

Indian Institute of Technology Bombay

Department of Electrical Engineering

EE-224: Digital Design

Course Project: IITB-CPU

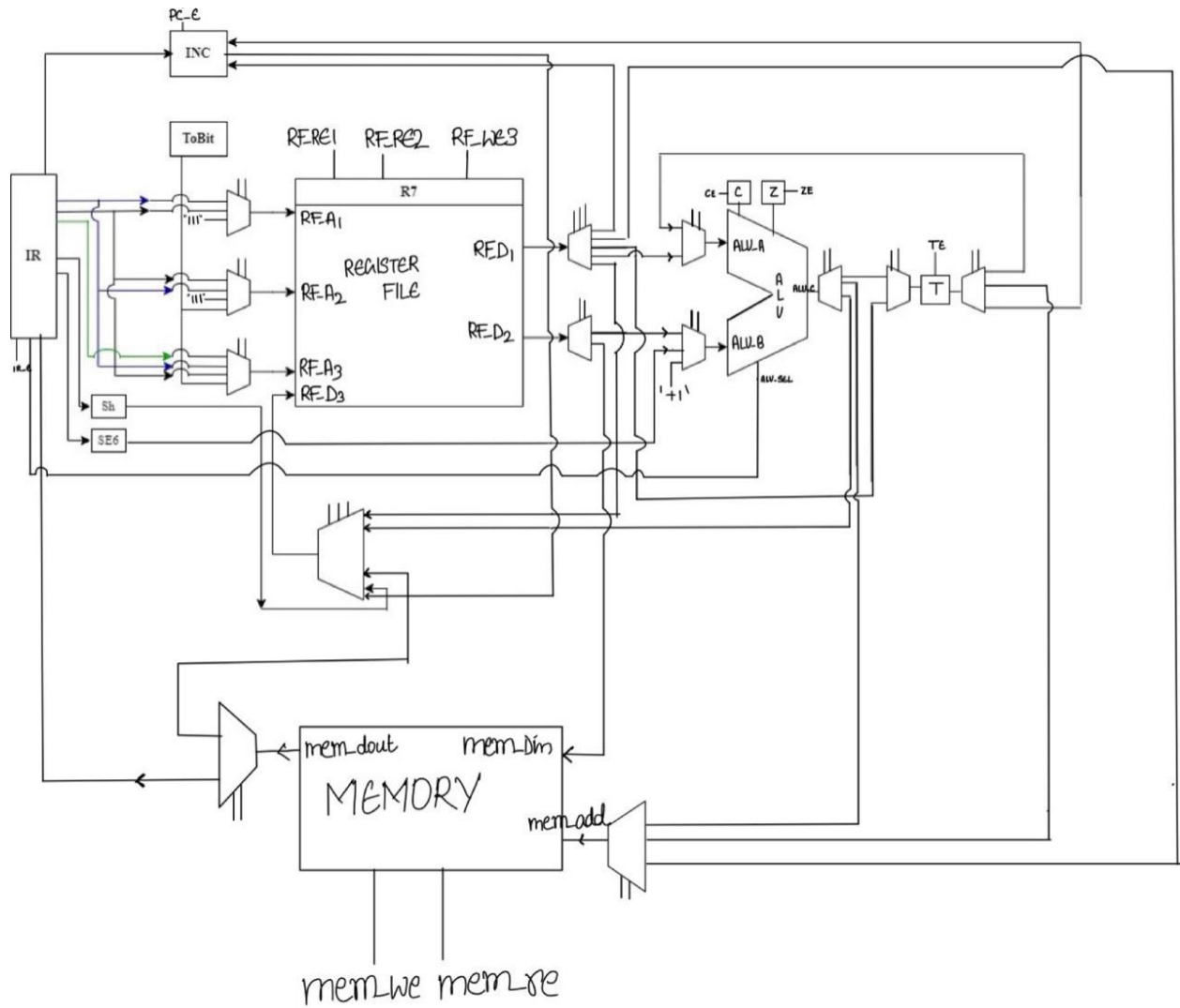
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COMPONENTS:

- ALU
- Memory
- Incrementor
- MUX_1_TO_2(DeMUX)
- MUX_1_TO_3(DeMUX)
- MUX_1_TO_5(DeMUX)
- MUX_2_TO_1
- MUX_3_TO_1
- MUX_4_TO_1
- MUX_5_TO_1
- Mux81
- Register_1
- Register_16
- Register_File
- Shifter_7bits
- Sign_Ext_6
- Controller
- Dataflow
- CPU

DATAPATH



STATES

S1:

(PC→Mem_Add) "111"→RF_A1 RF_D1→Mem_Add Mem_out→IR	RF_RE1='1' Mem_RE='1' IR_E=1
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S2:

IR _{11→9} →RF_A1 IR _{8→6} →RF_A2 IR _{5→3} →RF_A3 IR _{15→12} →ALU_Sel RF_D1→ALU_A RF-D2→ALU_B ALU_C→RF_D3 ALU_Carry→C ALU_Zero→Z	RF_RE1='1' RF_RE2='1' RF_WE3='1' Cflag_E=not(IR(13)) Zflag_E='1'
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S3:

IR→INC (PC→INC) "111"→RF_A1 RF_D1→INC T→INC (INC→PC) ToBit→RF_A3 INC→RF_D3	PC_E='1' RF_RE1='1' ToBit="111" RF_WE3='1'
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S4:

IR _{11→9} →RF_A1	RF_RE1='1'
IR _{8→6} →RF_A3	
IR _{5→0} →SE_6	RF_WE3='1'
IR _{15→12} →ALU_Sel	
RF_D1→ALU_A	
SE_6→ALU_B	
ALU_C→RF_D3	
ALU_Carry→C	Cflag_E='1'
ALU_Zero→Z	Zflag_E='1'

S5:

IR _{8→6} →RF_A1	RF_RE1='1'
IR _{11→9} →RF_A3	
IR _{5→0} →SE_6	RF_WE3='1'
IR _{15→12} →ALU_Sel	
RF_D1→ALU_A	
SE_6→ALU_B	
ALU_C→MEM_Add	Mem_RE='1'
MEM_Out→RF_D3	
ALU_Zero→Z	Zflag_E='1'

S6:

IR _{8→6} →RF_A1	RF_RE1='1'
IR _{11→9} →RF_A2	RF_RE2='1'
IR _{5→0} →SE_6	
RF_D1→ALU_A	
SE_6→ALU_B	
ALU_C→MEM_Add	Mem_WE='1'
RF_D2→Mem_Din	

S7:

IR _{11→9} →RF_A3 IR _{8→0} →SH_7 SH_7→RF_D3	RF_WE3='1'
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S8:

IR _{11→9} →RF_A1 IR _{8→6} →RF_A2 IR _{15→12} →ALU_Sel RF_D1→ALU_A RF-D2→ALU_B ALU_C→T	RF_RE1='1' RF_RE2='1' T_E='1'
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S9:

IR _{11→9} →RF_A3 "111"→RF_A1 RF-D1→RF_D3	RF_RE1='1' RF_WE3='1'
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S10:

IR _{8→6} →RF_A1 ToBit→RF_A3 RF-D1→RF_D3	RF_RE1='1' ToBit="111" RF_WE3='1'
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S11:

IR _{11→9} →RF_A1 RF_D1→T	RF_RE1='1' T_E='1'
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S12:

T→Mem_Add ToBit(count_13)→RF_A3	Mem_RE='1' RF_WE3=IR(count_13);
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S13:

T→ALU_A “0000000000000001”→ALU_B ALU_C→T IR _{15→12} →ALU_Sel	T_E='1'
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S14:

T→Mem_Add ToBit(count_14)→RF_A2 RF_D2→Mem_Din	RF_RE2='1' Mem_WE=IR(count_14);
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STATE TRANSITION

ADD/ADC/ADZ/NDU/NDC/NDZ

S1→S2→S3

ADI

S1→S4→S3

LW

S1→S5→S3

SW

S1→S6→S3

LHI

S1→S7→S3

BEQ

S1→S8→S3

JAL

S1→S9→S3

JLR

S1→S9→S10

LM

S1→S11→S12

↕

S13 ~~count_13=8~~ → S3

SM

S1→S11→S14

↕

S13 ~~count_14=8~~ → S3

