LELEC2531 - Design and architecture of digital electronic systems
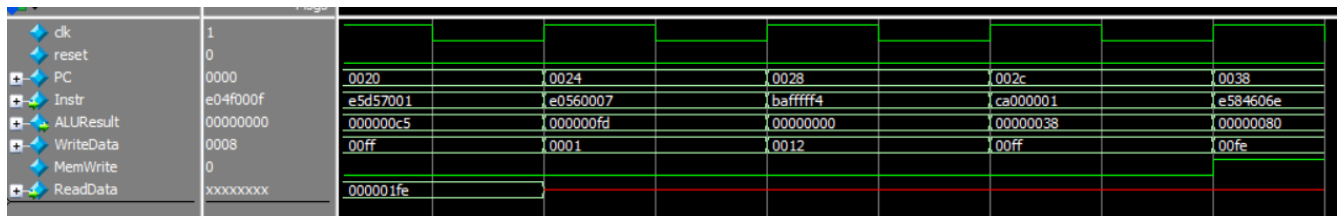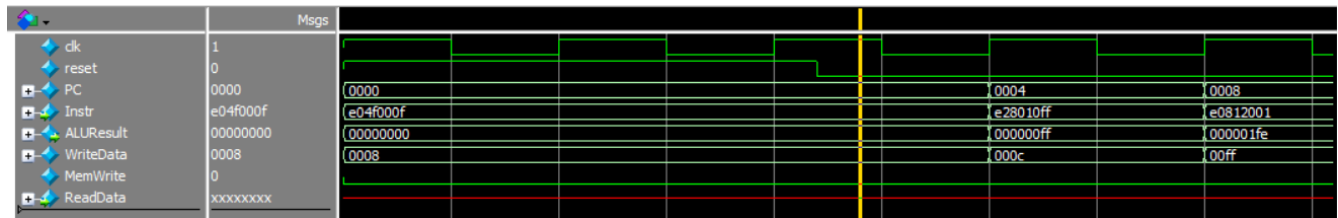
Théo Denis

1 ModelSim waveforms

The last operation is : STR R6, [R4, #110] because SUBS R0, R6, R7 creates a positive number bigger than 0. Therefore we branch to 'HERE'. This operation stores the value of R6 at address mem[128] ⇒ mem[128] = 0xFE.

2 Schematics

2.1 Single-cycle ARM processor

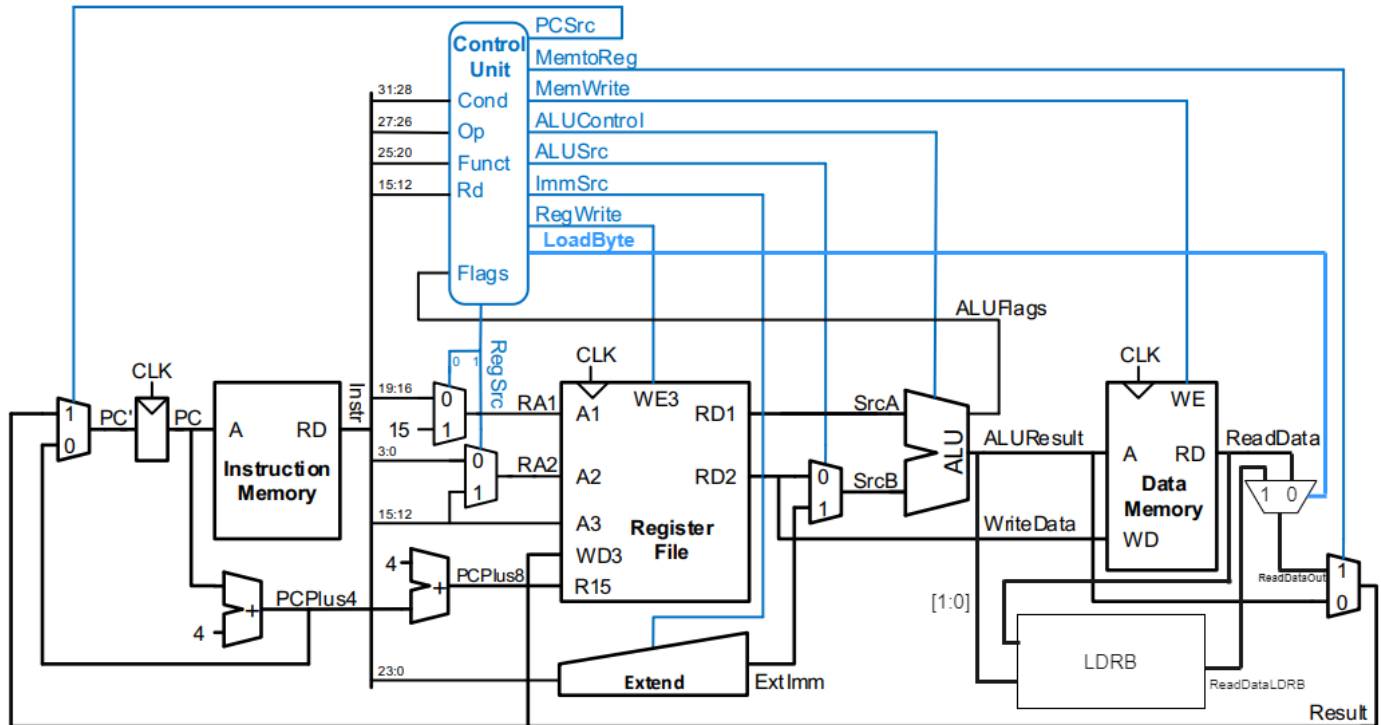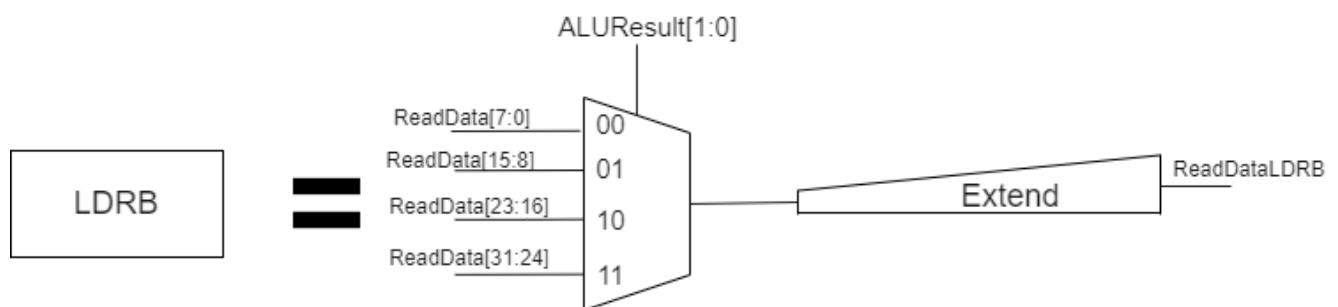Figure 1: Marked up single-cycle processor

