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Accelerating Engineering Innovation

RISC-V Pipeline Core

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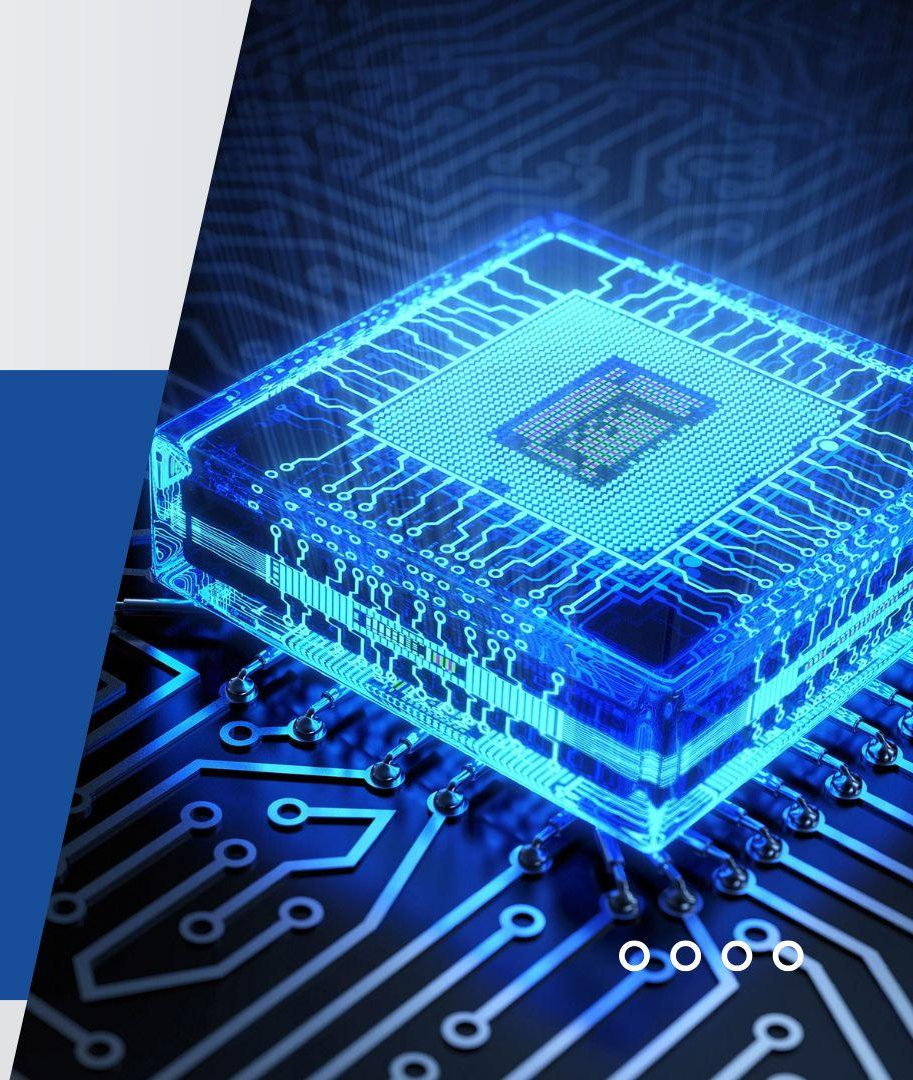
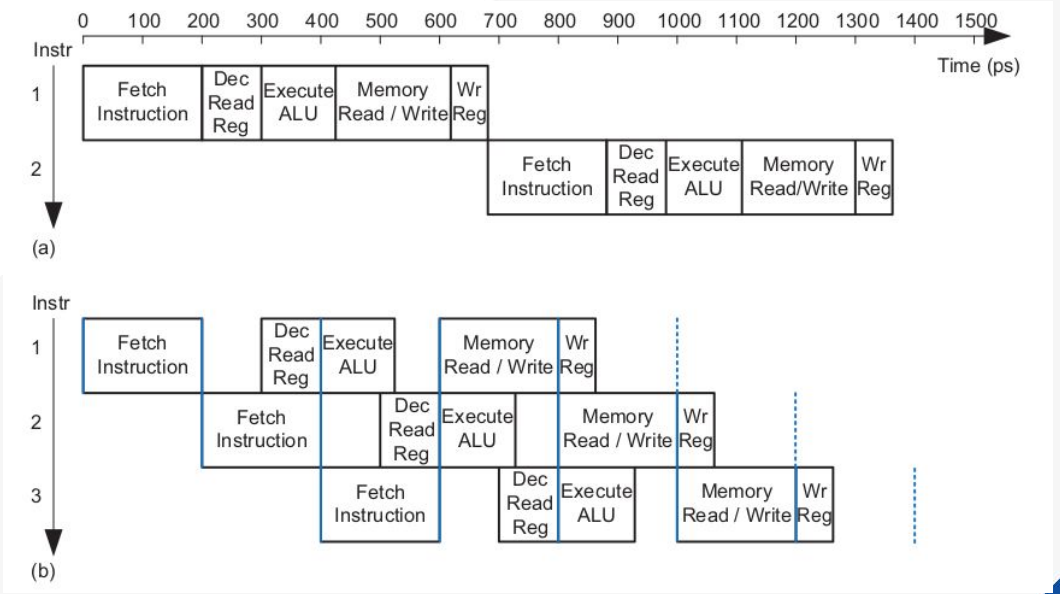


