needed to perform the above operations.
- Identify how many bits would be needed for "input1_sel", selecting the register for processing.
- Identify how many bits would be needed for "input2_sel" for selecting the 2nd register.
- Identify how many bits would be needed for "opcode" selecting the operation performed by Arithmetic Logic Unit (ALU).
- Identify how many bits would be needed for "output_sel" (selecting the output register to be written into).
- Identify anything else needed in the instruction's machine code for the processor to perform the required operations.

The project document in pdf should contain the following sections:

- A. Requirements: Describe the requirements of the processor
- B. Design: Describe the architecture of the processor. Using full sentences and high-level diagram, use the information gathered from the above questions to describe how the registers are connected to the ALU unit and back to the registers. It is not necessary to show all the details in the diagram; it is sufficient to show a couple of registers and use "..." to indicate the presence of the remaining registers. It is not necessary to show details of add or subtract operation; each of them can be showed as a block instead. Use mux block and decode block as described earlier in the class.
- C. Instruction Fields: List all the fields needed in the processor (input1_sel, input2_sel, opcode, output_sel, etc.) and the bit width needed for each field. Provide explanation of the bit width chosen for each field. Identify the total bit width of each instruction in the processor (assume that each instruction contains all fields even if some of the fields are not used by the instruction).
- D. Instruction Set Reference: Create a subsection for each instruction and in each subsection, provide opcode for the instruction and how the Instruction Fields are used by the instruction. If an Instruction Field isn't needed for an instruction, please state it.

Example is shown below:

D.1 XOR - Exclusive-OR operation

- opcode for this instruction is 0 (note that each instruction should have an unique opcode)
- input1_sel field is used to select the first input
- input2_sel field is used to select the second input
- immediate field is not used
- etc.