Adding Instruction Decoder to the Datapath

Begin by reading your lab manual. Then use the Instruction Set document available on Canvas as a road map for answering the following questions.

1 Instruction Decoder

1.1 Control Signal

Based on the instruction set document find out the values of control signals for all of the op-codes and complete the table below showing the control signal values corresponding to each op-code,

Opcode	RegDst	RegWrite	ALUSrc1	ALUSrc2	ALUOp[2:0]	MemWrite	MemToReg
0000	1'b0	1'b1	1'b0	1'b1	3'b000	1'b0	1'b1
0001							
0010							
0011							
0100							
0101							
0110							
0111							
1000							
1001							
1010							
1011							
1100							
1101							

Table 1: Table for opcodes and their corresponding control signals

1.2 Instruction Decoder

Write verilog code for the instruction decoder with the interface shown in Figure 2 of the lab manual.

Verify your code using XSIM in the Vivado tools and make sure there is no syntax error in the code.

Your response to the prelab should include a separate file containing this verilog code.

2 Translate the Steps to Instructions!

Translate the steps for the load and store example (`load_store_steps.txt` file to a sequence of MIPS-like assembly instructions. You can optimize out the redundant steps or add intermediate steps while keeping the functionally and results the same after the translation.

As an example for the test result steps we will have:

1- Change the regfile_read_address1 to 2
2- Change the ALUOp to 3'b011
3- Change the instr_i to 8'hF0

4- Change the ALUSrc2 to 1
5- Change the regfile_write_address to 2
6- Change the RegWrite to 1
7- Change the RegWrite to 0

You should see the output of ALU changes to 8'bFE.

The corresponding instruction for these steps is an immediate OR (ori) as below:

ori $2, $2, 0xF0

3 Generate the Machine Codes

Use the field coding from the Instruction Set document to convert your assembly instructions to a sequence of 16-bit instructions. Create a table and list the instructions in the first column while writing the corresponding machine codes in the second column.

Instruction	**Machine Code**
ori $2, $2, 0xF0	1000101011110000

Table 2: Example table for an instruction and the corresponding machine code