Figure 2: Equivalent schematic of LDRB

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2.2 ALU

Figure 3: Marked up ALU

3 Decoder tables

$Funct_2$	Op	$Funct_5$	$Funct_6$	Type	Branch	MemtoReg	MemW	ALUSrc	ImmSrc	RegW	RegSrc	ALUOp	LoadByte
X	00	0	X	DP Reg	0	0	0	0	XX	1	00	1	0
X	00	1	X	DP Imm	0	0	0	1	00	1	X0	1	0
0	01	X	0	STR	0	X	1	1	01	0	10	0	0
X	01	X	1	LDR	0	1	0	1	01	1	X0	0	0
X	10	X	X	B	1	0	0	1	10	0	X1	0	0
1	01	x	1	LDRB	0	1	0	1	01	1	X0	0	1

Figure 4: Main Decoder

ALUOp	$Funct_{4:1}$ (cmd)	$Funct_0$ ($\overline{S}$)	Notes	$ALUControl_{2:0}$	$FlagW_{1:0}$
0	X	X	Not DP	000	00
1	0100	0	ADD	000	00
		1			11
	0010	0	SUB	001	00
		1			11
	0000	0	AND	010	00
		1			10
	1100	0	ORR	011	00
		1			10
1	0001	0	EOR	100	00
		1			10

Figure 5: Alu decoder

4 SignalTap waveforms

I couldn't get the clock nor the reset to work. Hence, the constant value 0 for both of them.

Type	Alias	Name	-3	-2	-1	0	1
		arm:arm|clk	0				
		arm:arm|reset	0				
		arm:arm|PC[31..0]	35E7D100h	35E7D104h	35E7D108h	35E7D10Ch	
		arm:arm|Instr[31..0]	E04F000Fh	E28010FFh	E0812001h	E58020C4h	
		arm:arm|ALUResult[31..0]	00000000h	000000FFh	000001FEh	000000C4h	
		arm:arm|WriteData[31..0]	35E7D108h	35E7D10Ch	000000FFh	000001FEh	
		arm:arm|MemWrite	0				
		arm:arm|ReadData[31..0]		00000000h		000001FEh	

Name	0	1	2	3	4
arm:arm|clk	0				
arm:arm|reset	0				
arm:arm|PC[31..0]	35E7D10Ch	35E7D110h	35E7D114h	35E7D118h	
arm:arm|Instr[31..0]	E58020C4h	E221304Dh	E203401Fh	E0835004h	
arm:arm|ALUResult[31..0]	000000C4h	000000B2h	00000012h		000000C4h
arm:arm|WriteData[31..0]	000001FEh	00000000h	35E7D11Ch	00000012h	
arm:arm|MemWrite	0				
arm:arm|ReadData[31..0]	000001FEh		00000000h		

Name	4	5	6	7	8
arm:arm|clk	0				
arm:arm|reset	0				
arm:arm|PC[31..0]	35E7D11Ch	35E7D120h	35E7D124h	35E7D128h	
arm:arm|Instr[31..0]	E5D56000h	E5D57001h	E0560007h	BAFFFFF4h	
arm:arm|ALUResult[31..0]	000000C4h	000000C5h	000000FDh	35E7D100h	
arm:arm|WriteData[31..0]	00000000h	000000FFh	00000001h	00000012h	
arm:arm|MemWrite	0				
arm:arm|ReadData[31..0]		000001FEh		00000000h	

Name	7	8	9	10	
arm:arm|clk	0				
arm:arm|reset	0				
arm:arm|PC[31..0]	35E7D128h	35E7D12Ch	35E7D138h	35E7D13Ch	
arm:arm|Instr[31..0]	BAFFFFF4h	CA000001h	E584606Eh		
arm:arm|ALUResult[31..0]	35E7D100h	35E7D138h	00000080h		
arm:arm|WriteData[31..0]	00000012h	000000FFh	000000FEh		
arm:arm|MemWrite	0				
arm:arm|ReadData[31..0]		00000000h		000000FEh	