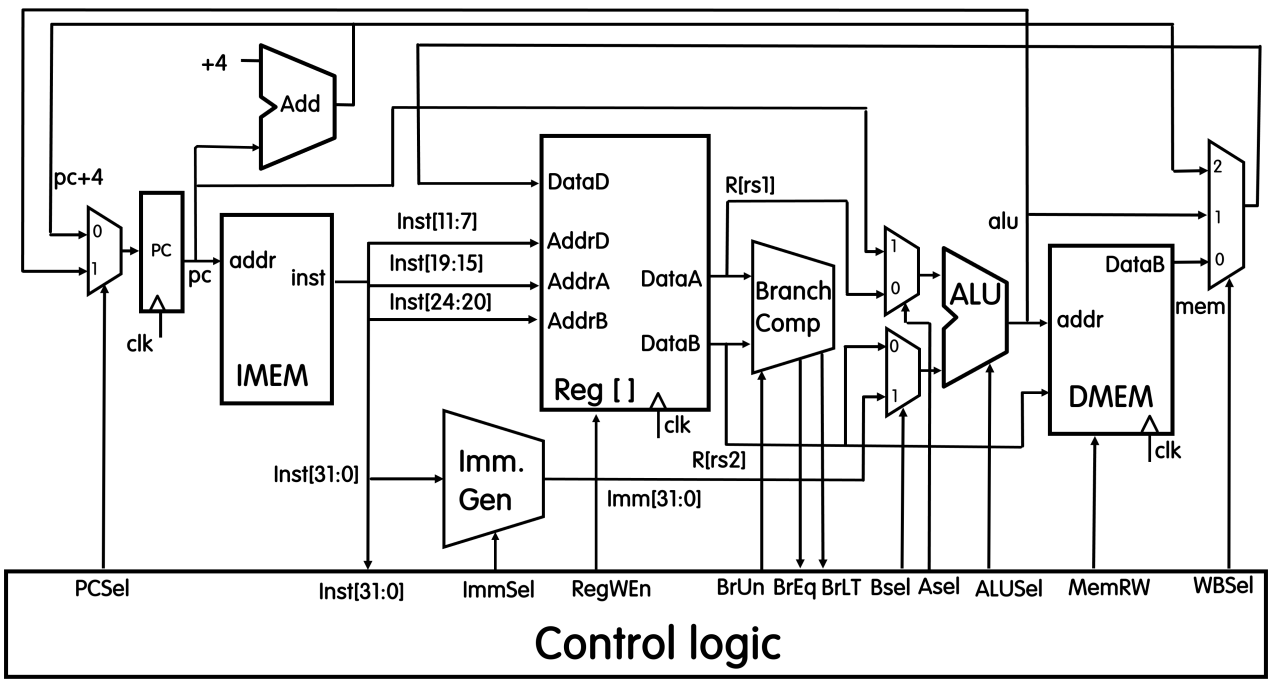
HW6.4. Datapath control signals

Consider the following datapath:



Suppose we have the following options for the ALUSel and ImmSel:

ALUSel	ALU operation
000	ADD: Result = A + B
001	SUB: Result = A - B
010	AND: Result = A & B
011	OR: Result = A | B
100	XOR: Result = A ^ B
101	SLL: Result = A << B
110	SRL: Result = A >> B
111	Pass B: Result = B

ImmSel	Immediate format
00	I-type
01	S-type
10	B-type
11	J-type

Now we are tasked to write the control signals for different instructions.

For each instruction listed below, write the corresponding control signals as a group of 13-bit binary code that follows the bit order below:

PCSel	RegWEn	ImmSel	BrUn	ASel	BSel	ALUSel	MemRW	WBSel
1 bit	1 bit	2 bits	1 bit	1 bit	1 bit	3 bits	1 bit	2 bits

For control signals that are not relevant to the instruction, put "X" for every bit of the control signal

As an example, the `addi` instruction will have the following control signals:

PCSel	RegWEn	ImmSel	BrUn	ASel	BSel	ALUSel	MemRW	WBSel
0	1	00	X	0	1	000	0	01

Here's the explanation for the `addi` control signals:

PCSel = 0, because you just execute the next instruction after `addi` if ever (it's not a jump or branch instruction), so you just select pc+4 branch. PC+4 branch corresponds to multiplexer input 0.

RegWEn = 1, because we have to write back to the register file to save the result of the `addi` instruction to rd.

ImmSel = 00, because `addi` is an I-type instruction, so you take in the I-type immediate. This corresponds to 00 according to the provided table.

BrUn = X, we technically don't care about this signal because we are not executing a branch instruction, so we put "X".

ASel = 0, because we have to select the output from the register file (this is rs1). Register file output (rs1) corresponds to the multiplexer input 0.

BSel = 1, because we have to select the immediate for the `addi` instruction. Immediate generator output corresponds to the multiplexer input 1.

Homework 6

Assessment overview

Total points: 0/100

Score: 0%

Question

Value: 20

History:

Awarded points: 0/20

Report an error in this question

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Attached files

No attached files

Attach a file

Attach text

ALUSel = 000, because we have to select the addition operation on the ALU. This corresponds to 000 according to the provided table.

MemRW = 0, because we don't have to write to the memory.

WBSel = 01, because we have to select the output of the ALU to be written back to the register file. ALU output corresponds to the multiplexer input 1 (so binary 01).

This 13-bit code can then be written as `0100X01000001`

Now it's your turn. For the following instructions, write the corresponding 13-bit binary string (without the 0b prefix) that would correspond to the control signals to properly execute the instruction. **All answers should be 13 bits long.**

`or` instruction

`lw` instruction

`sw` instruction

`jal` instruction

`bgeu` instruction (*assume that the branch condition is true in this case*)

Save & Grade *20 attempts left* | Save only

Additional attempts available with new variants