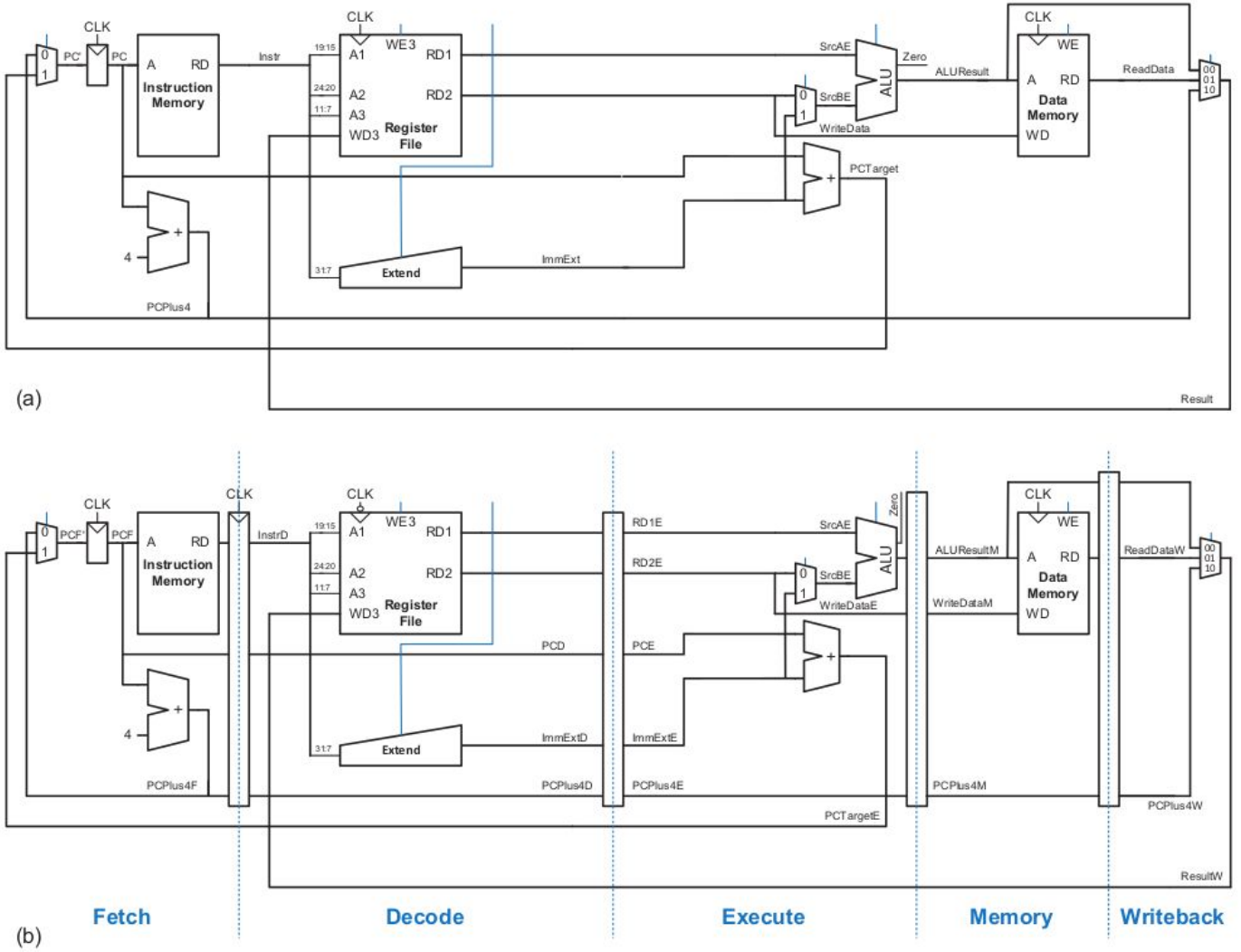
Overview

Pipelining

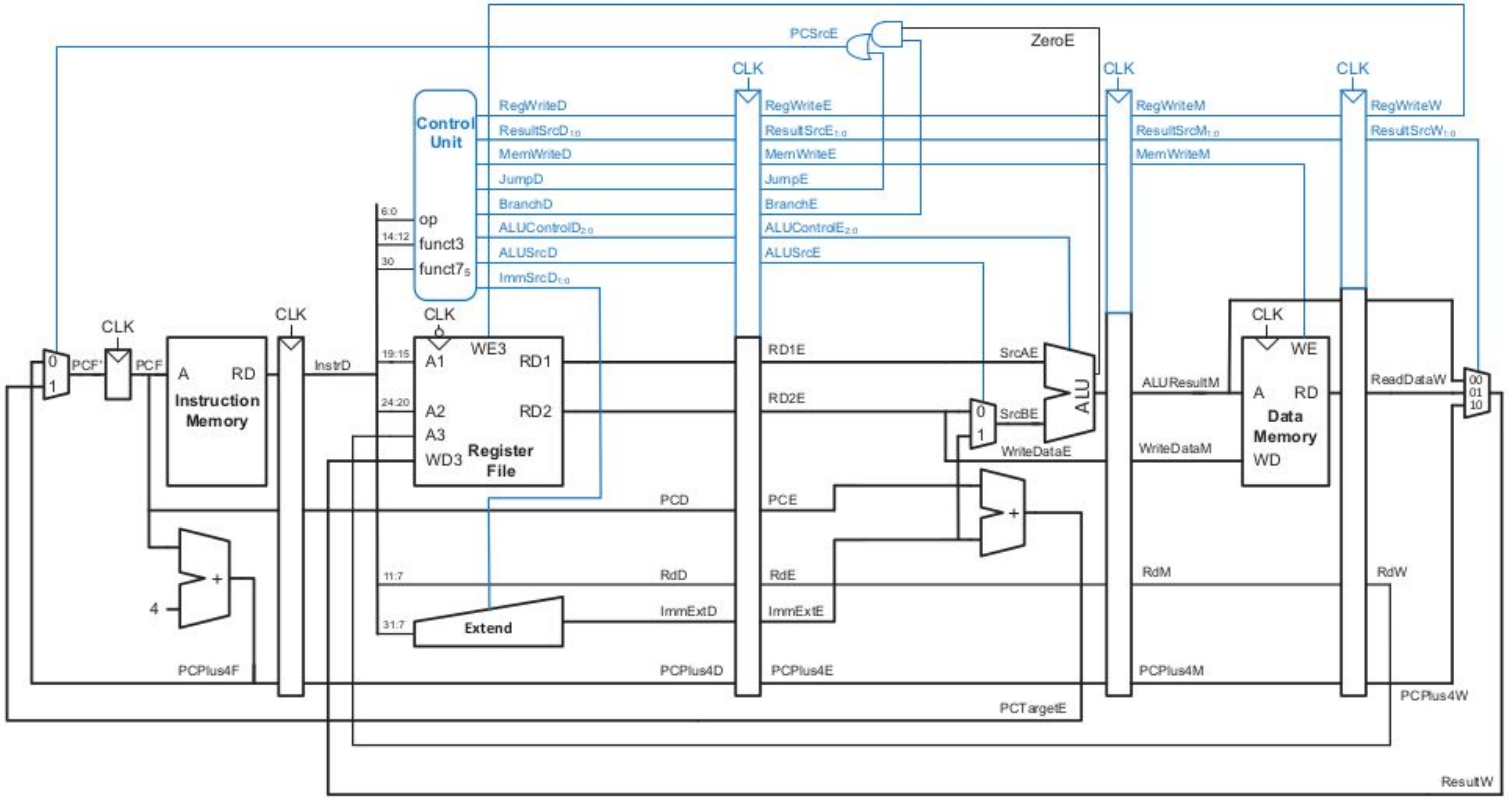
We design a pipelined processor by subdividing the single-cycle processor into five pipeline stages. Thus, five instructions can execute simultaneously, one in each stage. Because each stage has only one-fifth of the entire logic, the clock frequency is approximately five times faster.



Pipelining


CLK
PC
PC
A
RD
Instruction Memory
Instr
19:15
24:20
11:7
A1
A2
A3
WD3
WE3
RD1
RD2
Register File
SrcAE
Zero
ALU
ALUResult
SrcBE
WriteData
CLK
WE
A
RD
Data Memory
WD
ReadData
00
01
10
PCTarget
4
ImmExt
31:7
Extend
PCPlus4
Result
(a)
CLK
PCF'
PCF
A
RD
Instruction Memory
InstrD
19:15
24:20
11:7
A1
A2
A3
WD3
WE3
RD1
RD2
Register File
RD1E
RD2E
SrcAE
Zero
ALU
ALUResultM
SrcBE
WriteDataE
WriteDataM
CLK
WE
A
RD
Data Memory
WD
ReadDataW
00
01
10
PCD
PCE
4
ImmExtD
ImmExtE
31:7
Extend
PCPlus4F
PCPlus4D
PCPlus4E
PCPlus4M
PCPlus4W
PCTargetE
ResultW
Fetch
Decode
Execute
Memory
Writeback
(b)

Pipeline Datapath



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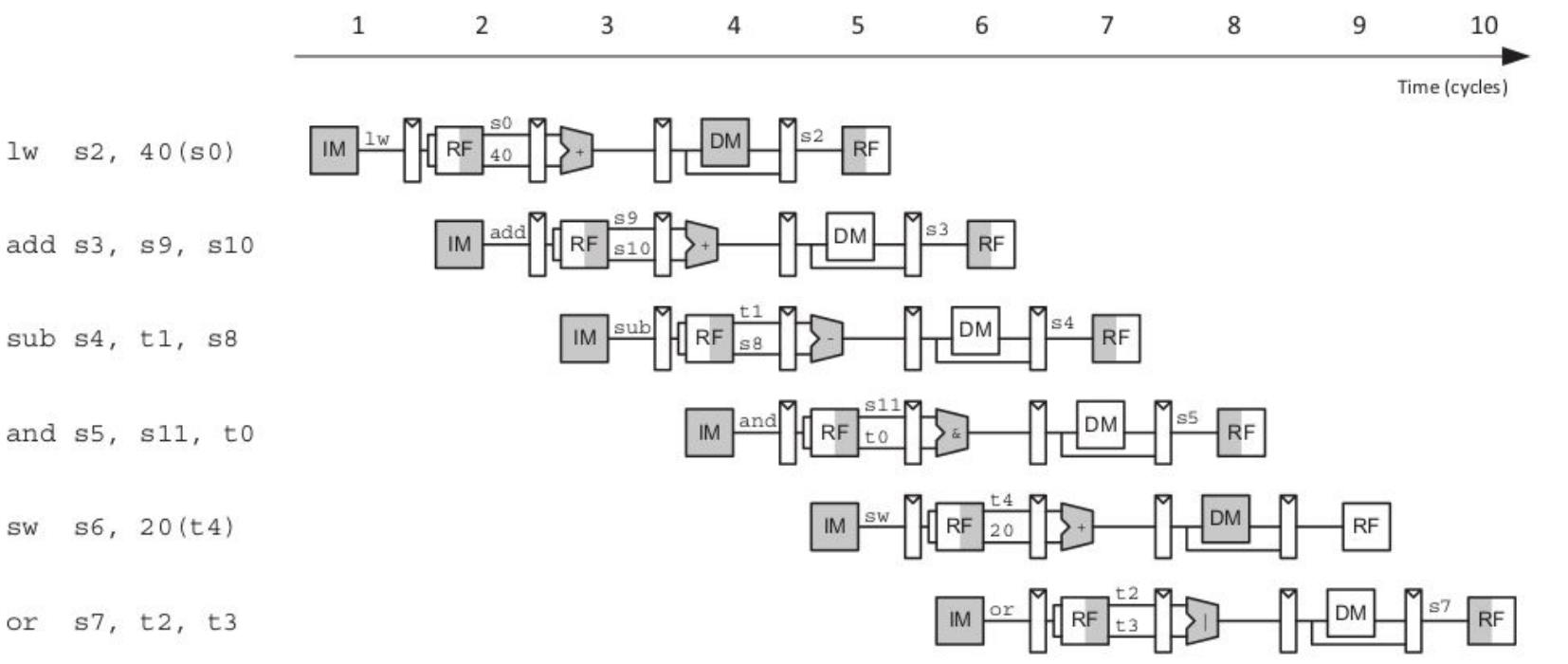
Implementation of Fetch Cycle

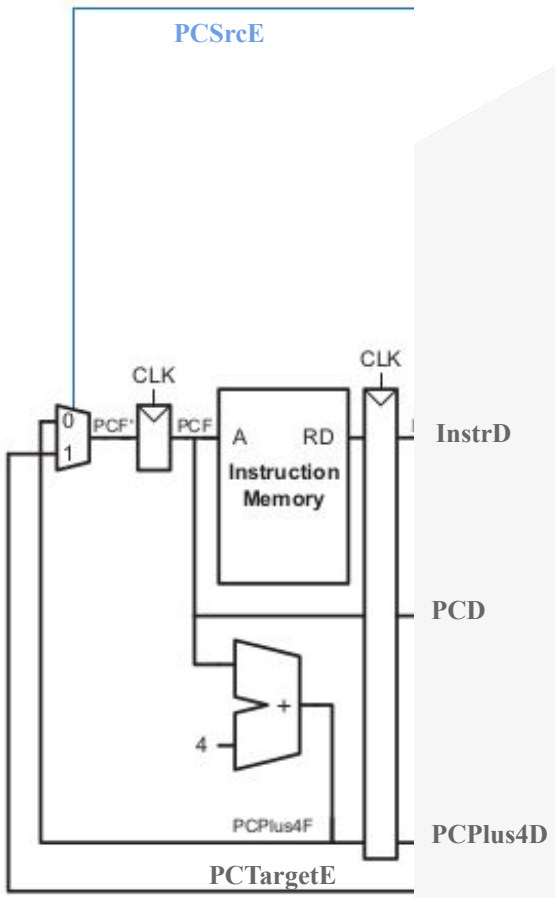
Abstract View of Pipelining



Fetch Cycle Datapath

Modules to be Integrated:

1) PC Mux
2) Program Counter
3) Adder
4) Instruction Memory
5) Fetch Stage Registers



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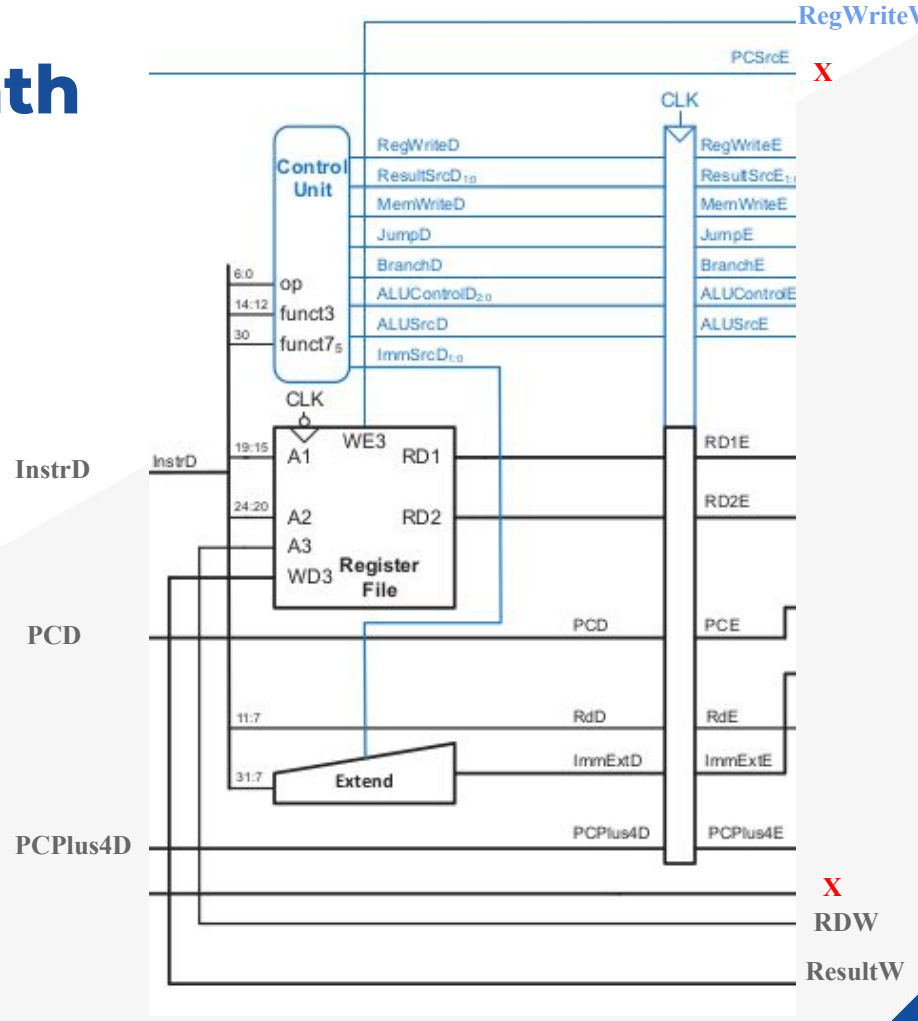
Implementation of Decode Cycle

Decode Cycle Datapath

Modules to be Integrated:

1) Control Unit
2) Register File
3) Extender
4) Decode Stage Registers



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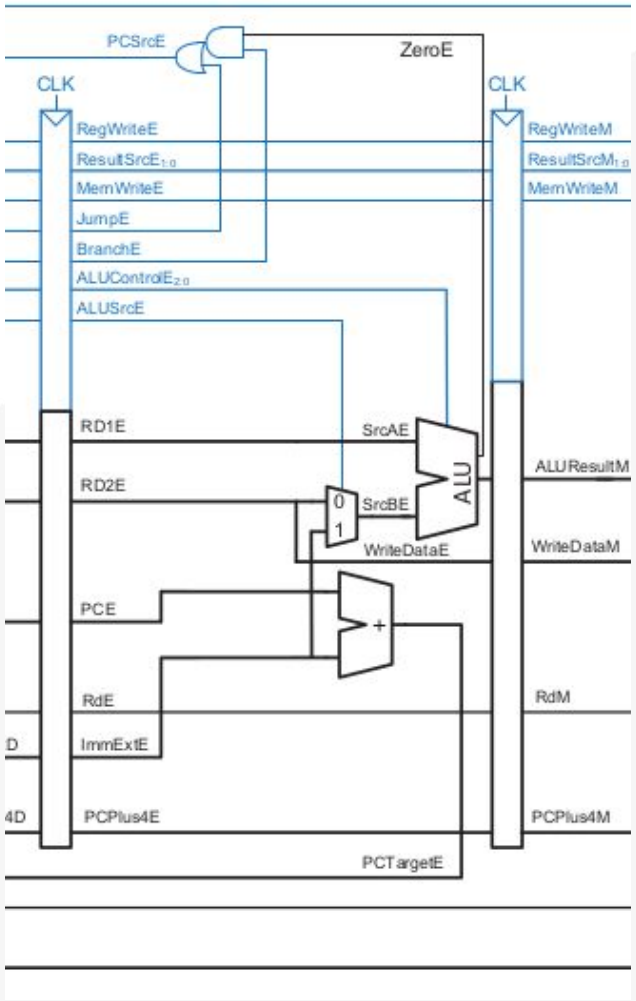
Implementation of Execute Cycle

Execute Cycle Datapath

Modules to be Integrated:

1) AND Gate
2) Mux
3) Adder
4) ALU
5) Execute Stage Registers



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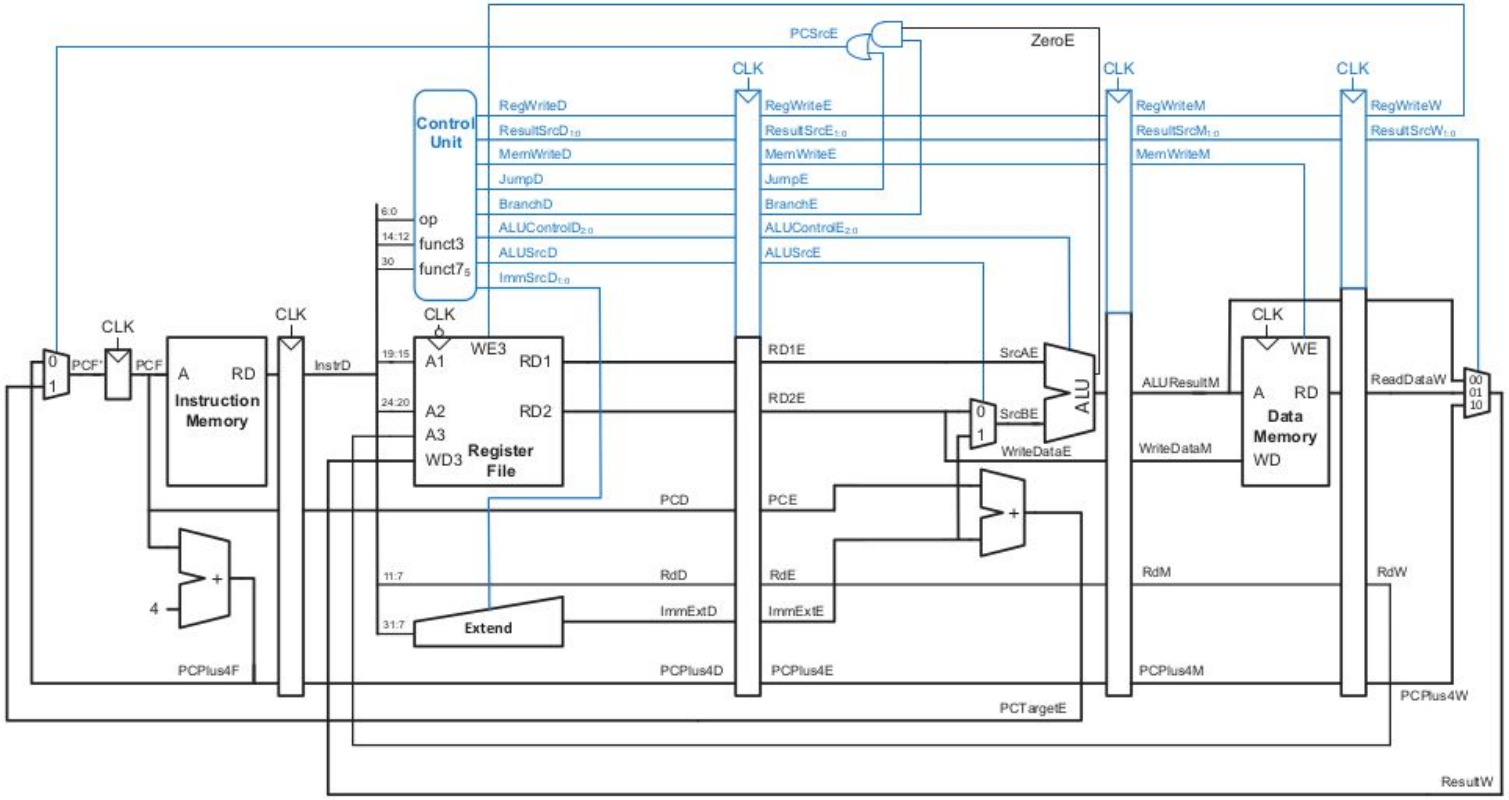
Implementation of Memory Cycle

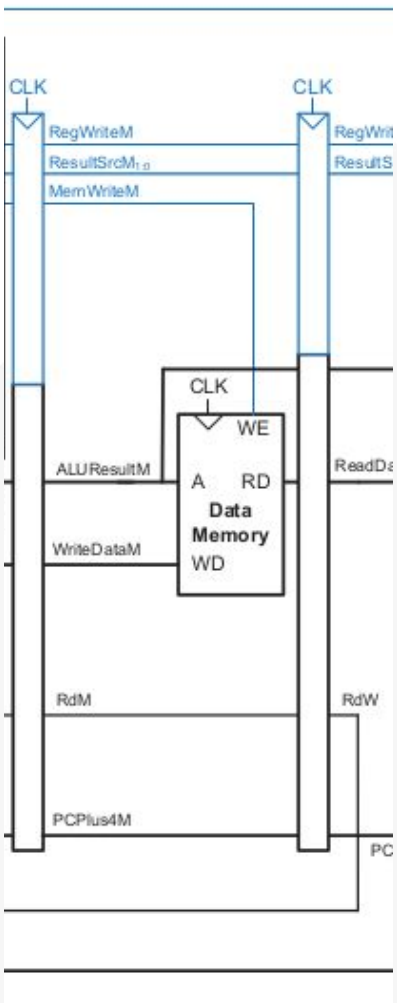
Pipeline Datapath



Memory Cycle Datapath

Modules to be Integrated:

1) Data Memory
2) Memory Stage Registers



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Implementation of Write Back Cycle

Write Back Cycle Datapath

Modules to be Integrated:

1) Mux