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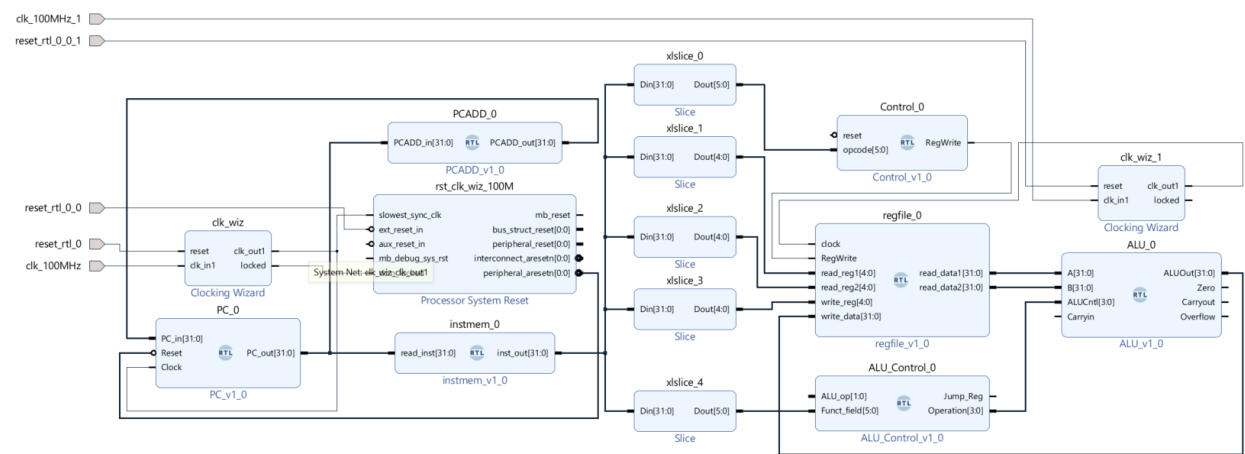## CECS 341 Lab 4 (R-Type Instruction Datapath)

Approach:

To understand this project, we must first dive into the process of such datapath. The R-Type datapath can look complicated, however, is just made up of several components that we have gone over in this course before. The first three components that are part of this large datapath that include a program counter, adder, and instruction memory. After the program counter is written with an address on a positive clock edge, a new instruction is read from the instruction memory. Simultaneously, the next address is calculated, waiting to be written to the PC on the next positive clock edge. Two other components that are needed for the datapath are the register file and ALU. These two elements are needed to implement R-format ALU operations. Two other components needed (atop of the register file and ALU) include the data memory unit and sign extension unit. These four units together allow for the datapath to perform loads and stores. For the final two parts to the datapath, we add two multiplexers and a control unit to the rest of the components. Overall, we result in a complete MIPS datapath. Understanding what the datapath consists of allowed us to conceptualize the block diagram for our lab, ultimately resulting in us creating/testing it with the given input values.

Table:

		Calculated		Simulated	
#	**Register**	**Initial Value**	**Final Value**	**Initial Value**	**Final Value**
0	$zero	00000000	00000000	00000000	00000000
1	$at	00000000	00000000	00000000	00000000
2	$v0	00000000	00000000	00000000	00000000
3	$v1	00000000	00000000	00000000	00000000
4	$a0	00000000	00000000	00000000	00000000
5	$a1	00000000	00000000	00000000	00000000
6	$a2	00000000	00000000	00000000	00000000
7	$a3	00000000	00000000	00000000	00000000
8	$t0	00000009	0000000F	00000009	0000000F
9	$t1	0000000A	00000002	0000000A	
10	$t2	0000000B	0000004F	0000000B	0000004F
11	$t3	0000000C	FFFFFF0	0000000C	FFFFFFF0

12	$t4	0000000D	000000F	0000000D	0000000F
13	$t5	0000000E	0000001F	0000000E	0000001F
14	$t6	0000000F	0000000F	0000000F	0000000F
15	$t7	00000010	00000010	00000010	00000010
16	$s0	00000011	FFFFFFFF	00000011	
17	$s1	00000012	FFFFFFFC	00000012	
18	$s2	00000013	00000001	00000013	00000001
19	$s3	00000014	00000000	00000014	00000000
20	$s4	00000015	00000015	00000015	00000015
21	$s5	00000016	00000016	00000016	00000016
22	$s6	00000017	00000017	00000017	00000017
23	$s7	00000018	00000018	00000018	00000018
24	$t8	00000019	00000019	00000019	00000019
25	$t9	0000001A	0000001A	0000001A	0000001A
26	$k0	00000000	00000000	00000000	00000000
27	$k1	00000000	00000000	00000000	00000000
28	$gp	00000000	00000000	00000000	00000000
29	$sp	00000000	00000000	00000000	00000000
30	$fp	00000000	00000000	00000000	00000000
31	$ra	00000000	00000000	00000000	00000000

Datapath Design:

Waveform: