RISC V RV32I

BASE INSTRUCTION SET

REFERENCE

www.riscv.org

The RISC-V Instruction Set Manual

Volume I: User-Level ISA

Document Version 2.2

R-FORMAT

funct7	rs2	rs1	funct3	rd	opcode

- ADD - Addition
- SUB - Subtraction
- SLL – Logical Left Shift
- SLT – Set Less Than
- SLTU – Set Less Than Unsigned
- XOR – Xor operation
- SRL – Logical Right Shift
- SRA – Arithmetic Right Shift
- OR – or operation
- AND – and operation

I -FORMAT

imm[11:0]	rs1	funct3	rd	opcode

- LB - Load Byte
- LH - Load Half Word
- LW - Load Word
- LBU - Load Byte Unsigned
- LHU - Load Half Word Unsigned
- ADDI - Add Immediate
- SLTI - Set Less Than Immediate
- SLTIU - Set Less Than Immediate Unsigned
- XORI - Xor with immediate
- ORI - OR with immediate
- ANDI - AND immediate
- SLLI - Logical Left Shift with immediate
- SRLI - Logical Right Shift with immediate
- SRAI - Arithmetic Right Shift with immediate
- JALR - Jump and Link register

I -FORMAT

Continue…

imm[11:0]	rs1	funct3	rd	opcode

- CSRRW - Atomic Read / Write CSR
- CSRRS - Atomic Read and Set Bits in CSR
- CSRRC - Atomic Read and Clear Bits in CSR
- CSRRWI - Atomic Read / Write CSR with unsigned immediate
- CSRRSI - Atomic Read and Set Bits in CSR with unsigned immediate
- CSRRCI - Atomic Read and Clear Bits in CSR with unsigned immediate
- ECALL - Environmental call
- EBREAK - Environmental break
- FENCE - Fence
- FENCE.I - Fence with immediate

S-FORMAT

Imm[11:5]	rs2	rs1	funct3	Imm[4:0]	opcode

- SB - Store Byte
- SH - Store Half Word
- SW - Store Word

B-FORMAT

Imm[11:5]	rs2	rs1	funct3	Imm[4:1] imm[11]	opcode

- BEQ - Branch Equality
- BNE - Branch Not Equal
- BLT - Branch Less Than
- BGE - Branch Greater Than
- BLTU - Branch Less Than Unsigned
- BGEU – Branch Greater Than Unsigned

U-FORMAT

Imm[31:12]	rd	opcode

- LUI - Load Upper Immediate
- AUIPC - Add Upper Immediate with PC

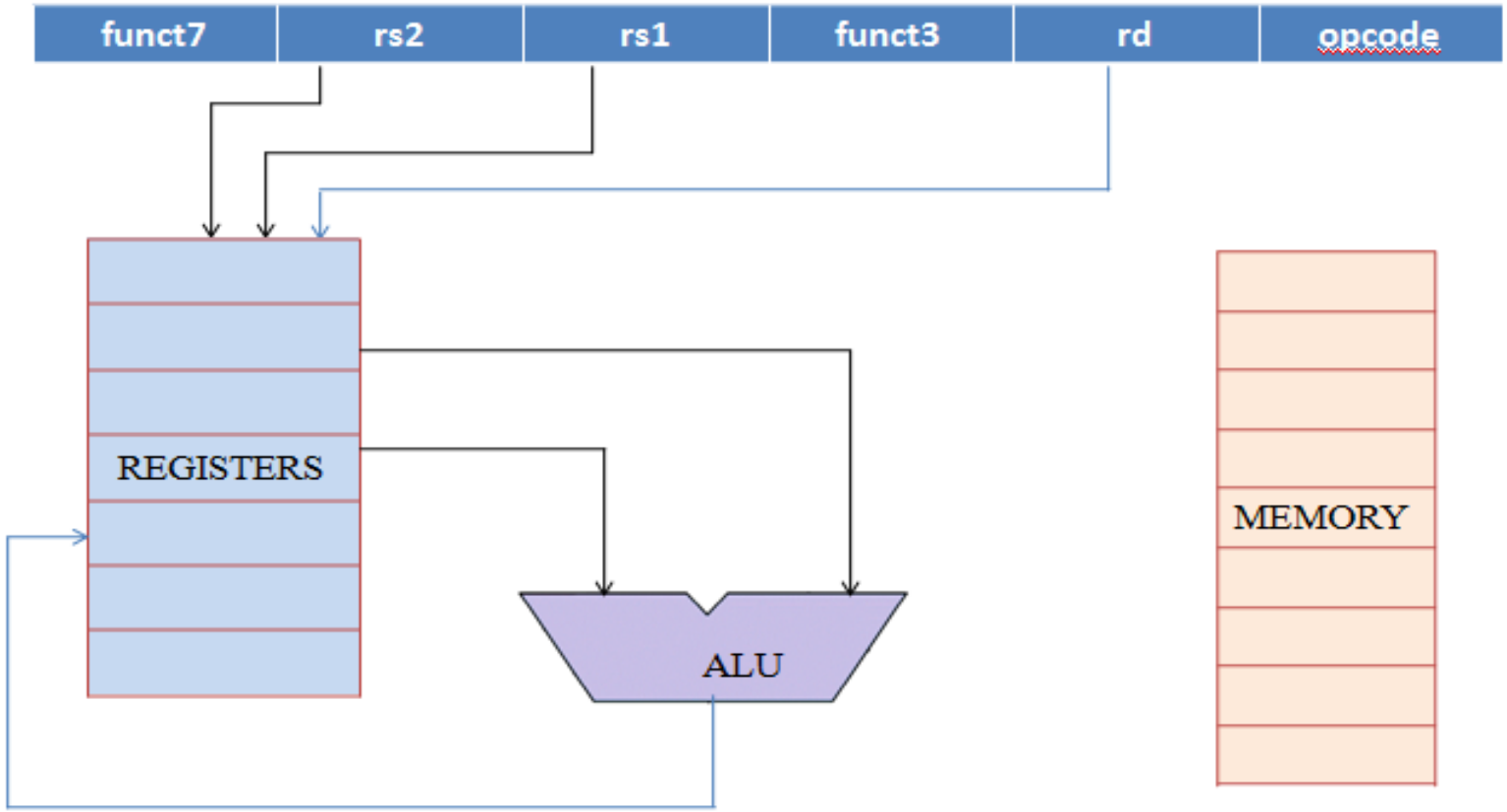
J-FORMAT

Imm[20] imm[10:1]imm[11] imm[19:12]	rd	opcode

- JAL - Jump And Link

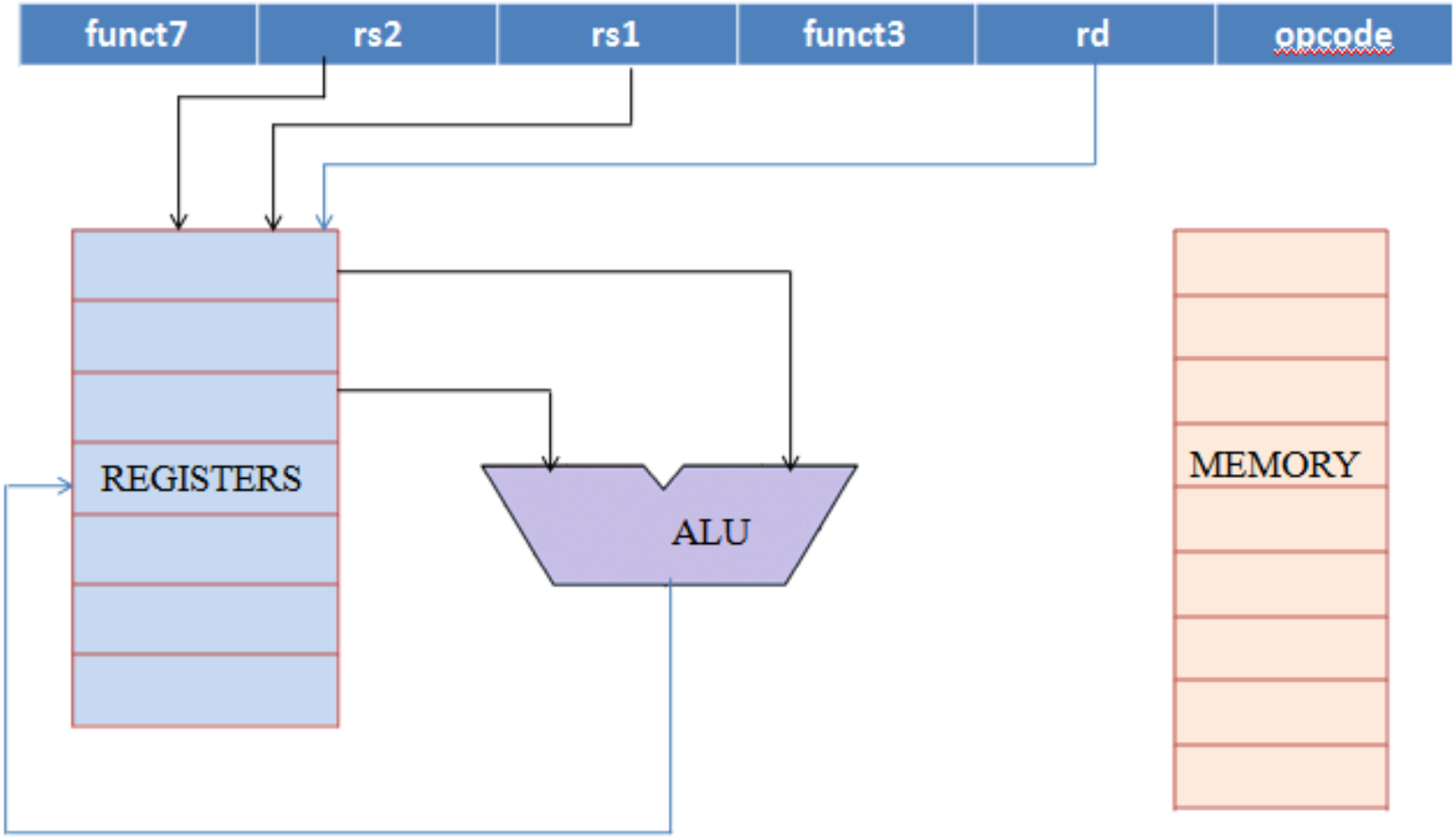
EXECUTION OF OPERATIONS IN R-FORMAT

ADD (Addition)



funct7=0000000;funct3=000;opcode =0110011

SUB (Subtraction) R-FORMAT



funct7=0100000;funct3=000;opcode =0110011

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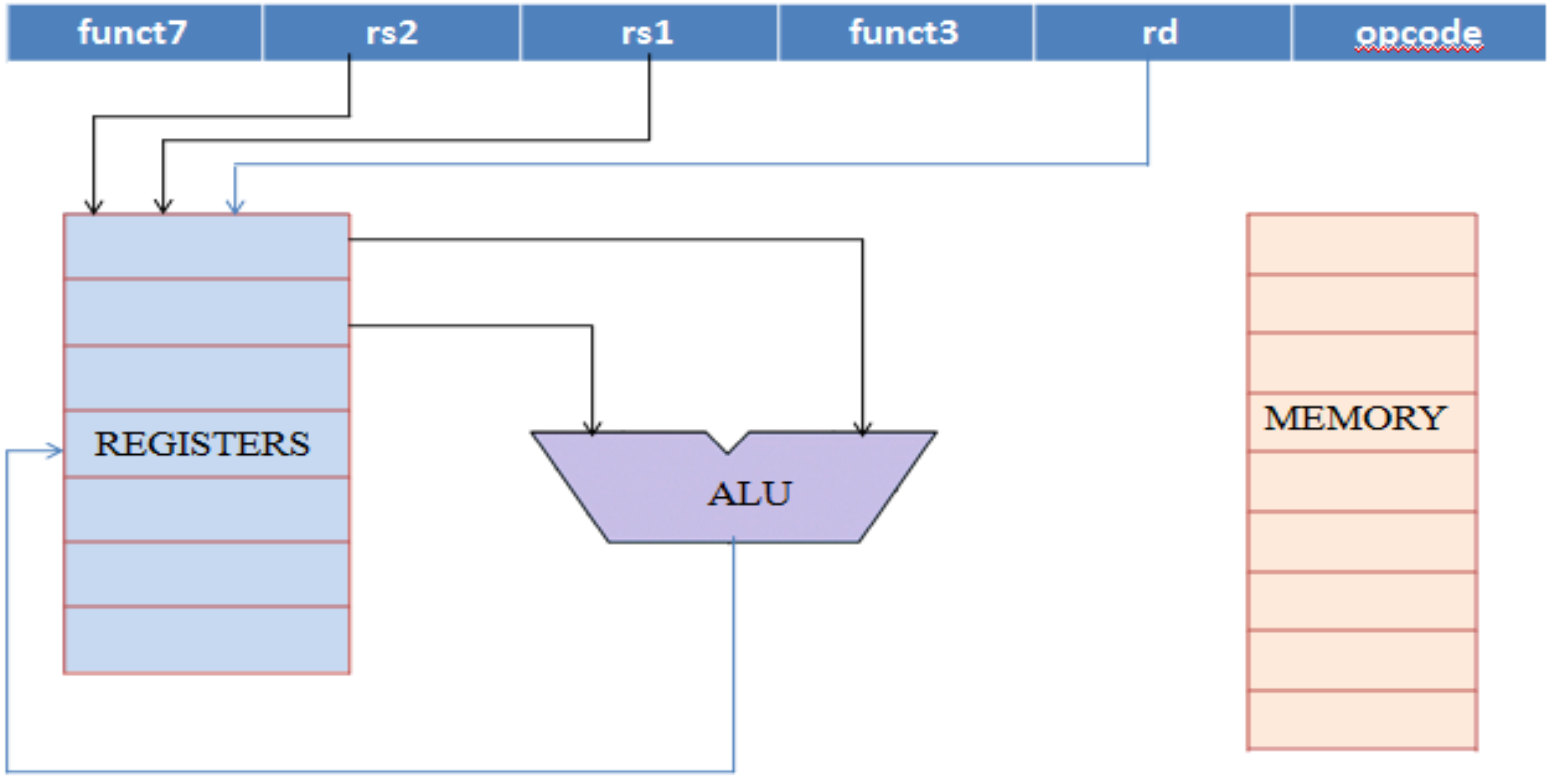
SLL (Logical Left Shift)

R-FORMAT



funct7=0000000;funct3=001;opcode =0110011

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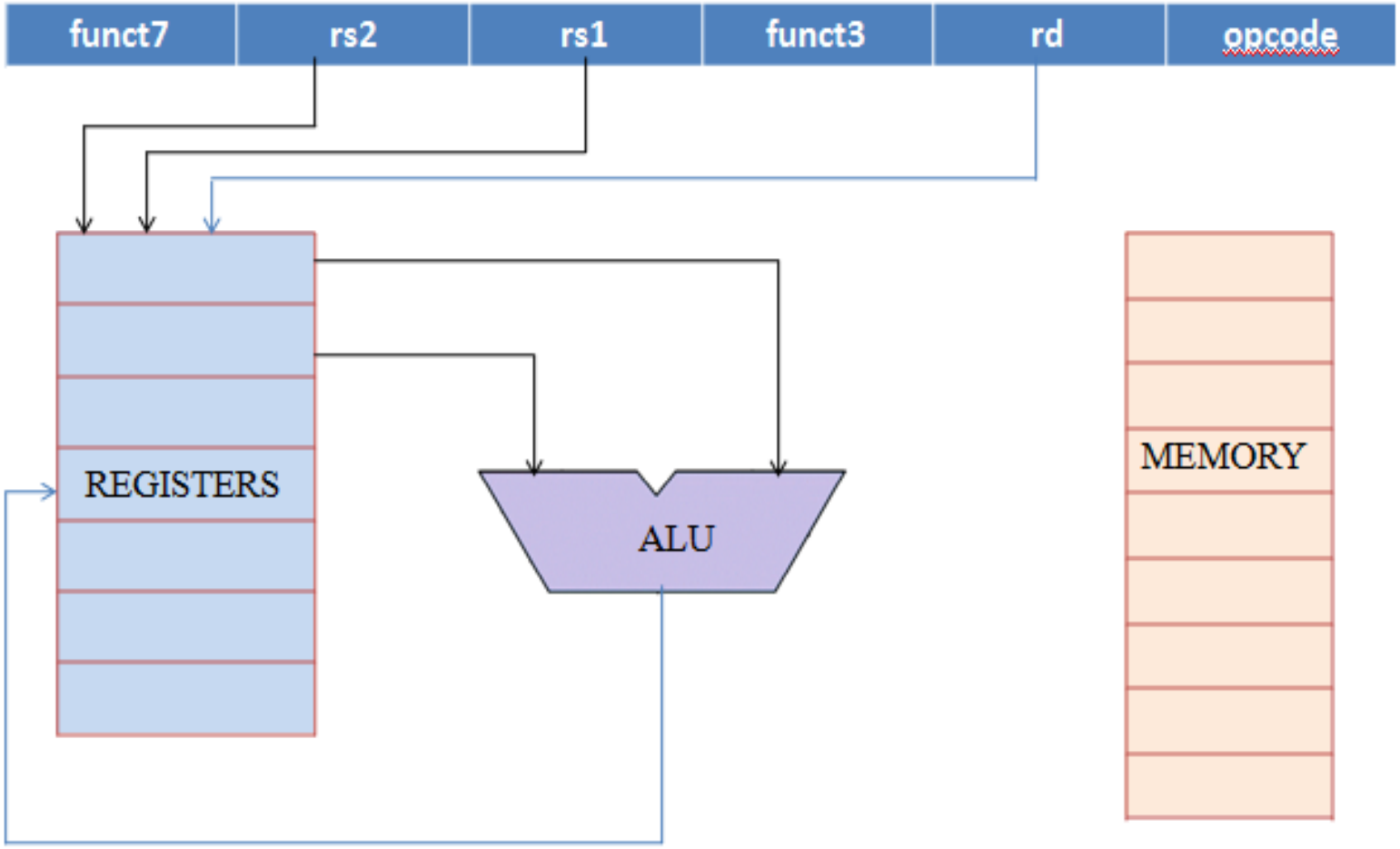
SLT (Set Less Than) R-FORMAT



funct7=0000000;funct3=010;opcode =0110011

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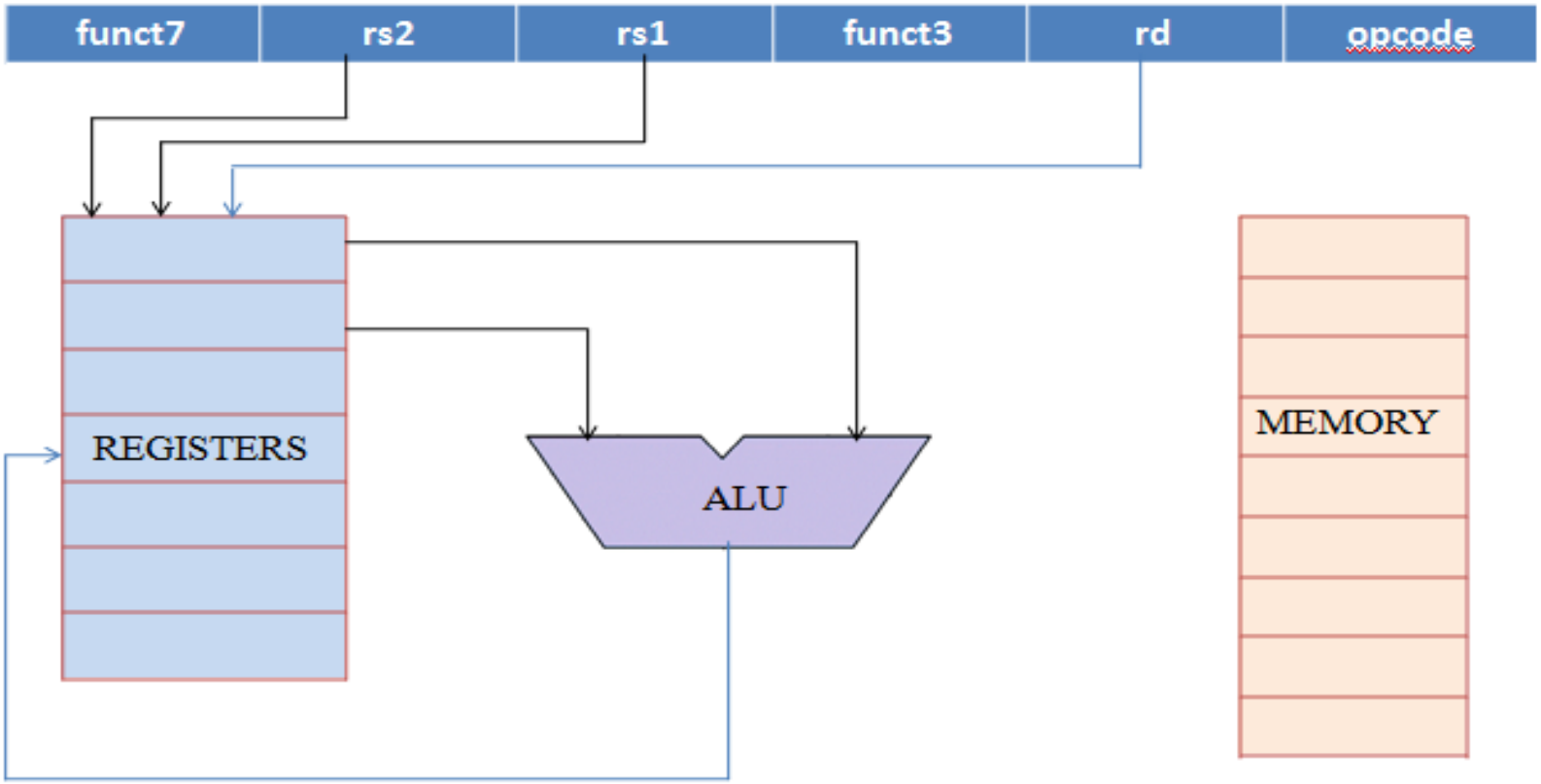
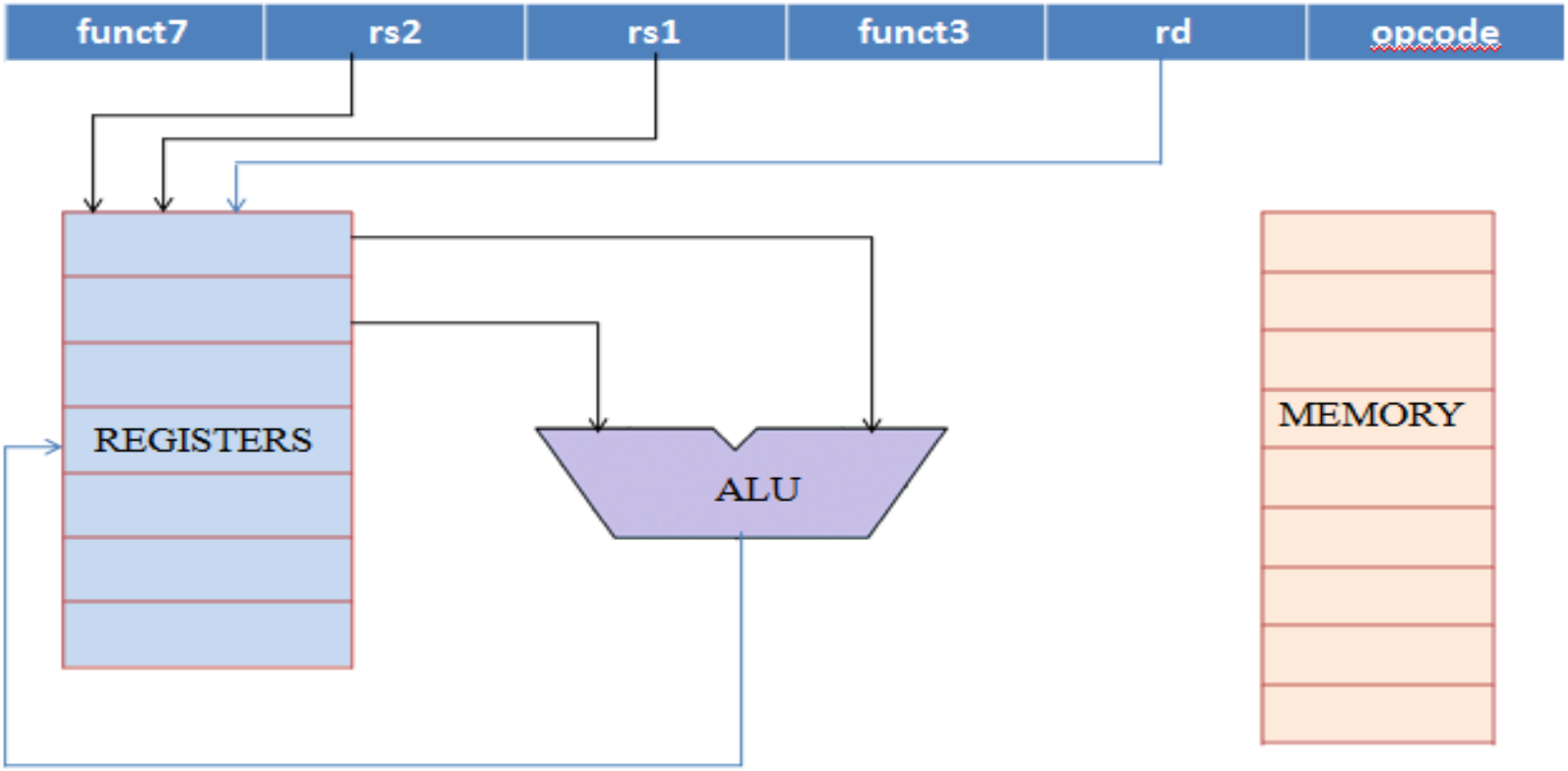
SLTU (Set Less Than Unsigned) R-FORMAT



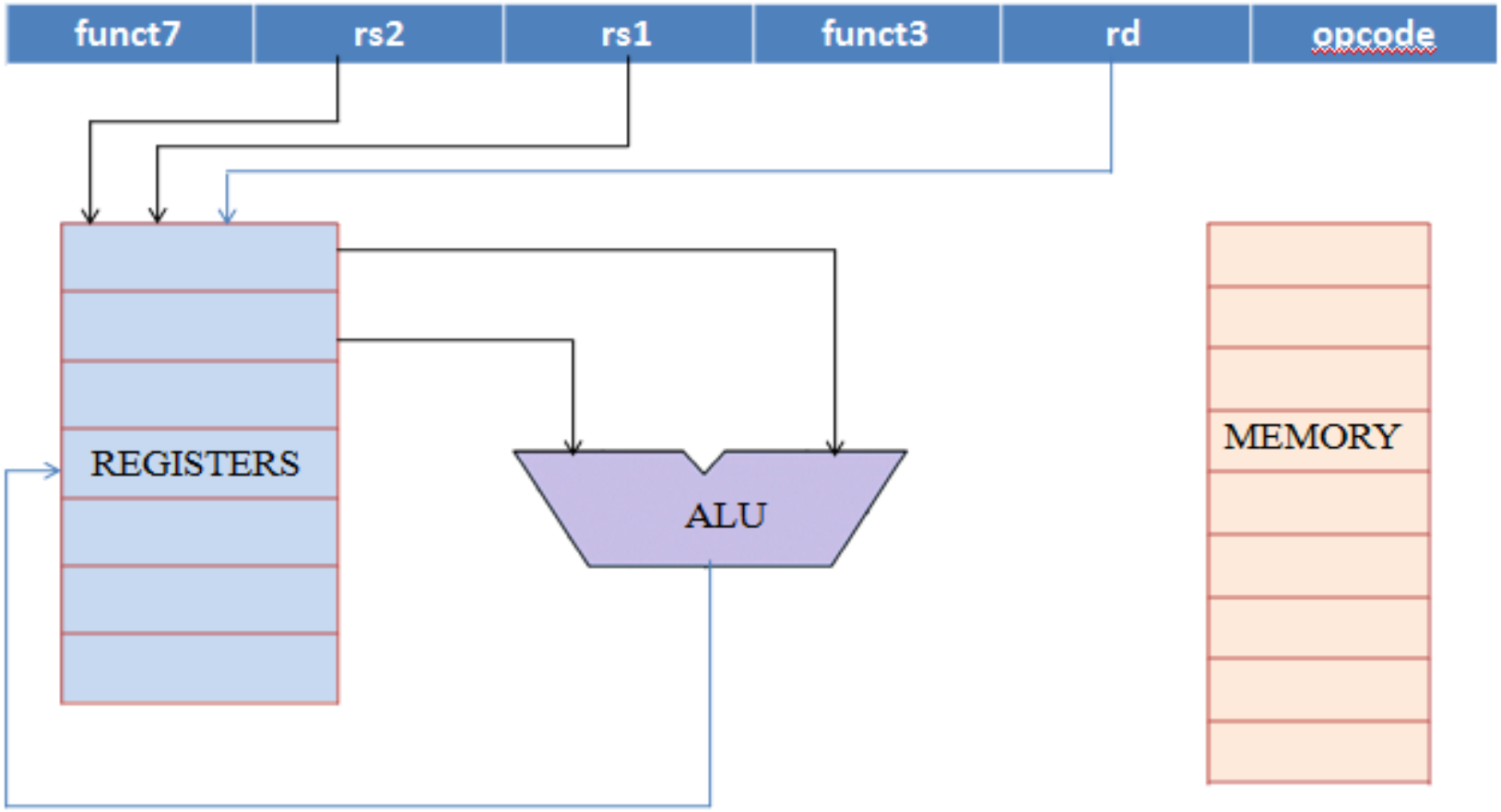
funct7=0000000;funct3=011;opcode =0110011

XOR(XOR Operation) R-FORMAT



funct7=0000000;funct3=100;opcode =0110011

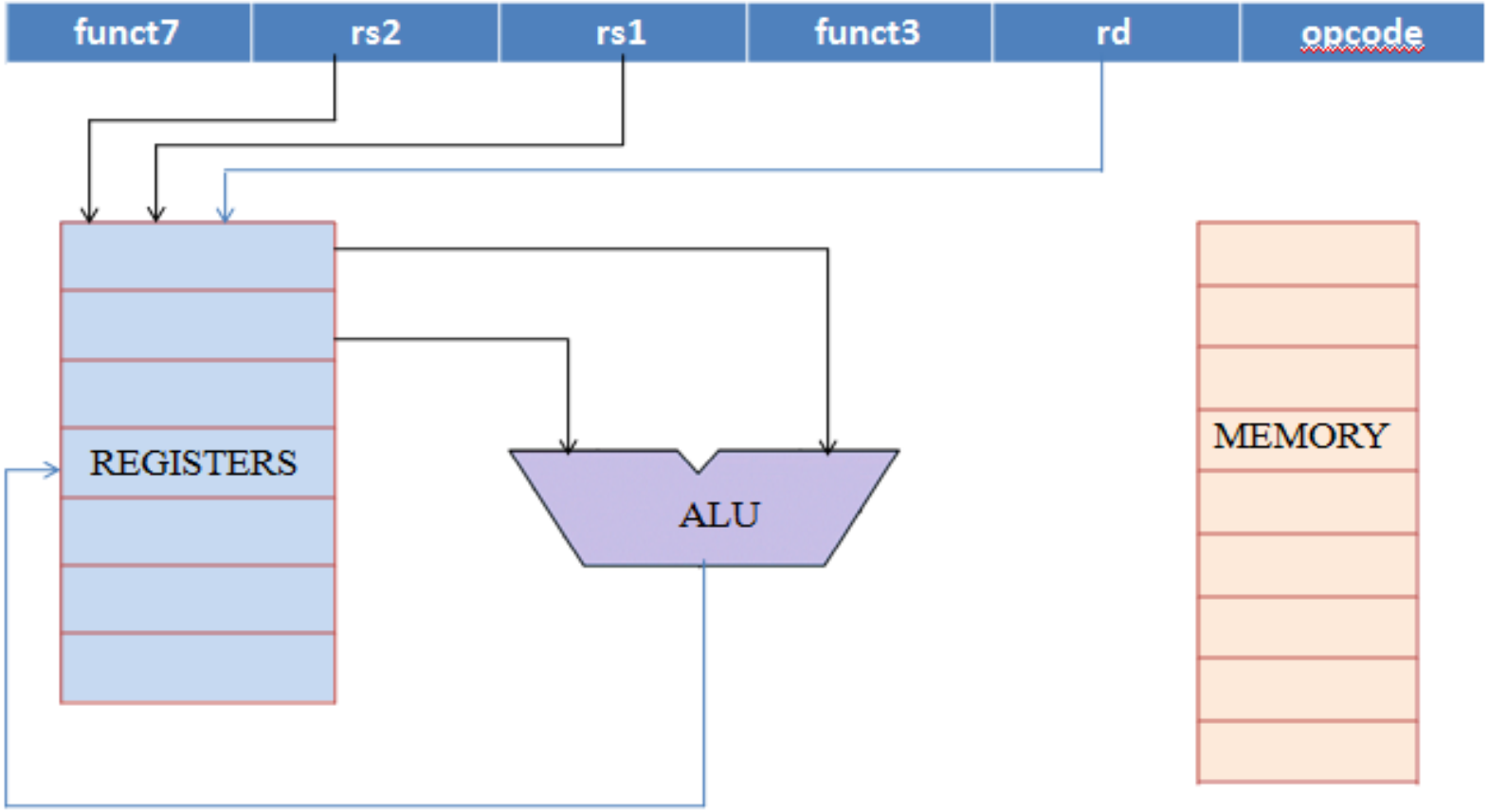
SRL (Logical Right Shift) R-FORMAT



funct7=0000000;funct3=101;opcode =0110011

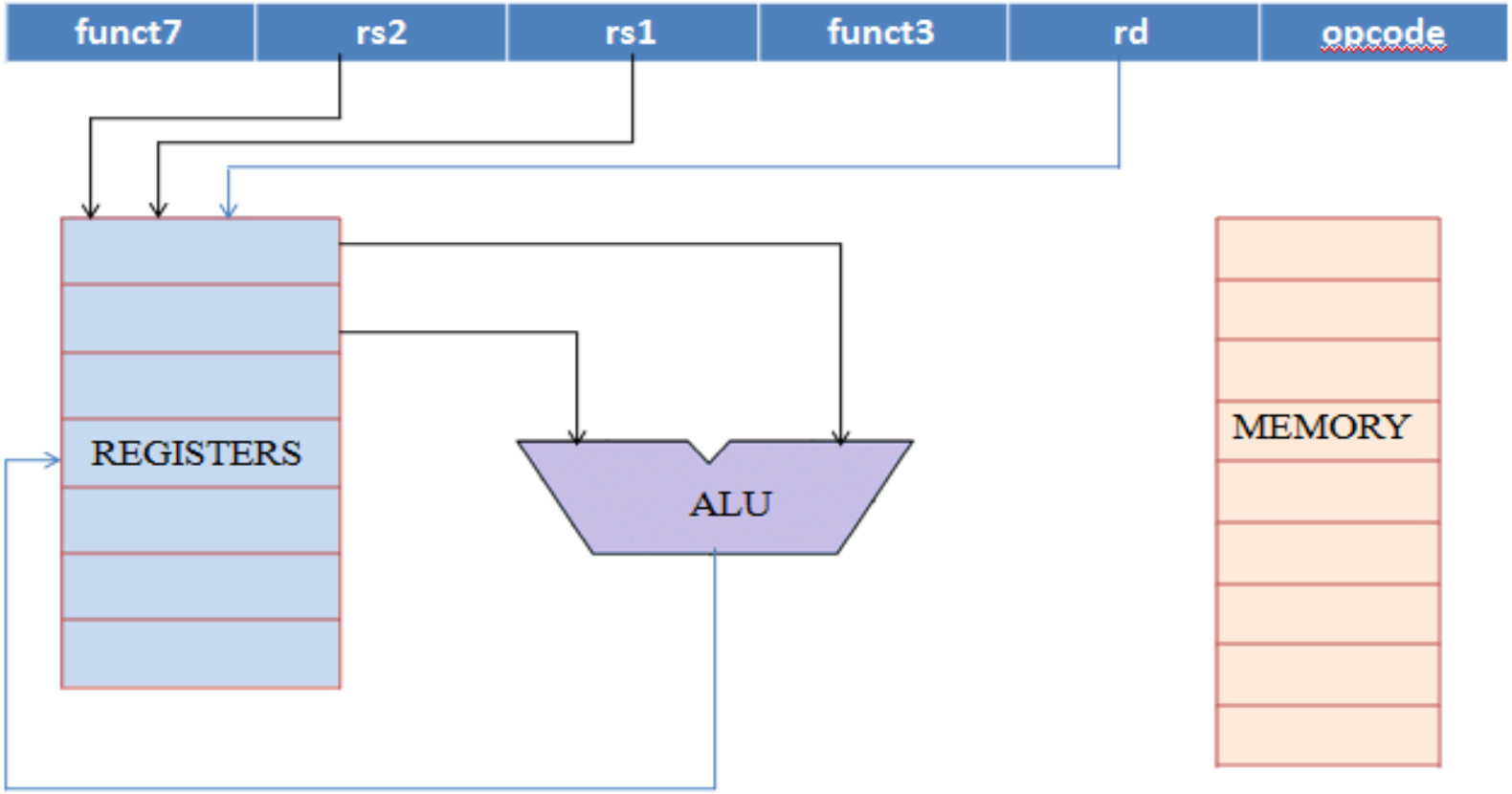
SRA(Arithmetic Right Shift)

R-FORMAT



funct7=0100000;funct3=101;opcode =0110011

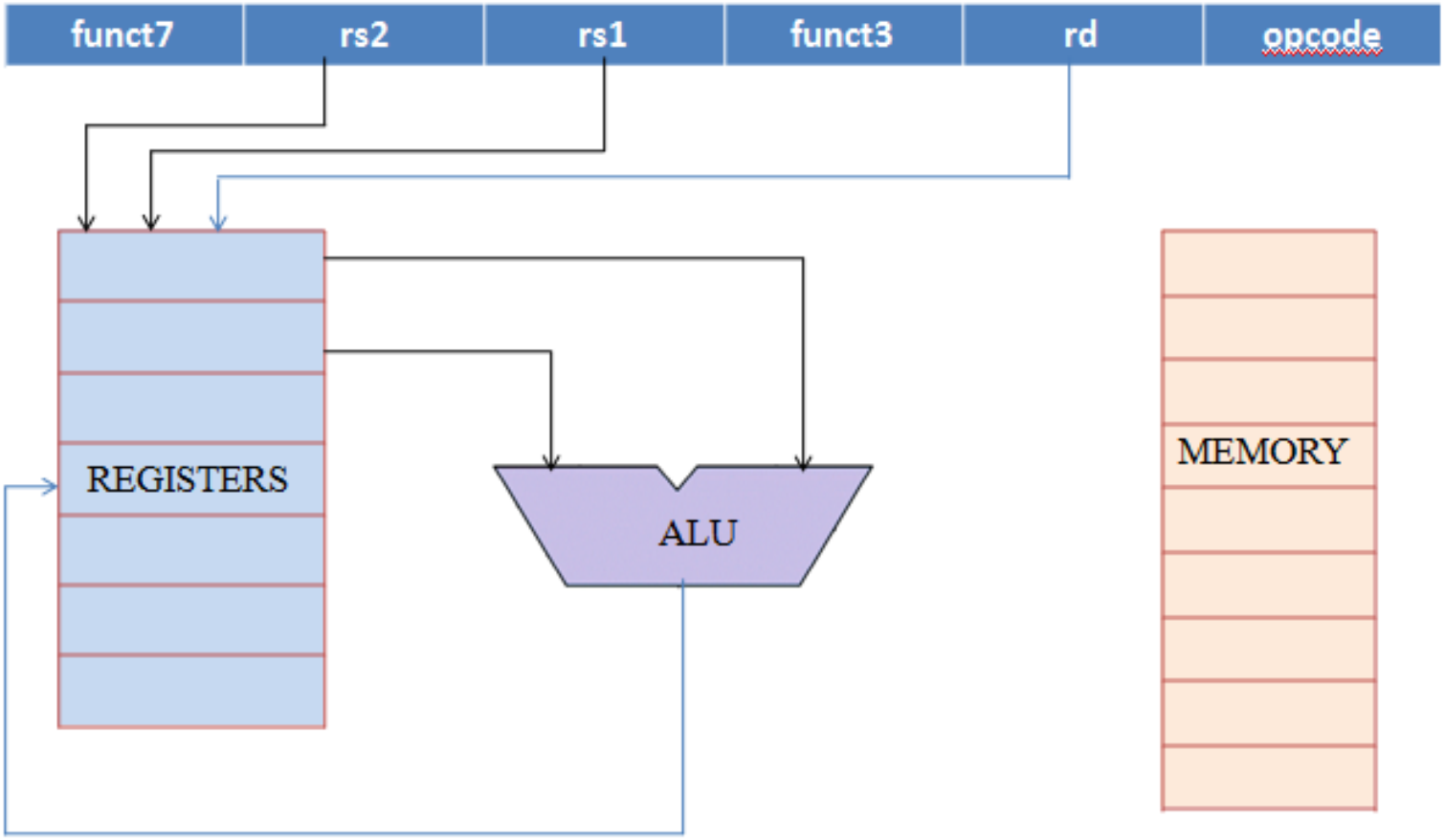
OR(OR Operation) R-FORMAT



funct7=0000000;funct3=110;opcode =0110011

AND (AND Operation)

R-FORMAT



funct7=0000000;funct3=111;opcode =0110011

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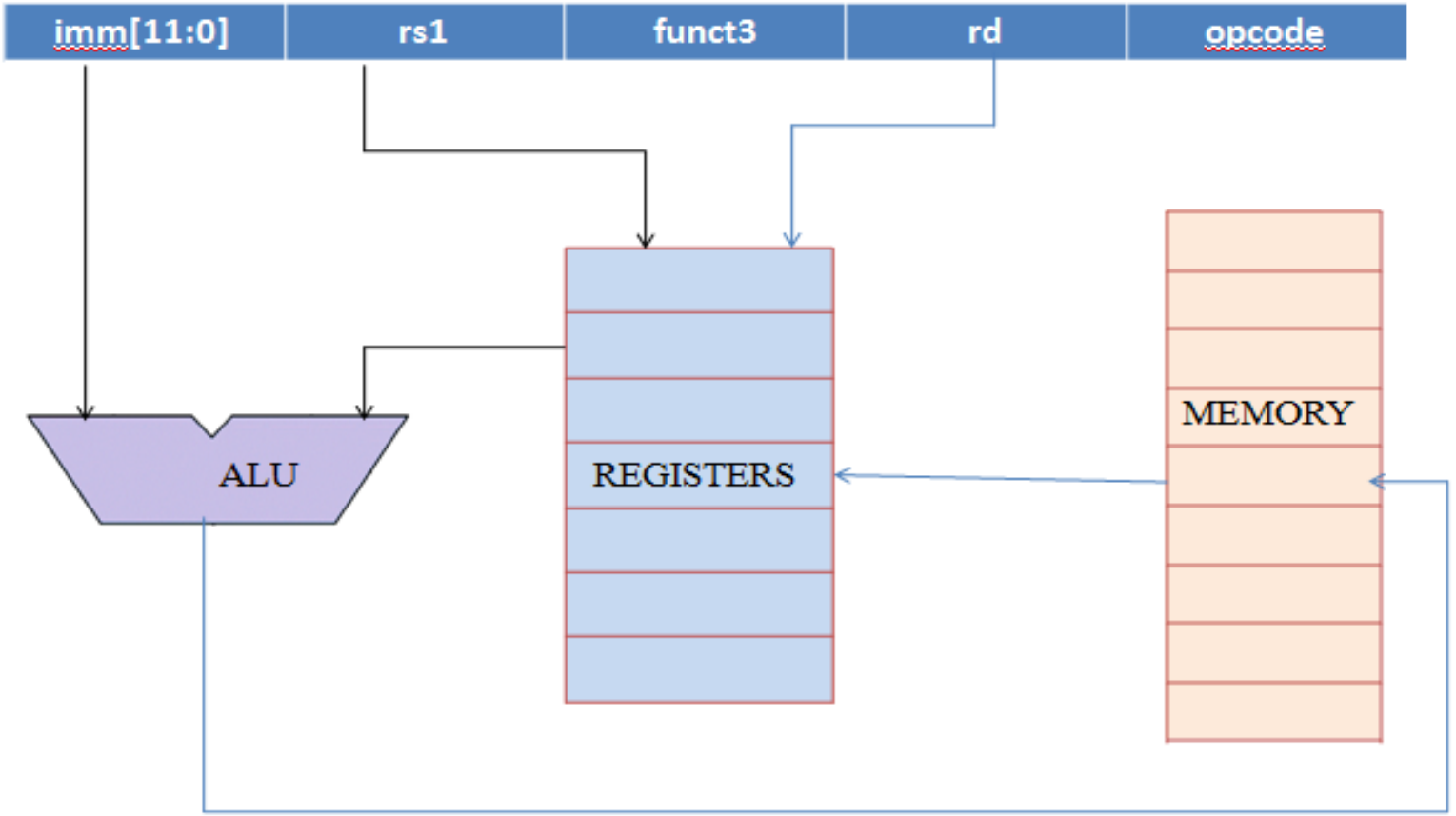
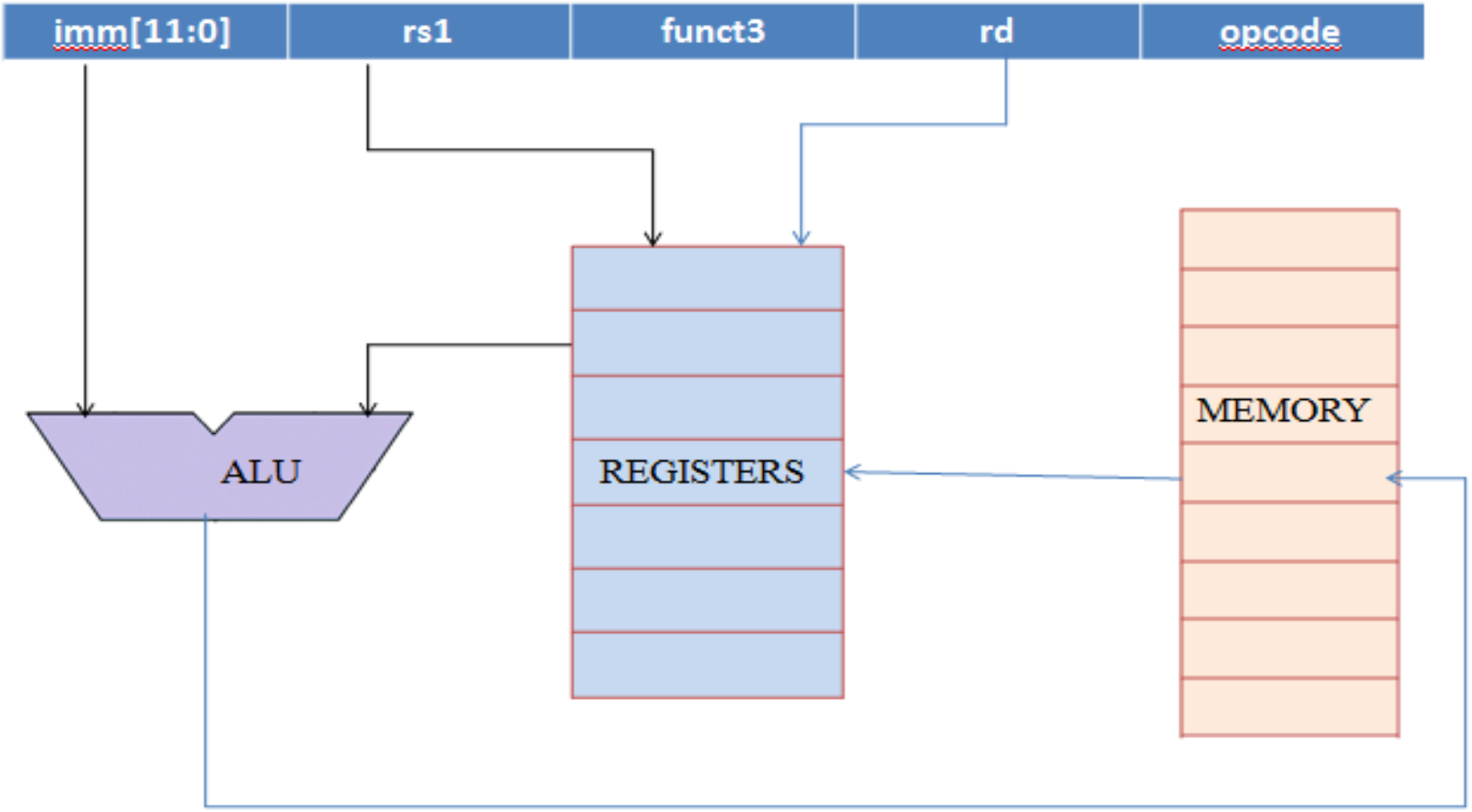
EXECUTION OF INSTRUCTIONS IN I-FORMAT

LB (Load Byte)



funct3=000;opcode =0000011

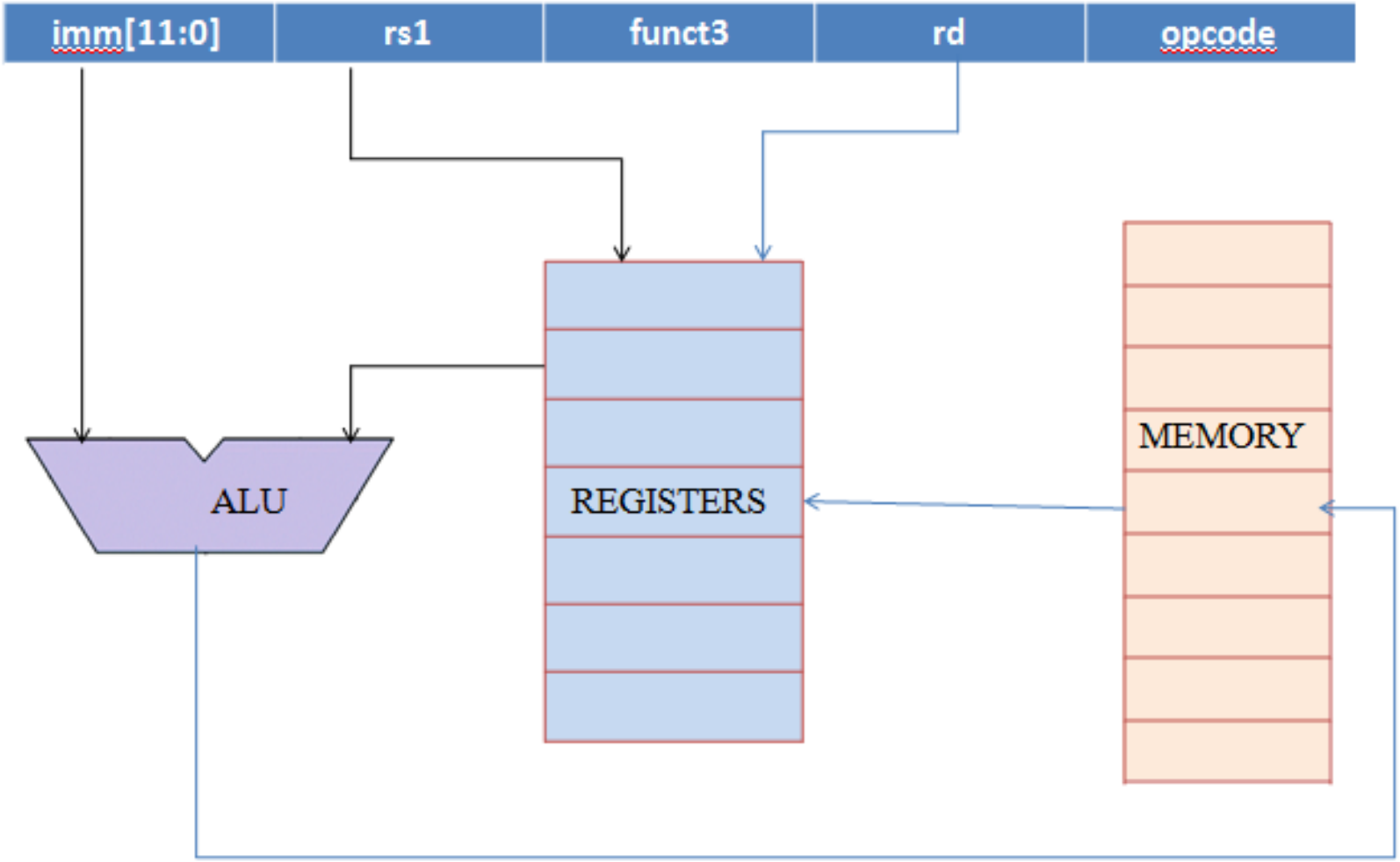
LH (Load Halfword) I-FORMAT



funct3=001;opcode =0000011

LW (Load Word)

I-FORMAT



funct3=010;opcode =0000011

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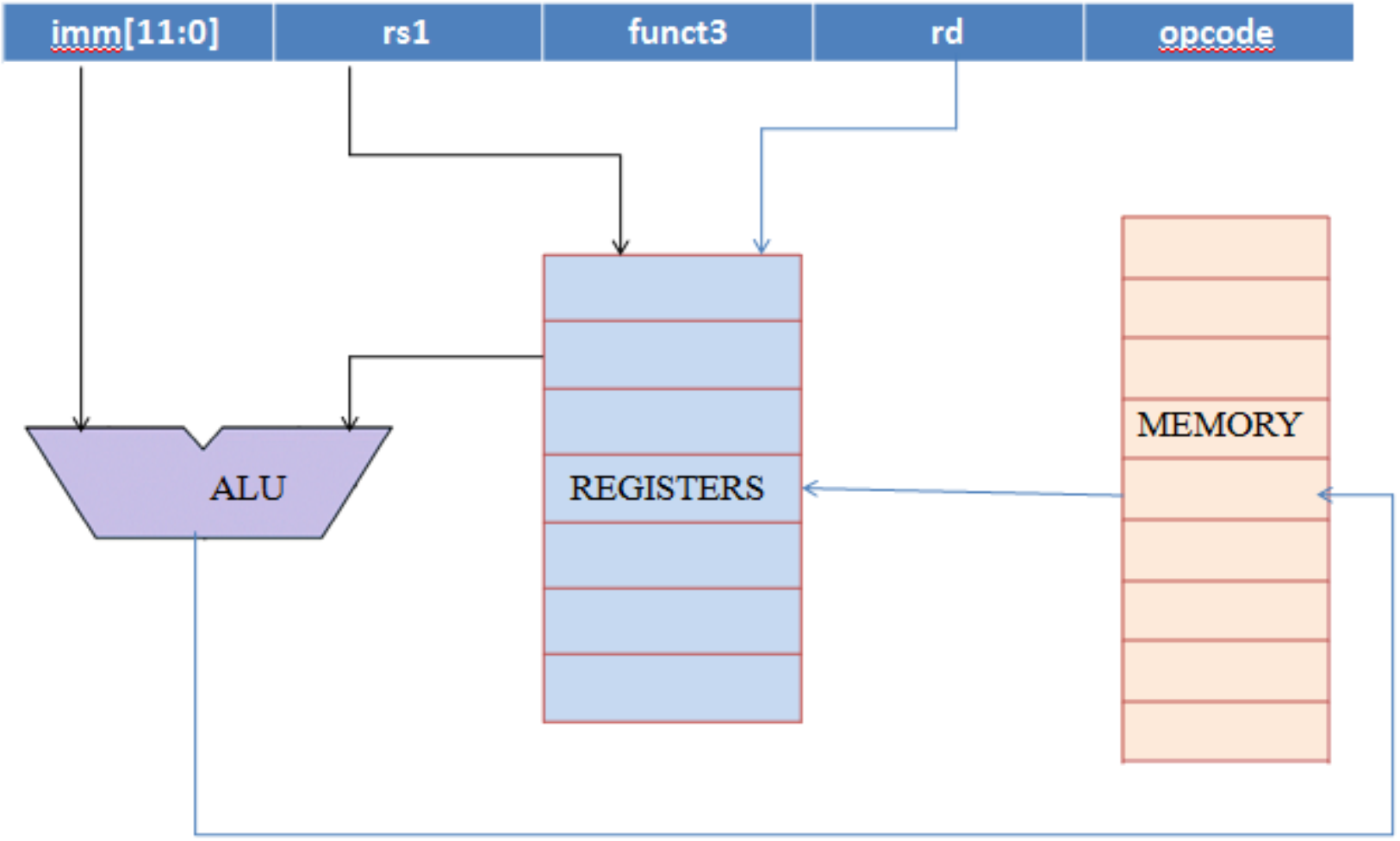
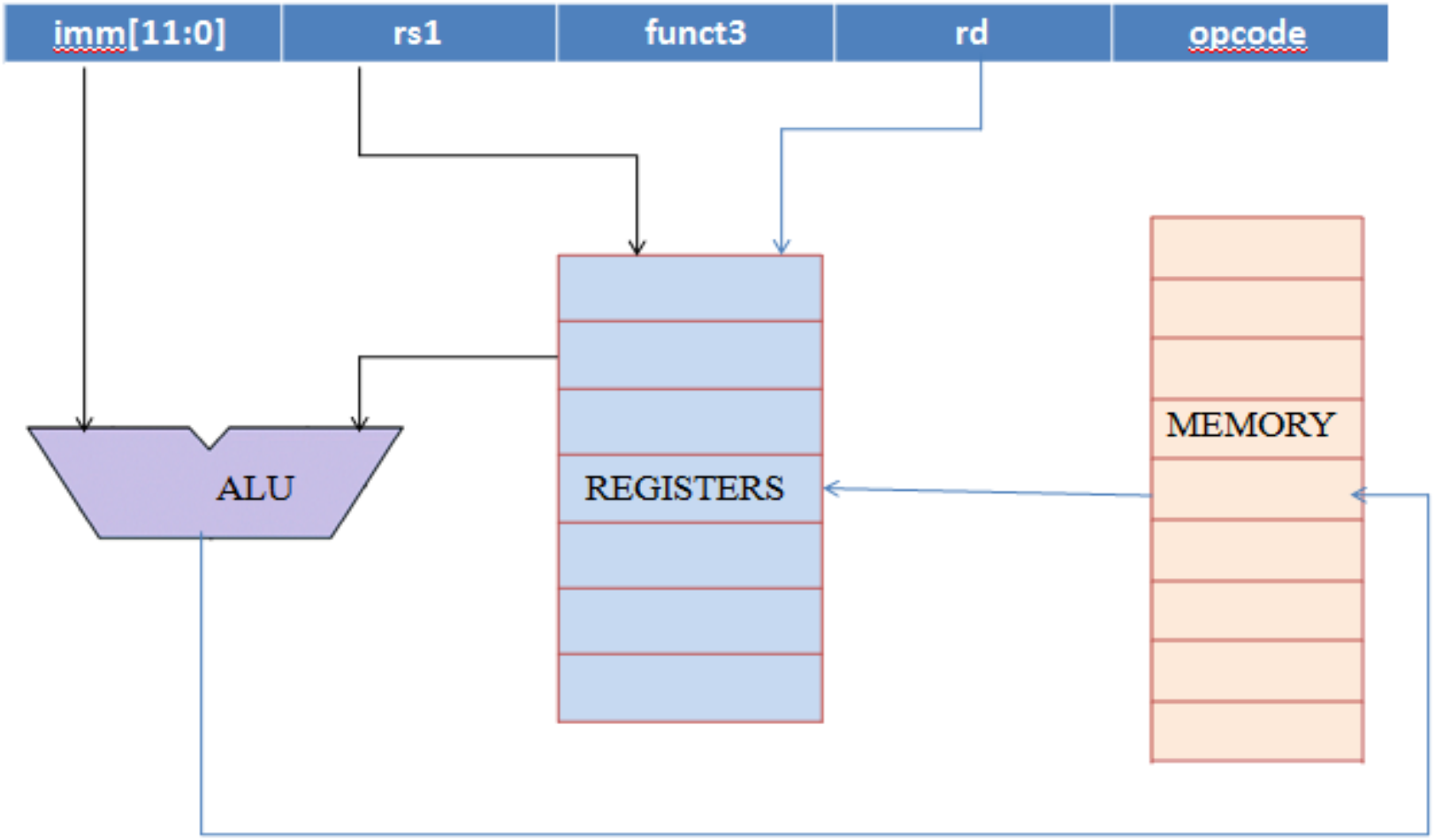
LBU(Load Byte Unsigned) I-FORMAT



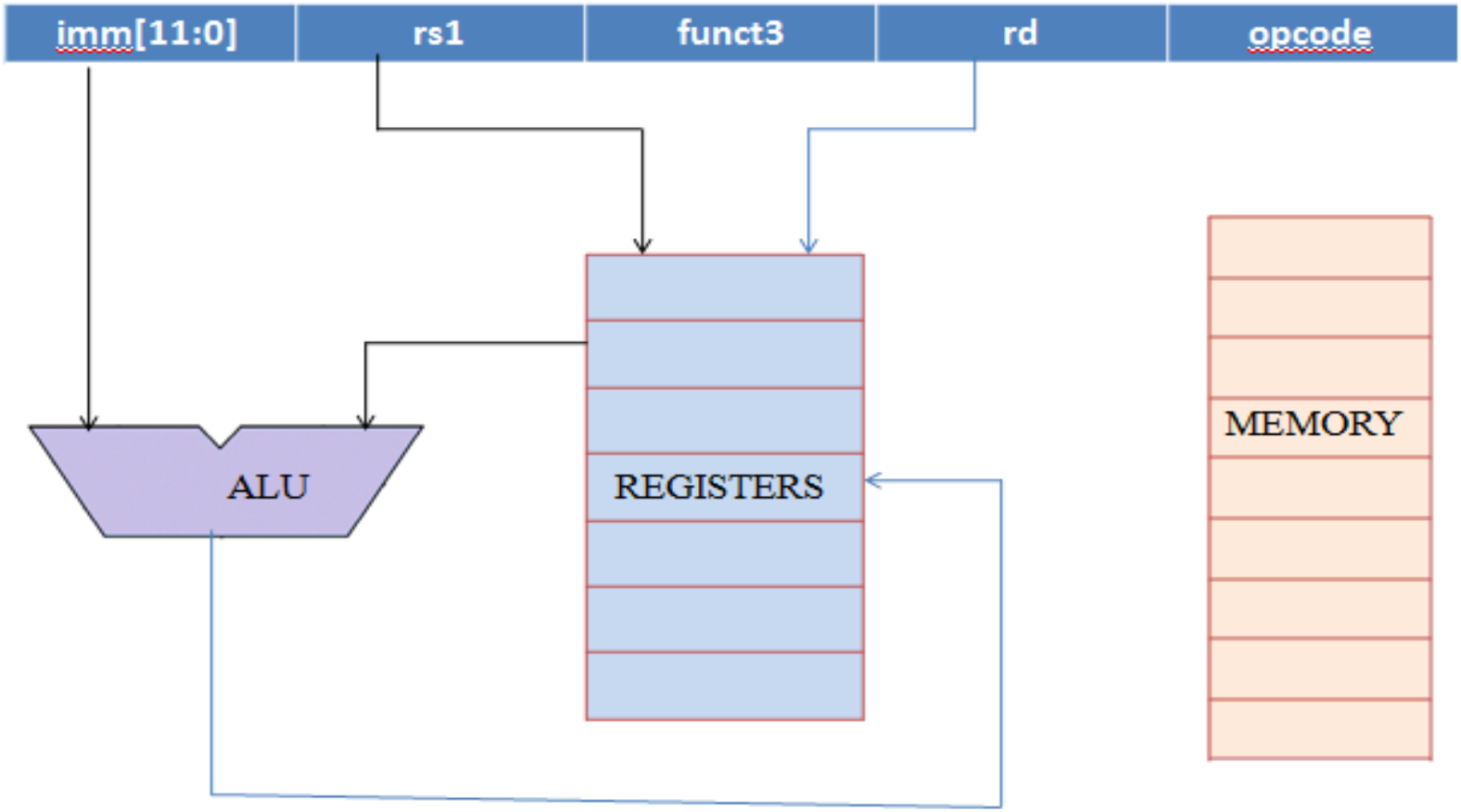
funct3=100;opcode =0000011

LHU(Load Halfword Unsigned) I-FORMAT



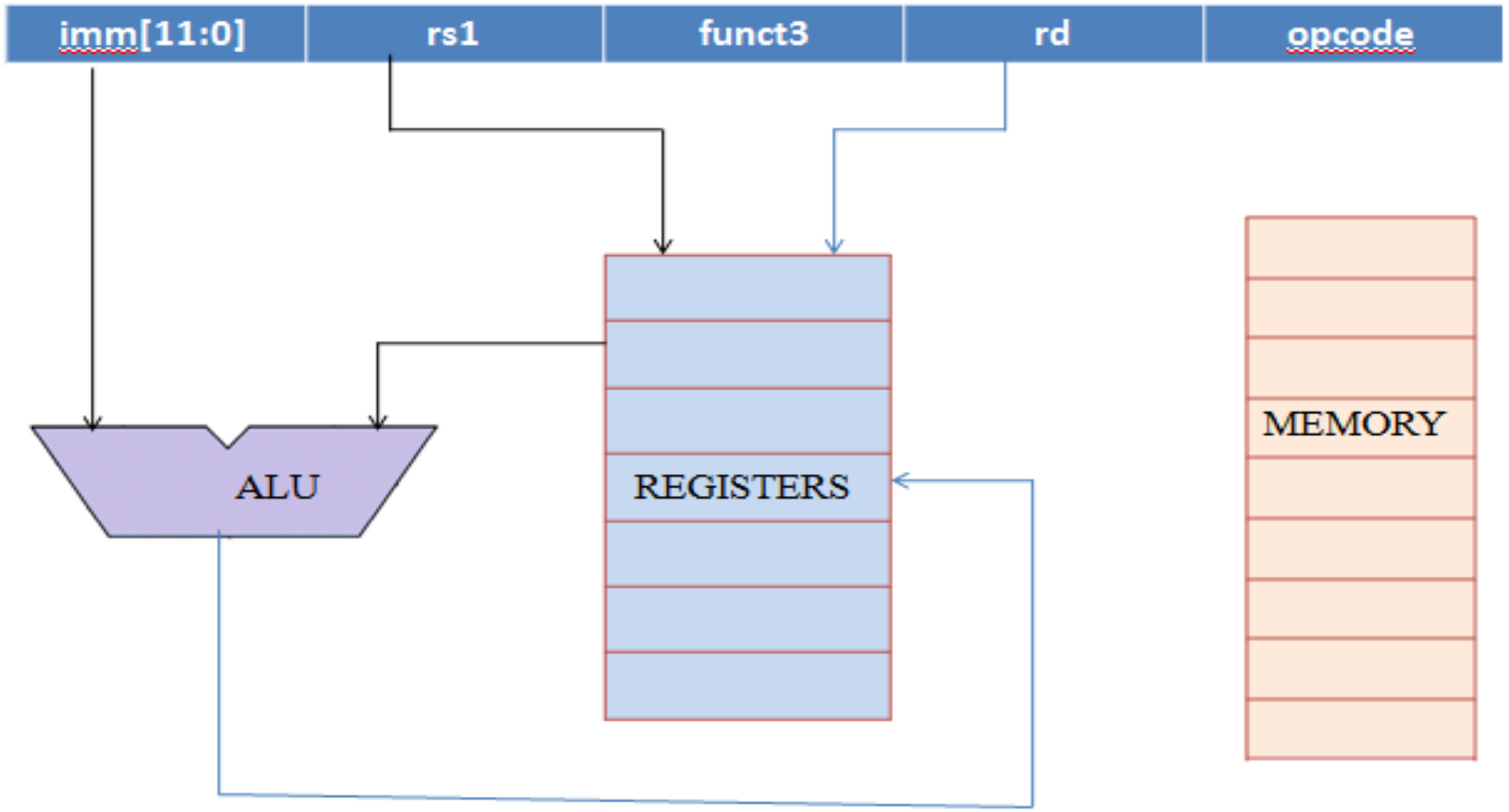
funct3=101;opcode =0000011

ADDI (Addition Immediate) I-FORMAT



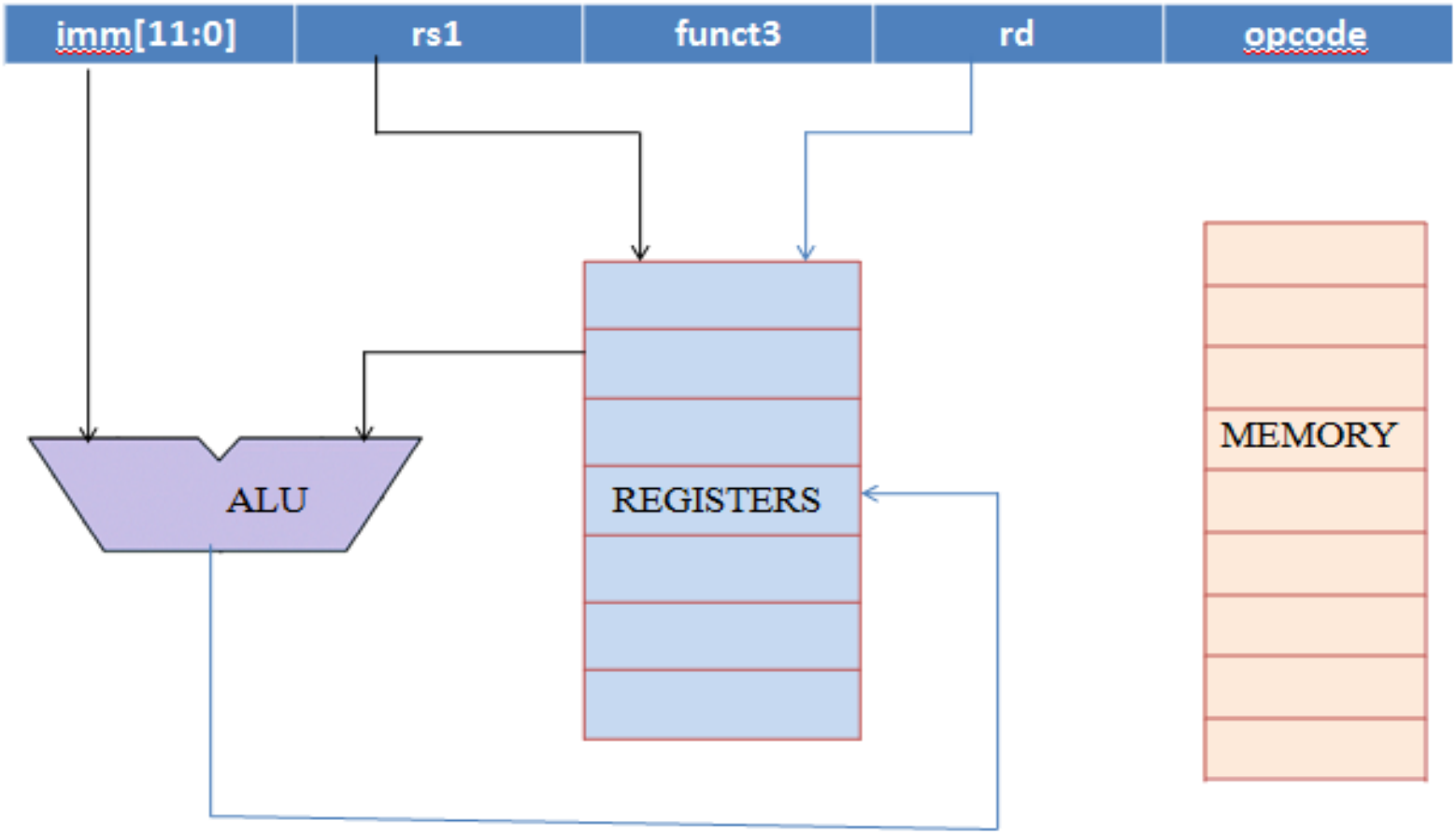
funct3=000;opcode =0010011

SLTI(Set Less Than Immediate) I-FORMAT



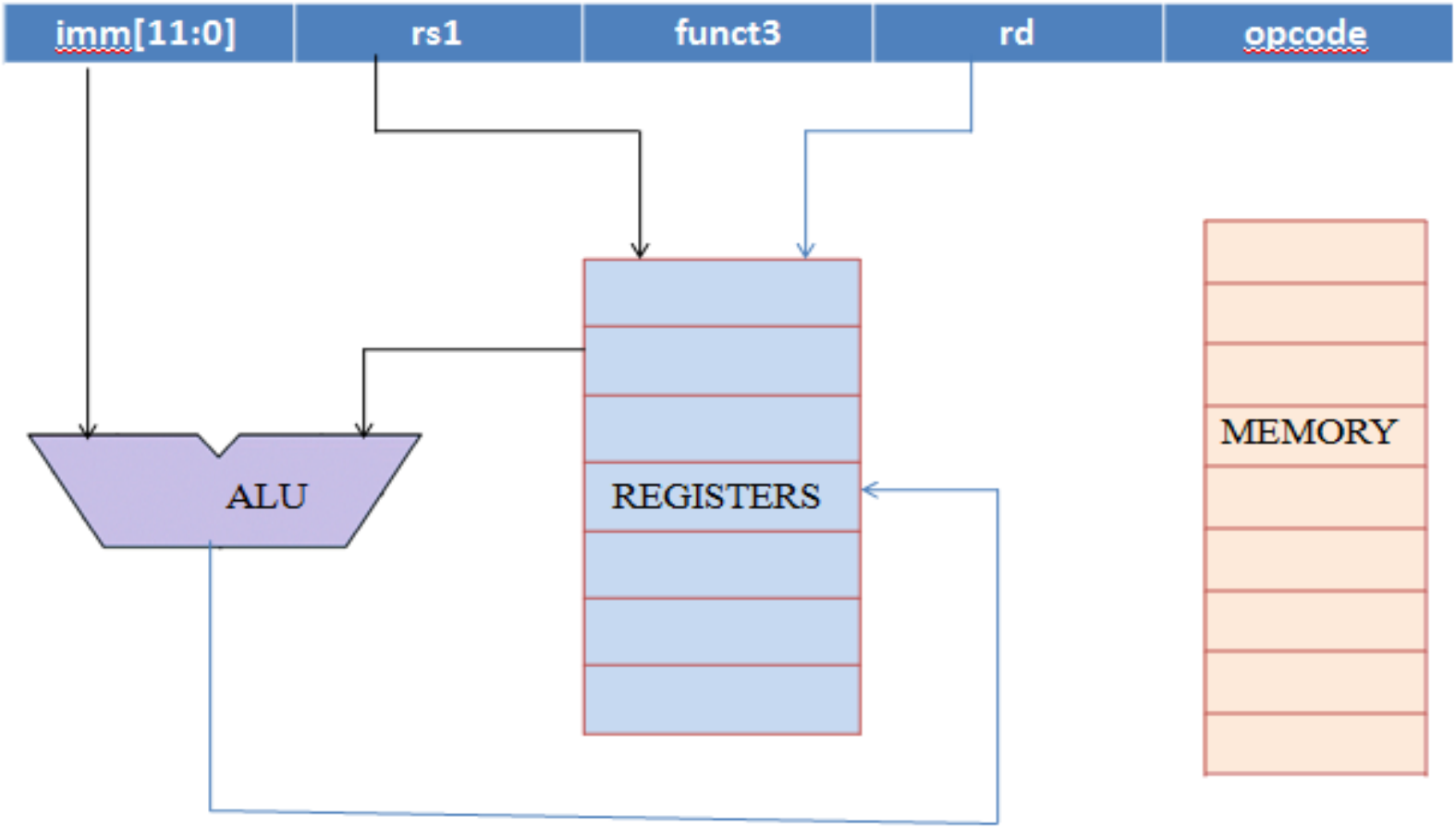
funct3=010;opcode =0010011

SLTIU(Set Less Than Immediate Unsigned) I-FORMAT



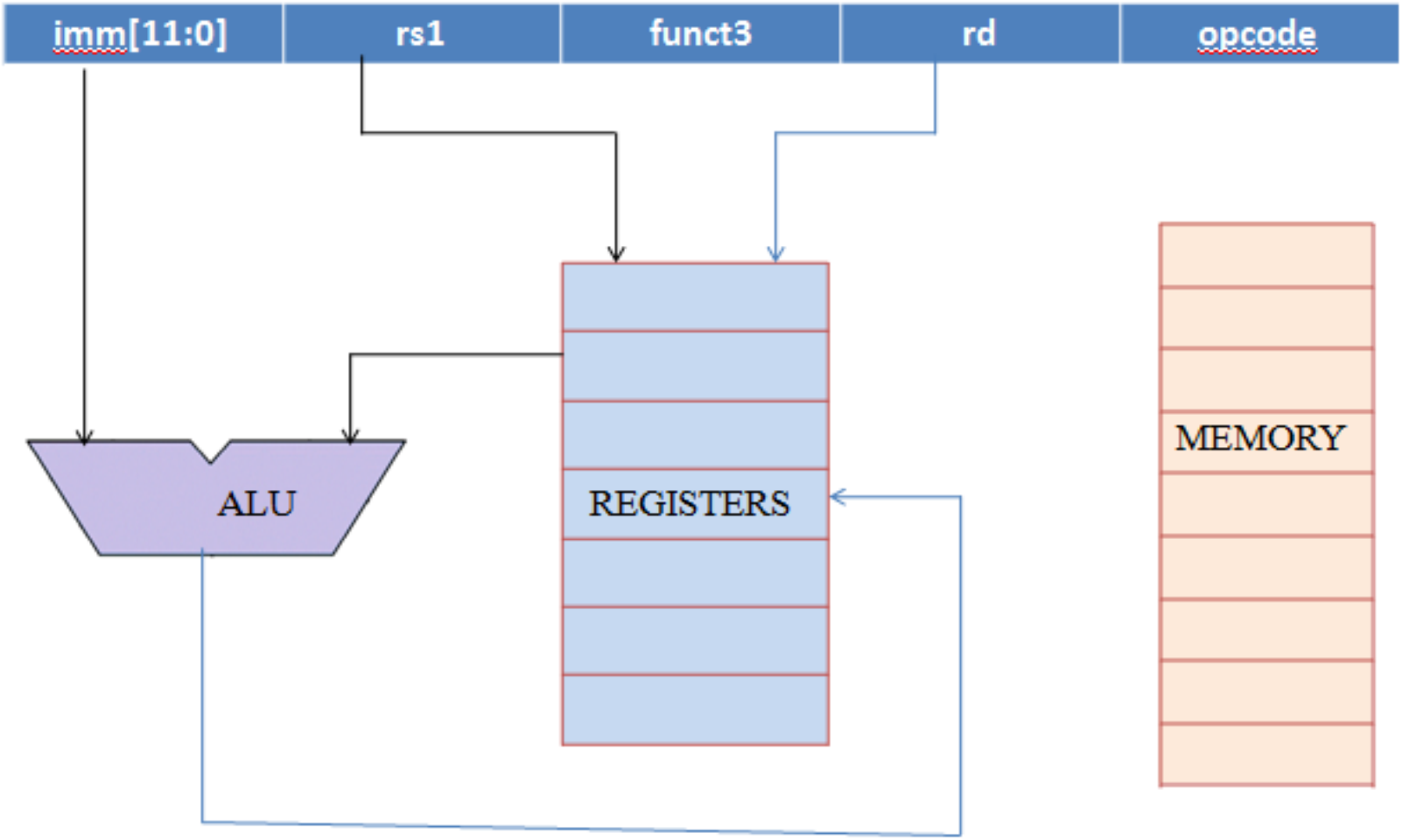
funct3=011;opcode =0010011

XORI(XOR Immediate) I-FORMAT



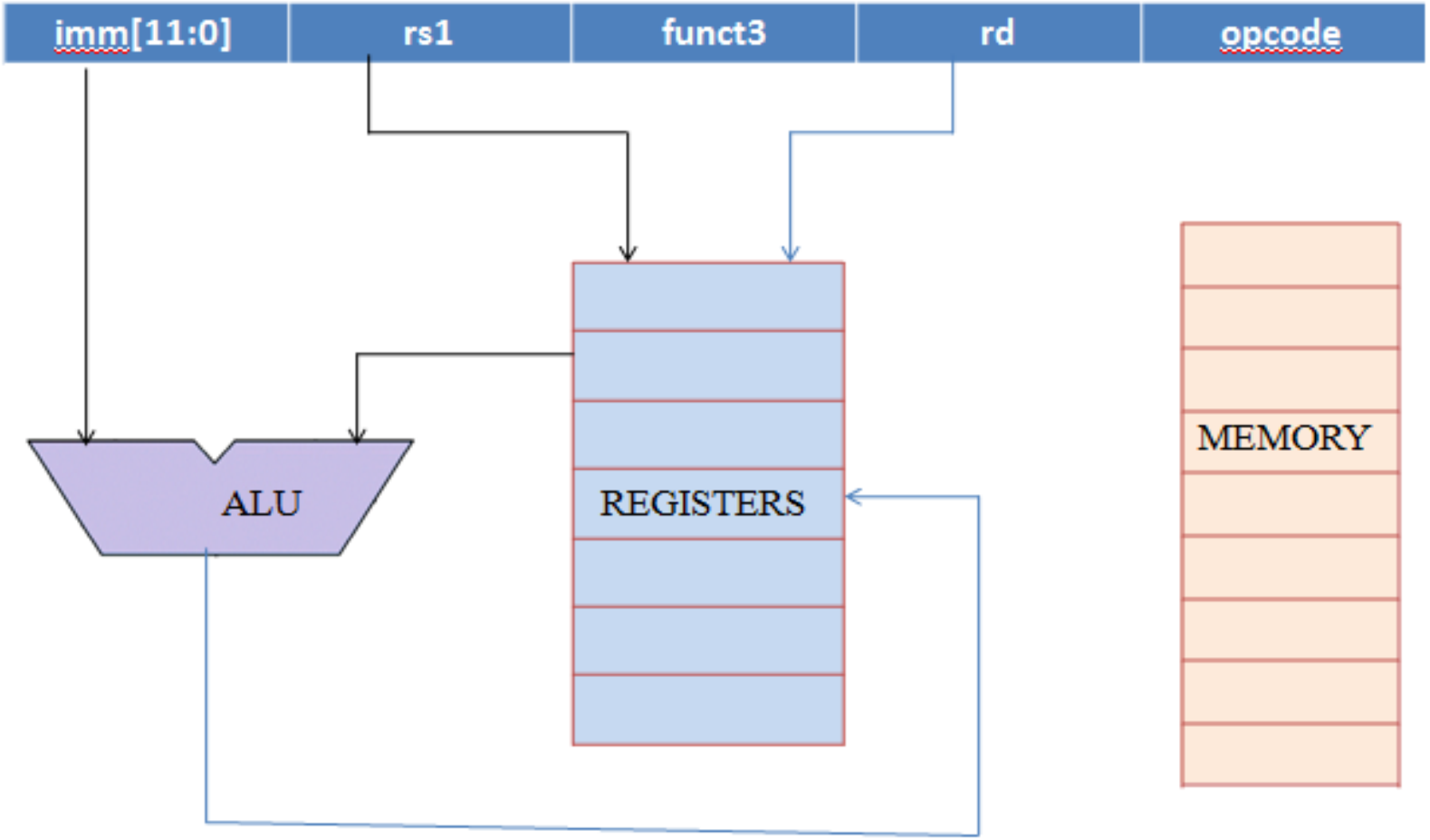
funct3=100;opcode =0010011

ORI (OR Immediate) I-FORMAT



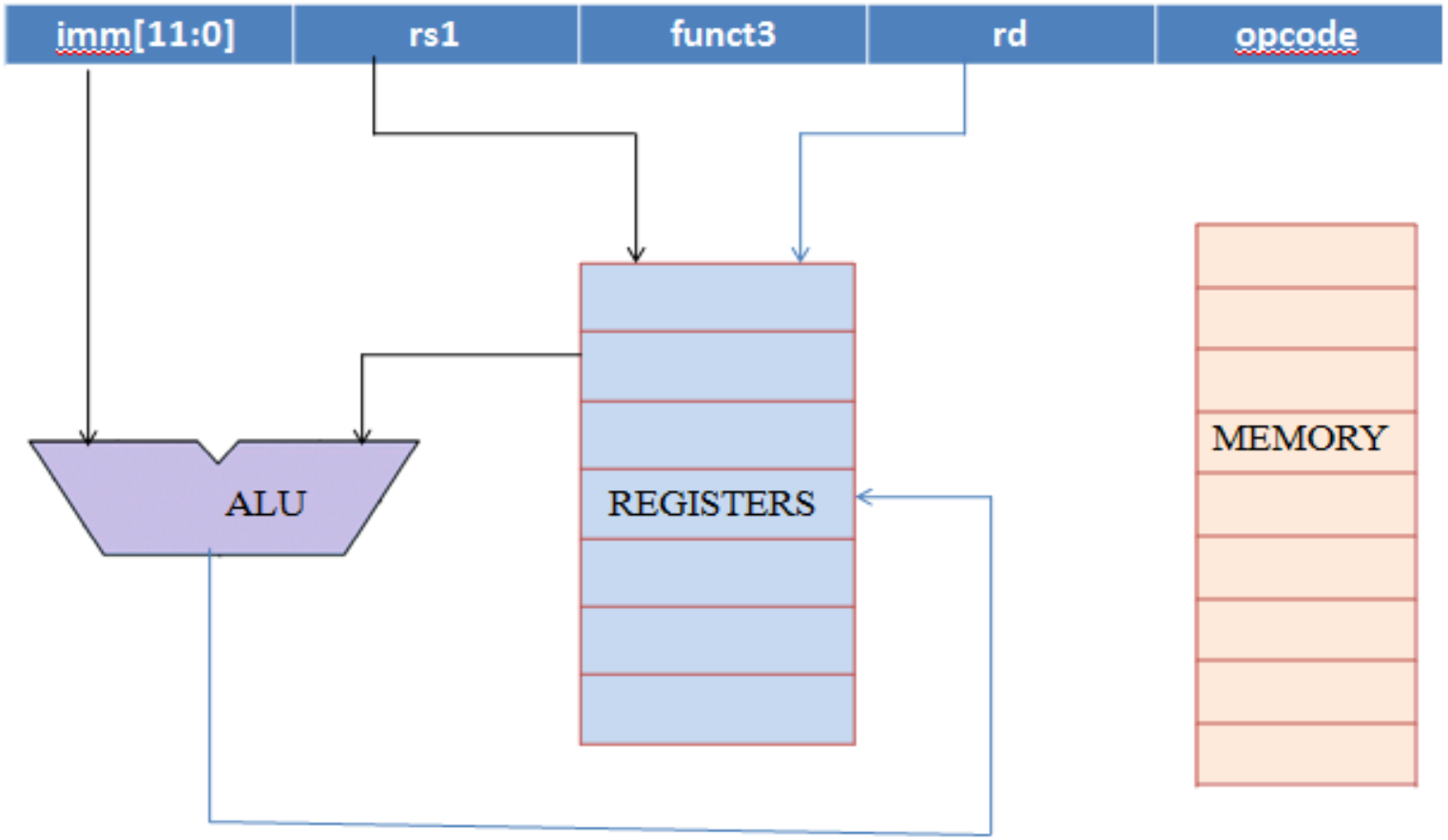
funct3=110;opcode =0010011

ANDI (AND Immediate) I-FORMAT



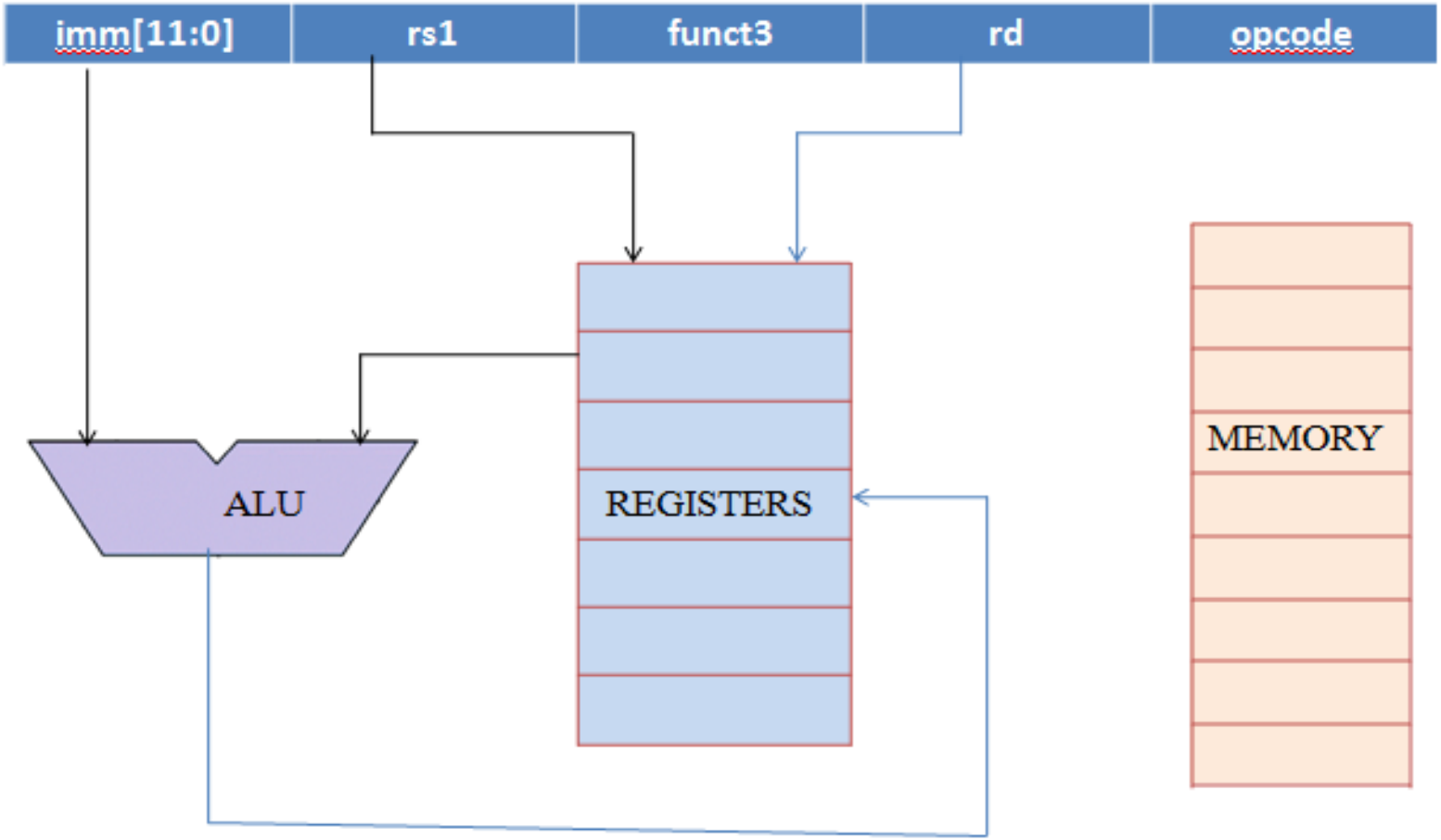
funct3=111;opcode =0010011

SLLI(Logical Left Shift With Immediate) I-FORMAT



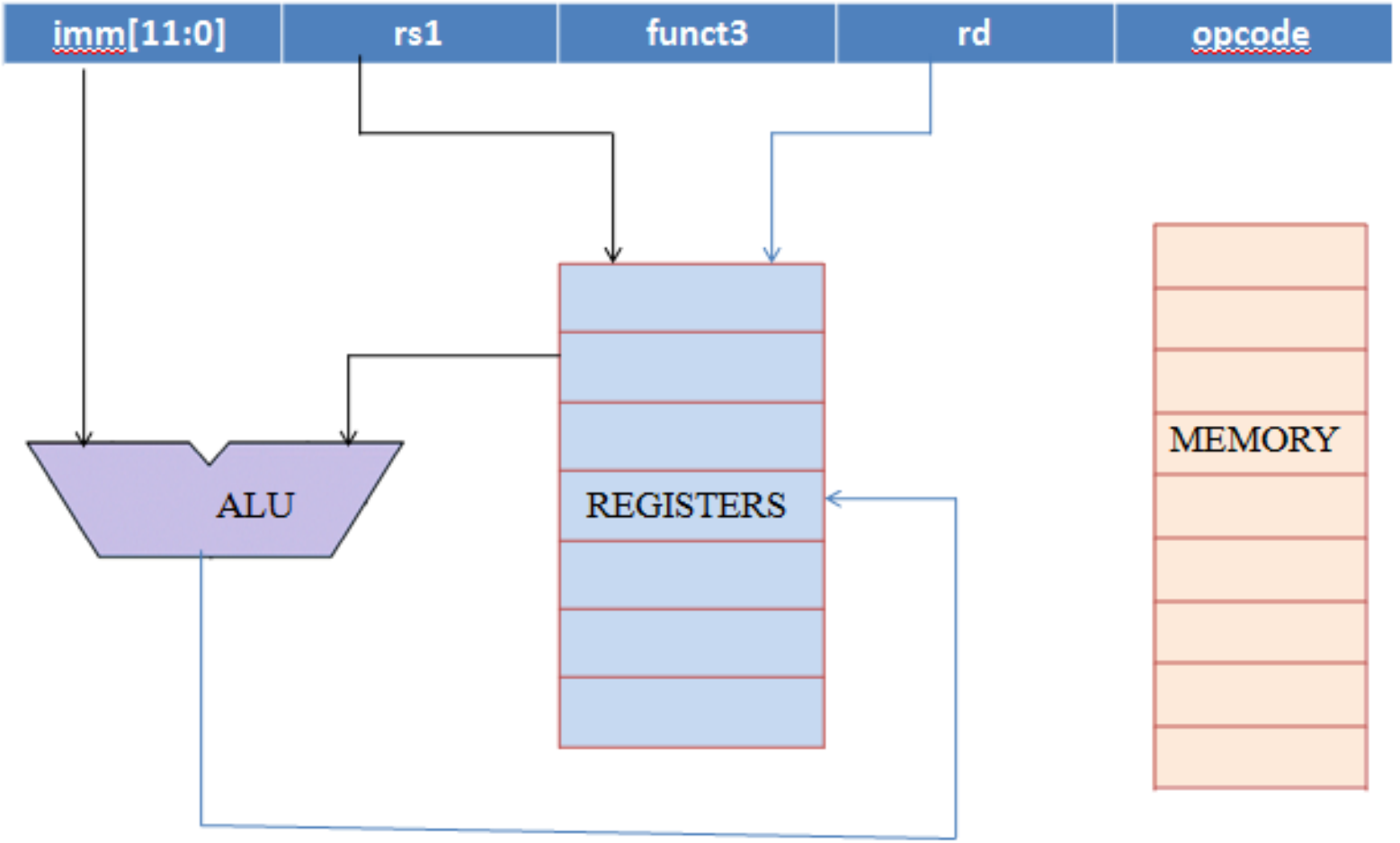
imm[11:5]=0000000; funct3=001;opcode =0010011

SRLI (Logical Right Shift with Immediate) I-FORMAT



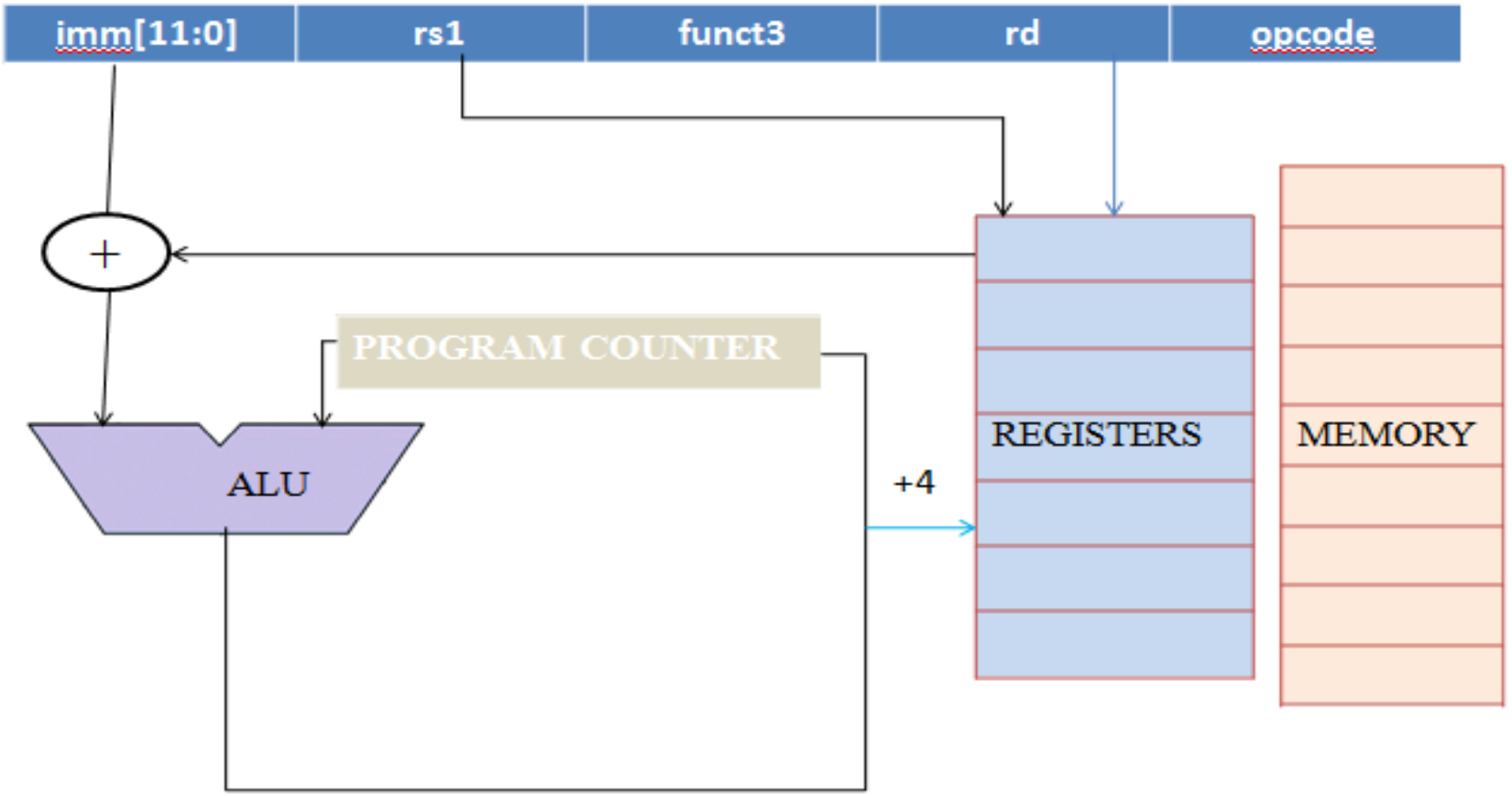
imm[11:5]=0000000; funct3=101;opcode =0010011

SRAI (Arithmetic Right Shift with Immediate) I-FORMAT



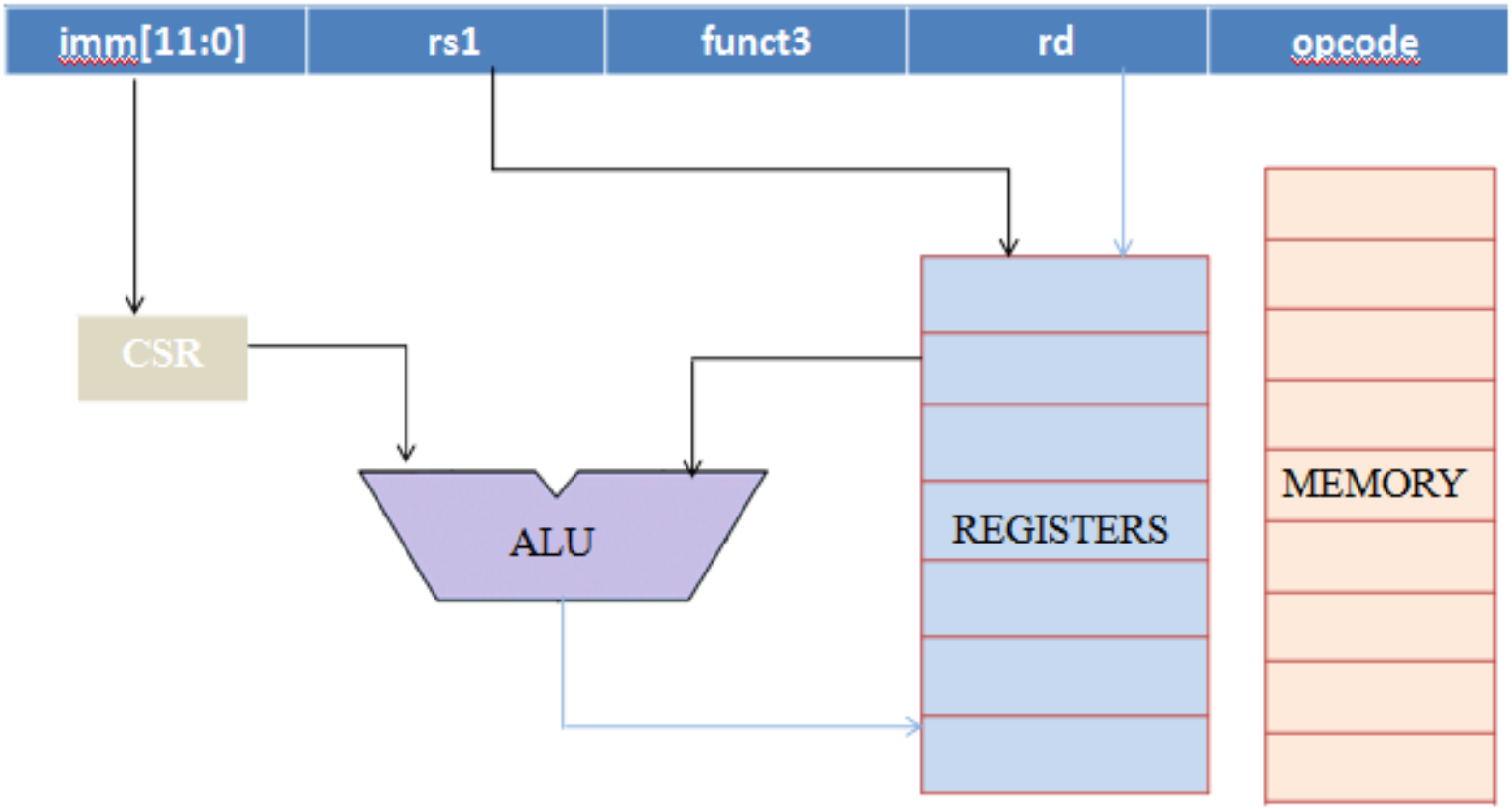
imm[11:5]=0100000; funct3=101;opcode =0010011

JALR(Jump And Link Register) I-FORMAT



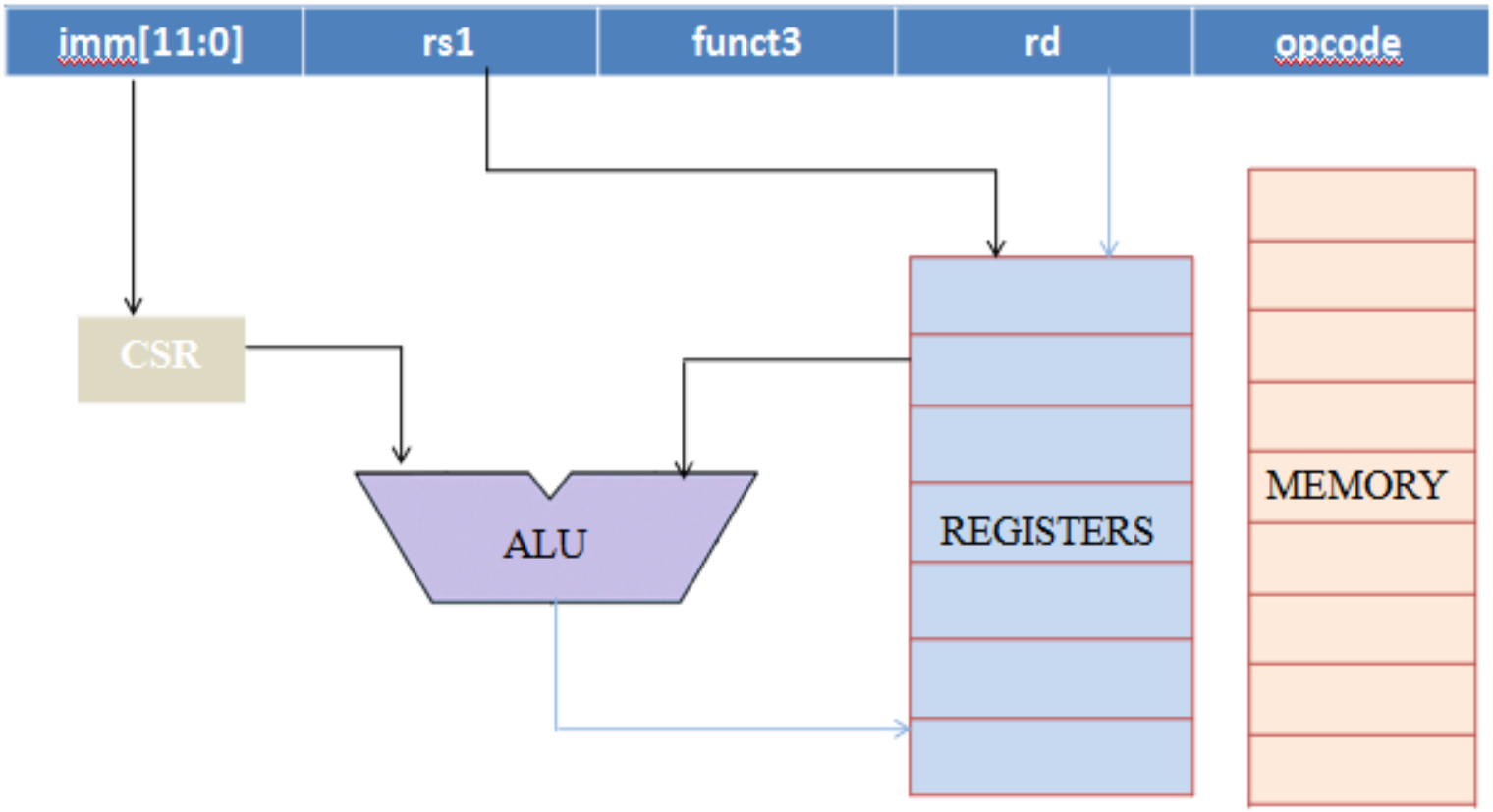
funct3=000;opcode =1100111

CSRRW (Atomic Read Write CSR) I-FORMAT



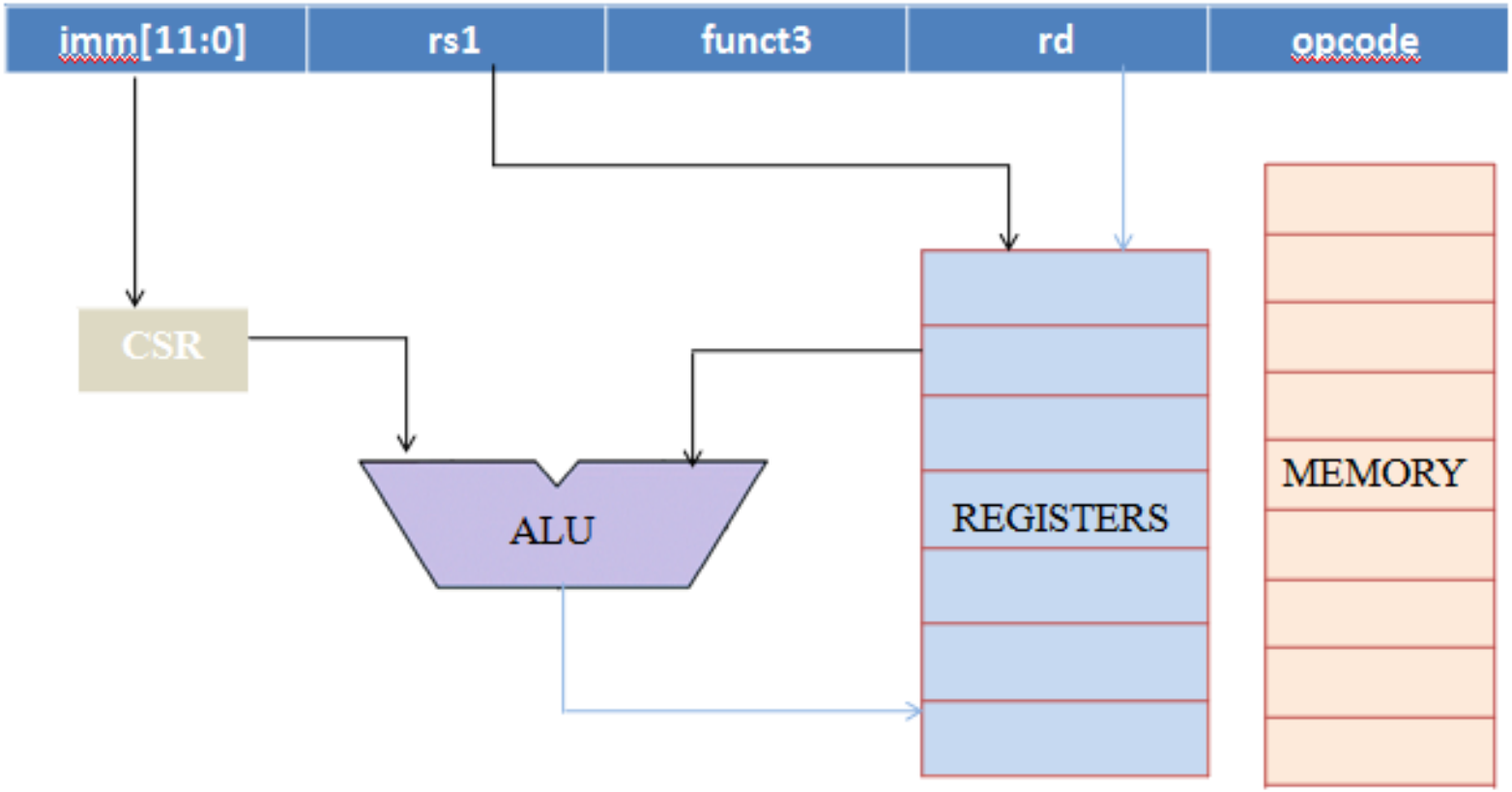
opcode = 1110011; funct3 = 001

CSRRS (Atomic Read Write Set Bit) I-FORMAT



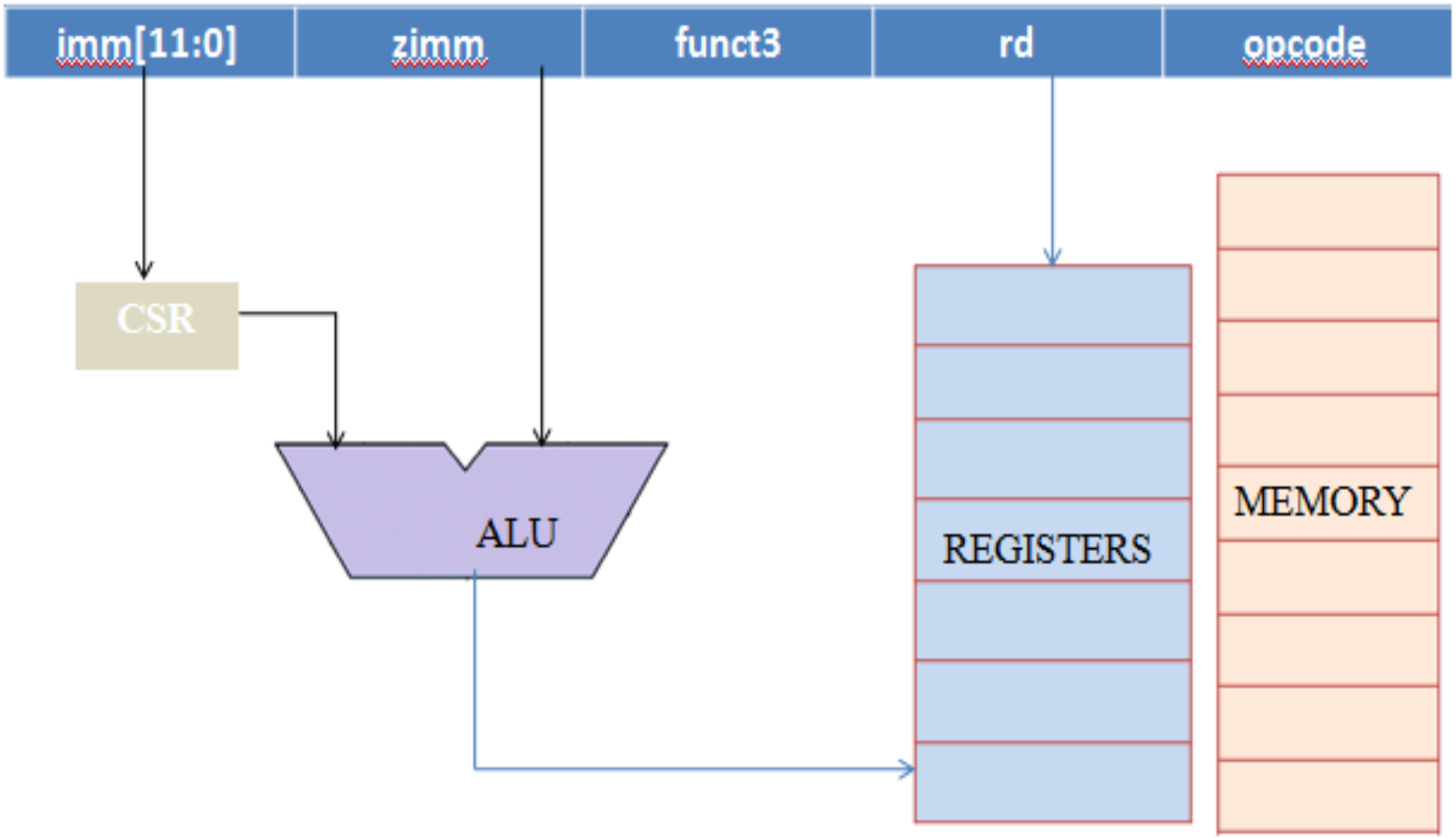
opcode = 1110011; funct3 = 010

CSRRC(Atomic Read Write Clear Bit) I-FORMAT



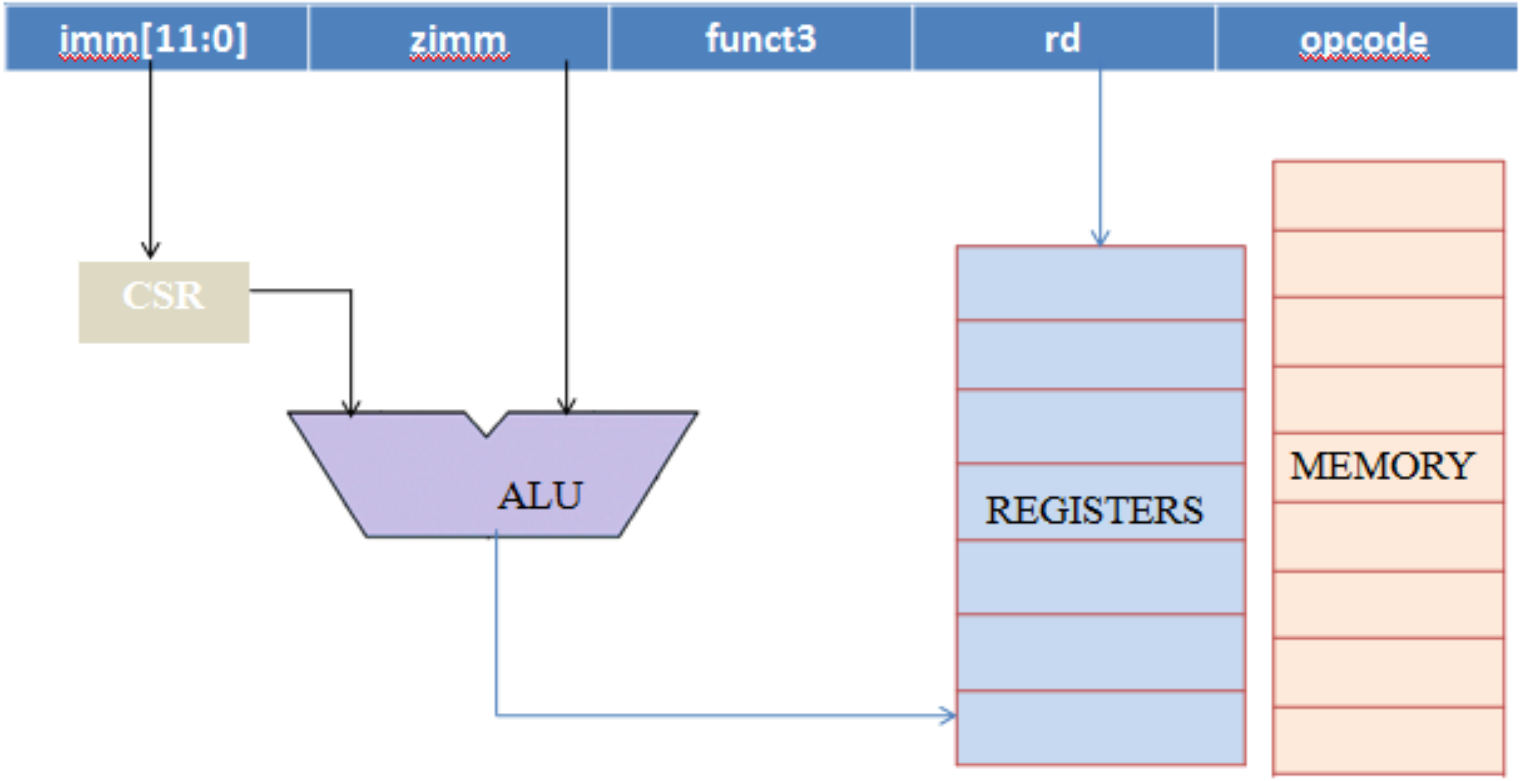
opcode = 1110011; funct3 = 011

CSRRWI (Atomic Read Write With Immediate) I-FORMAT



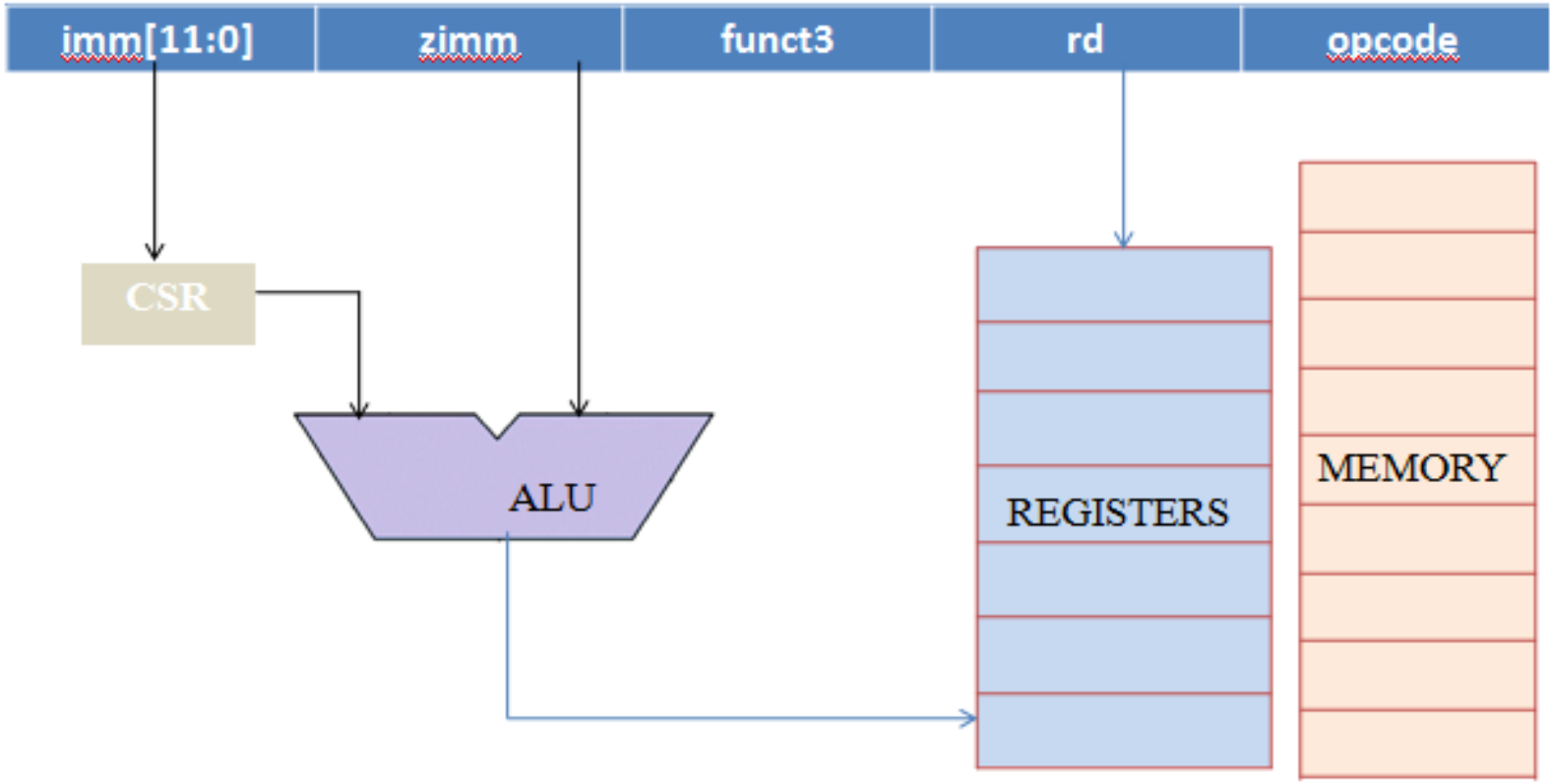
opcode = 1110011;funct3 = 101

CSRRSI(Atomic Read Write Set Bit with Immediate) I-FORMAT



opcode = 1110011;funct3 = 110

CSRRCI (Atomic Read Write Clear Bit with Immediate) I-FORMAT



opcode = 1110011;funct3 = 111

I- FORMAT

imm[11:0]	rs1	funct3	rd	opcode

ECALL – Transfer control to the operating system

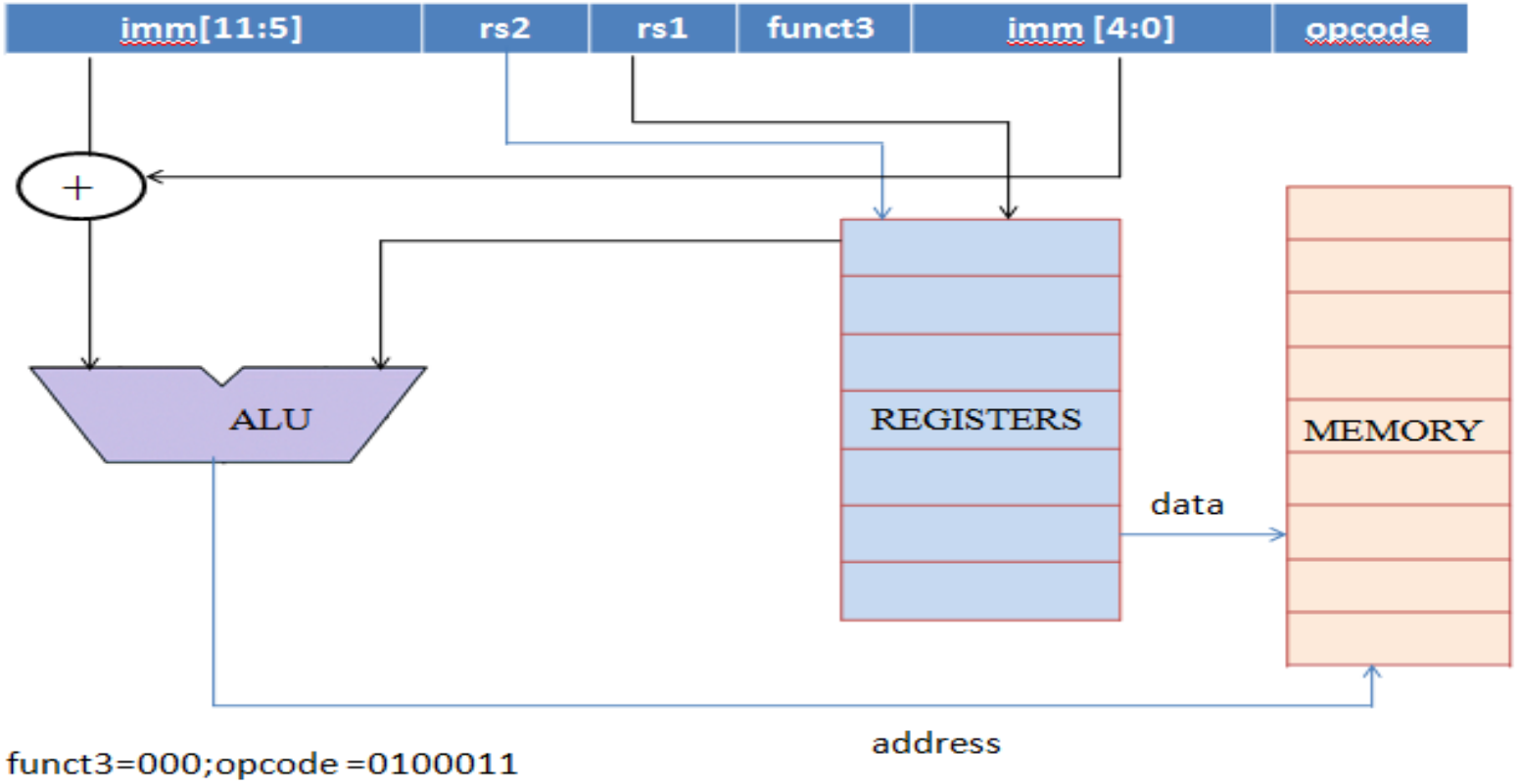
EBREAK – Transfer control to the debugger

FENCE – Synchronizes thread

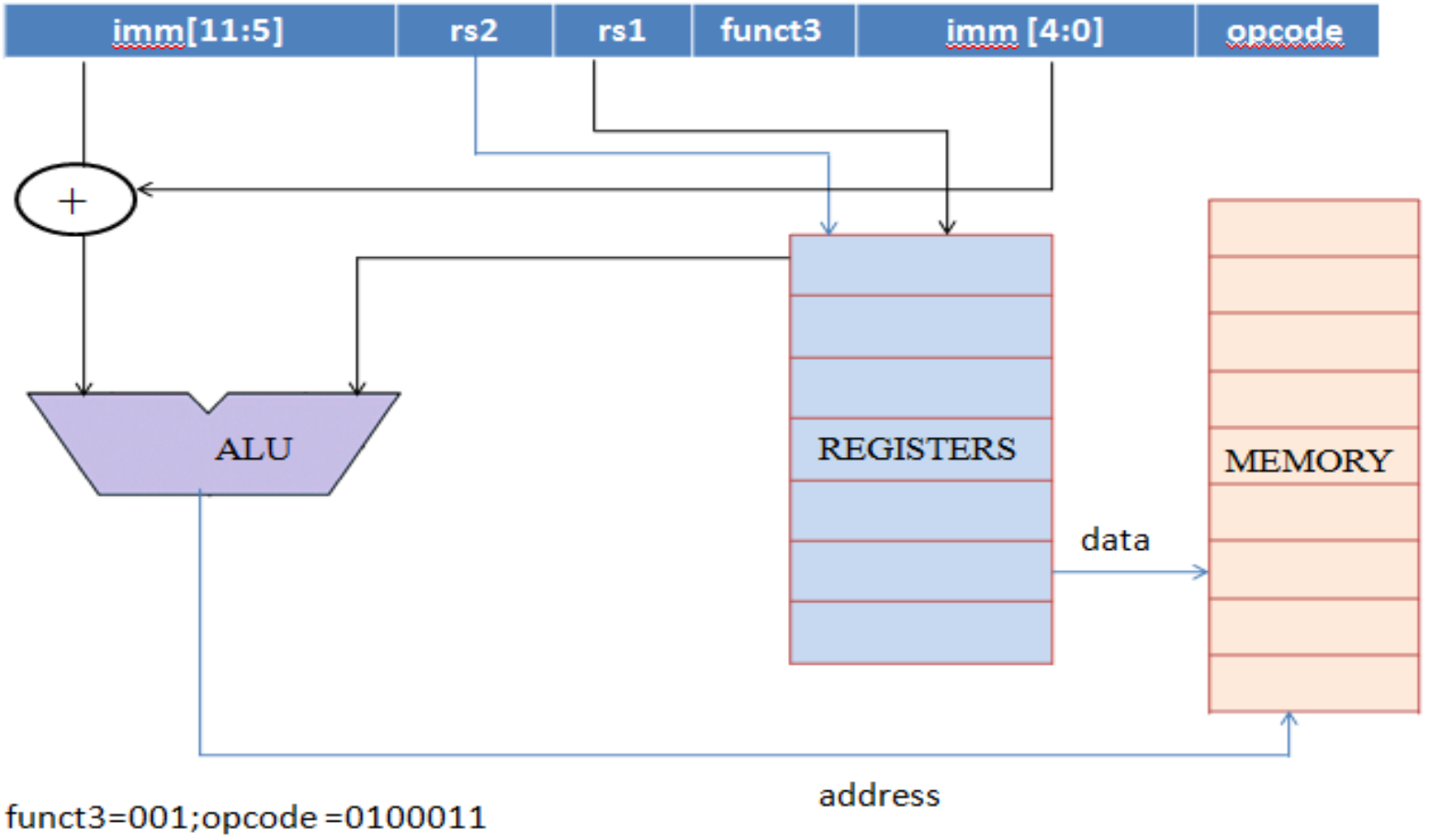
FENCE.I- Synchronizes write to the instruction stream.

EXECUTION OF INSTRUCTIONS IN S-FORMAT

SB (Store Byte)



SH (Store Halfword) S-FORMAT



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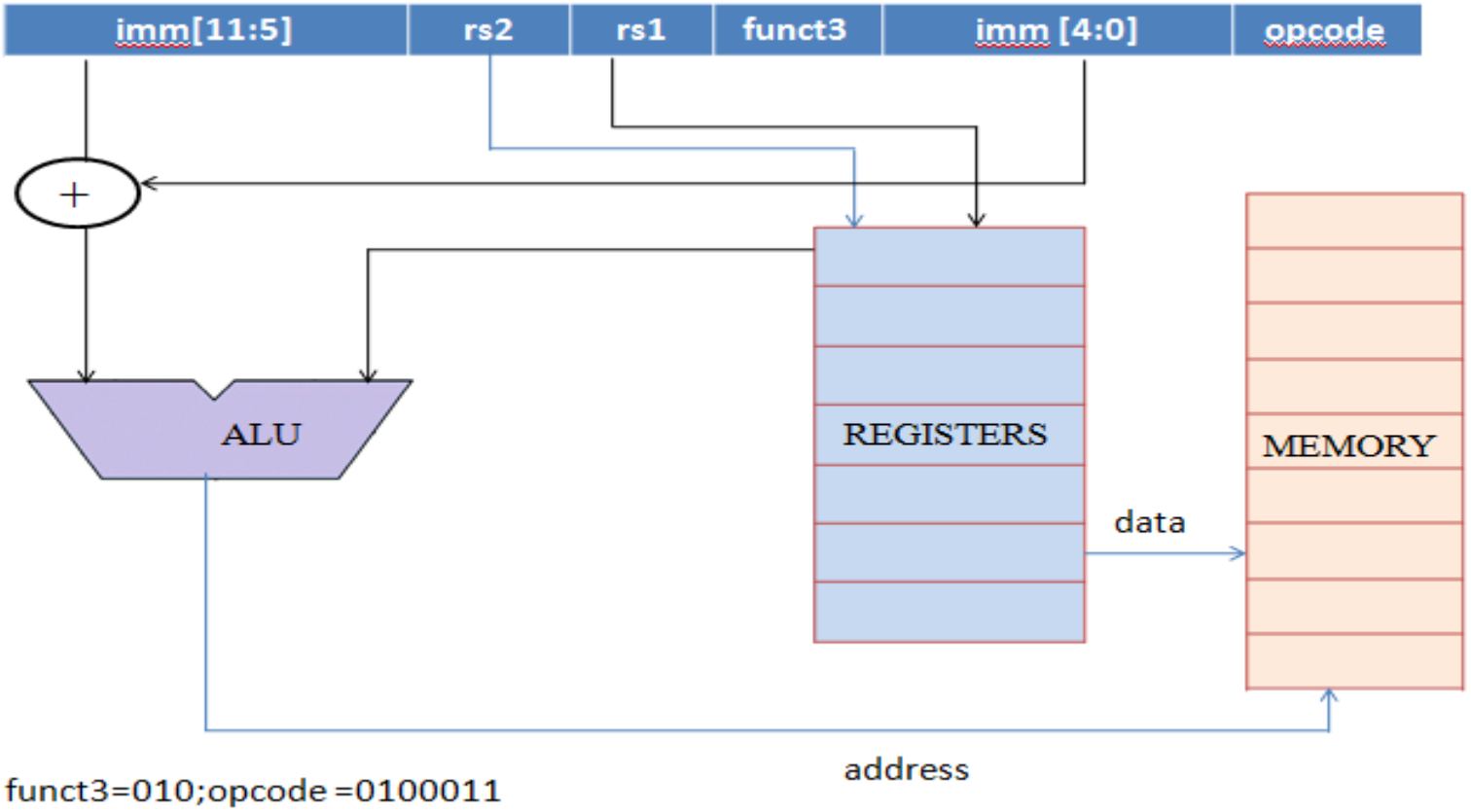
SW (Store Word) S-FORMAT



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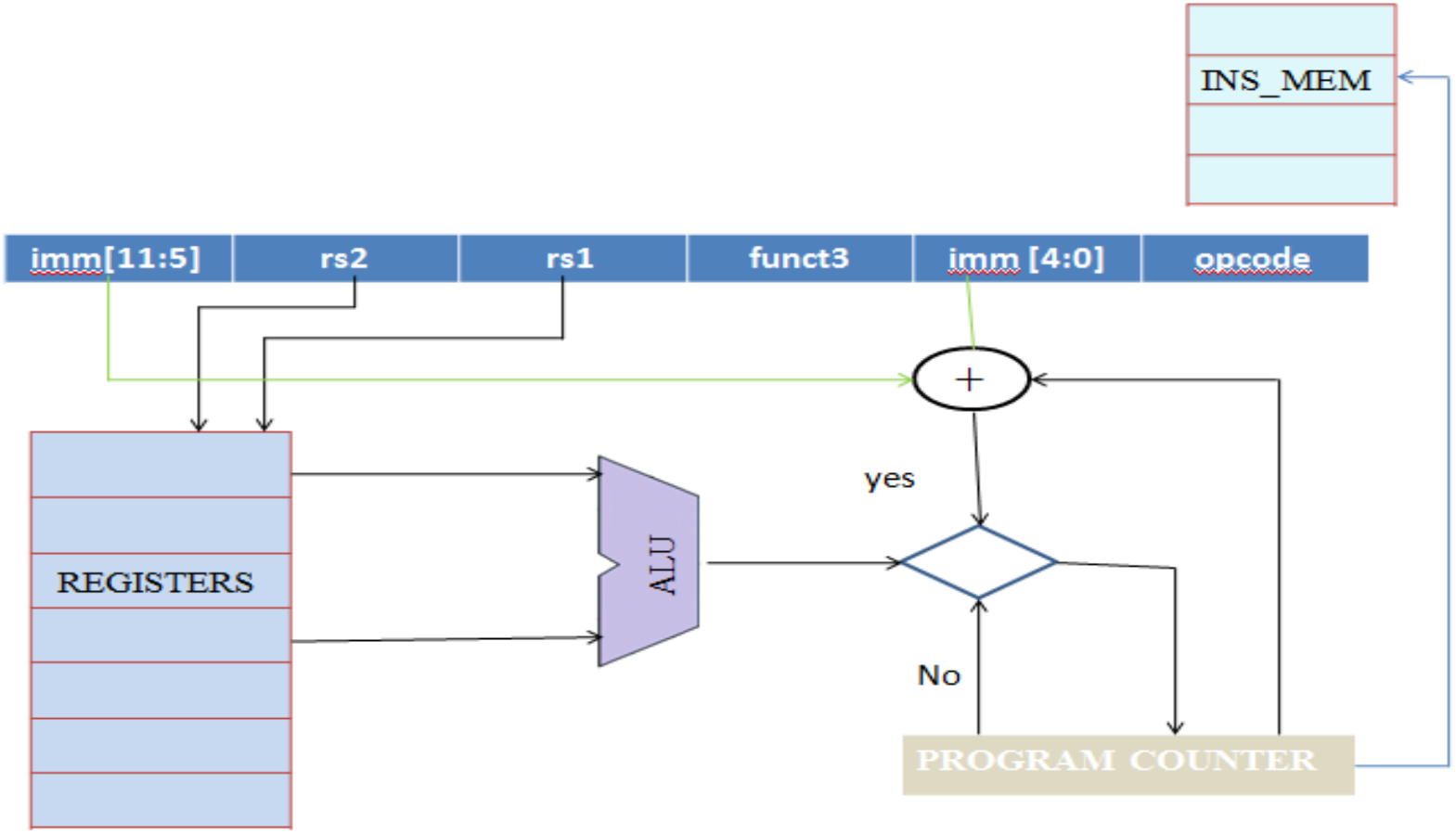
EXECUTION OF INSTRUCTION IN B-FORMAT

BEQ (Branch Equality)



funct3=000;opcode =1100011

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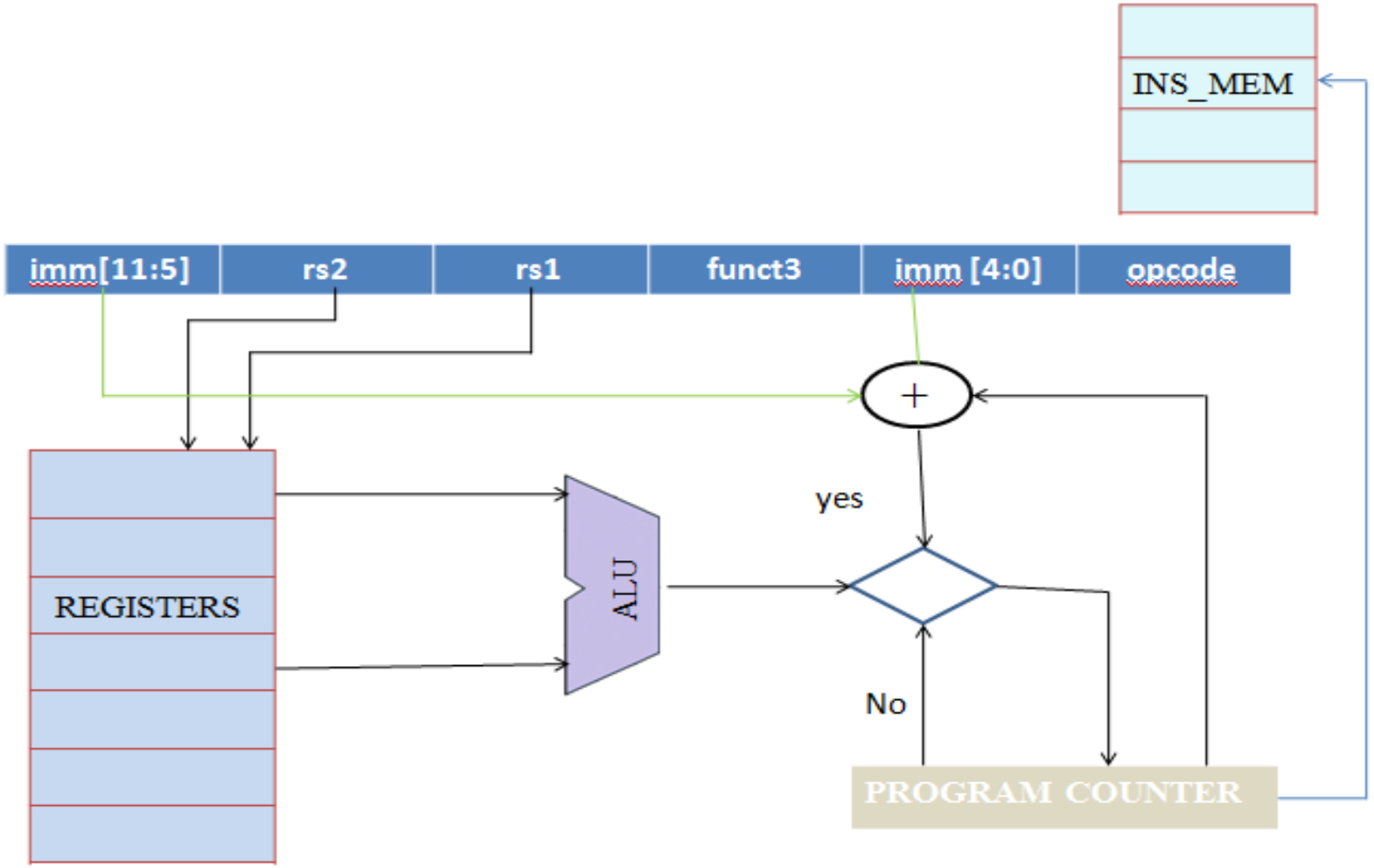
BNE (Branch Not Equal)

B-FORMAT



funct3=001;opcode =1100011

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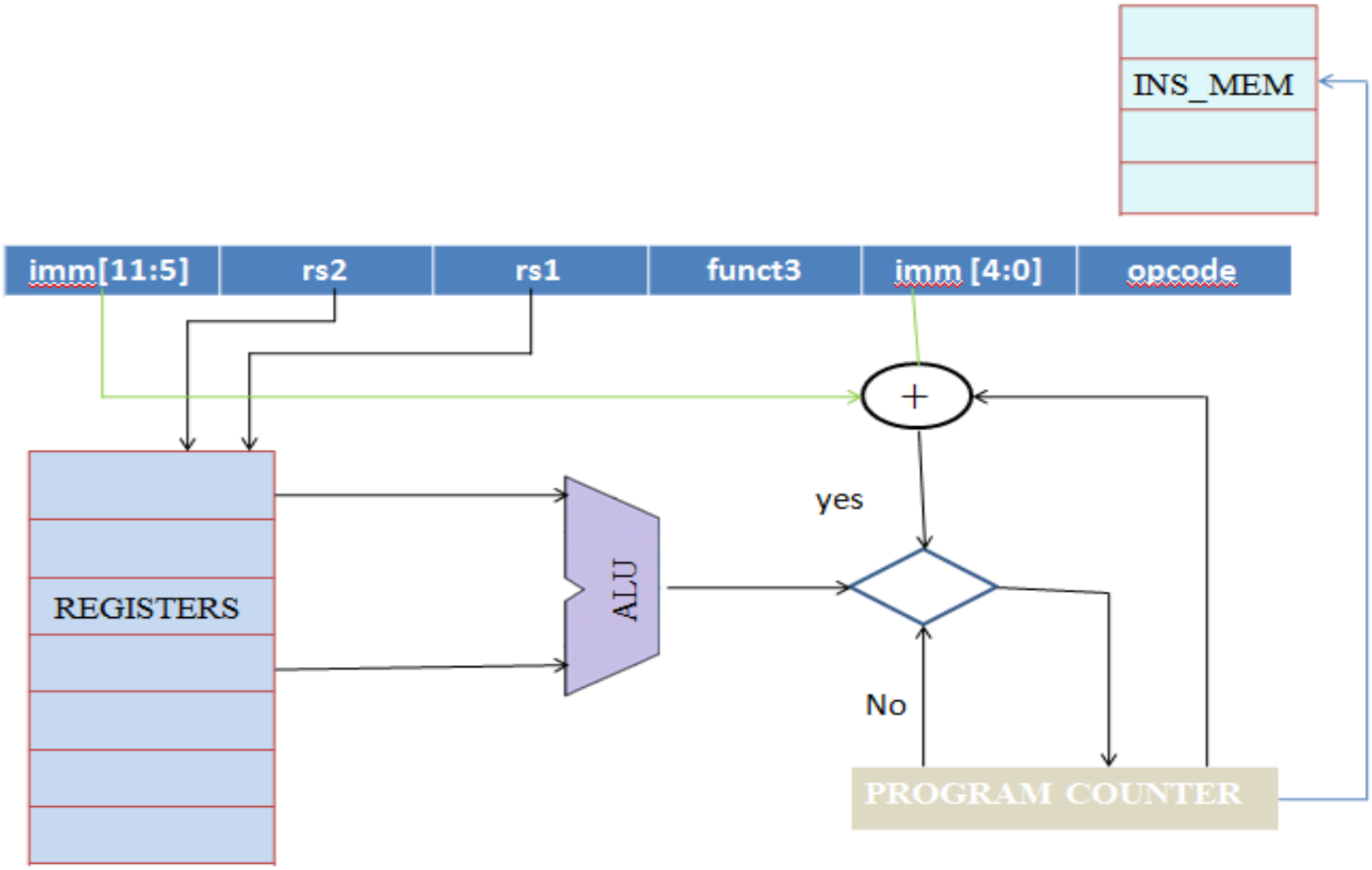
BLT(Branch Less Than)

B-FORMAT



funct3=100;opcode =1100011

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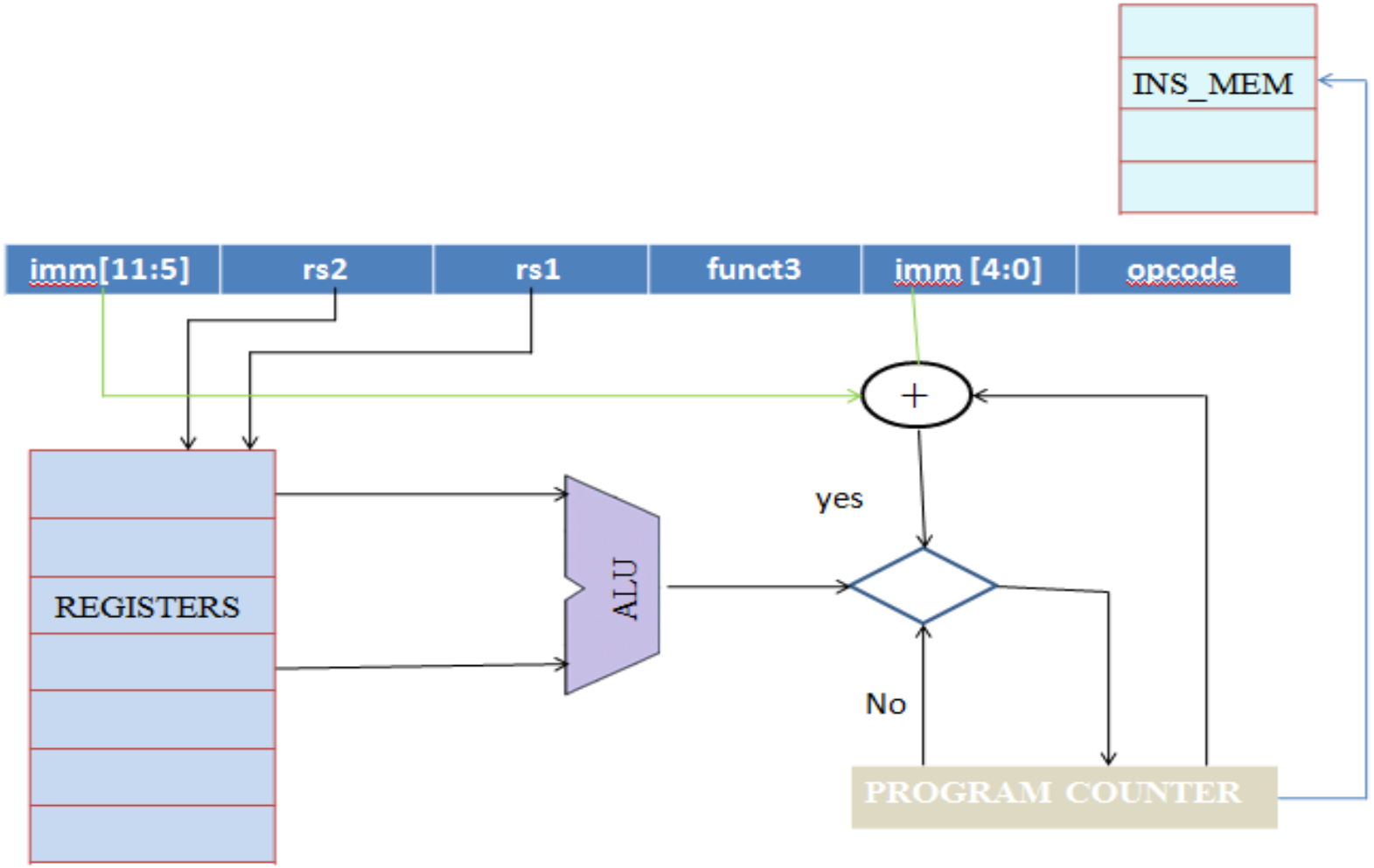
BGE (Branch Greater Than)

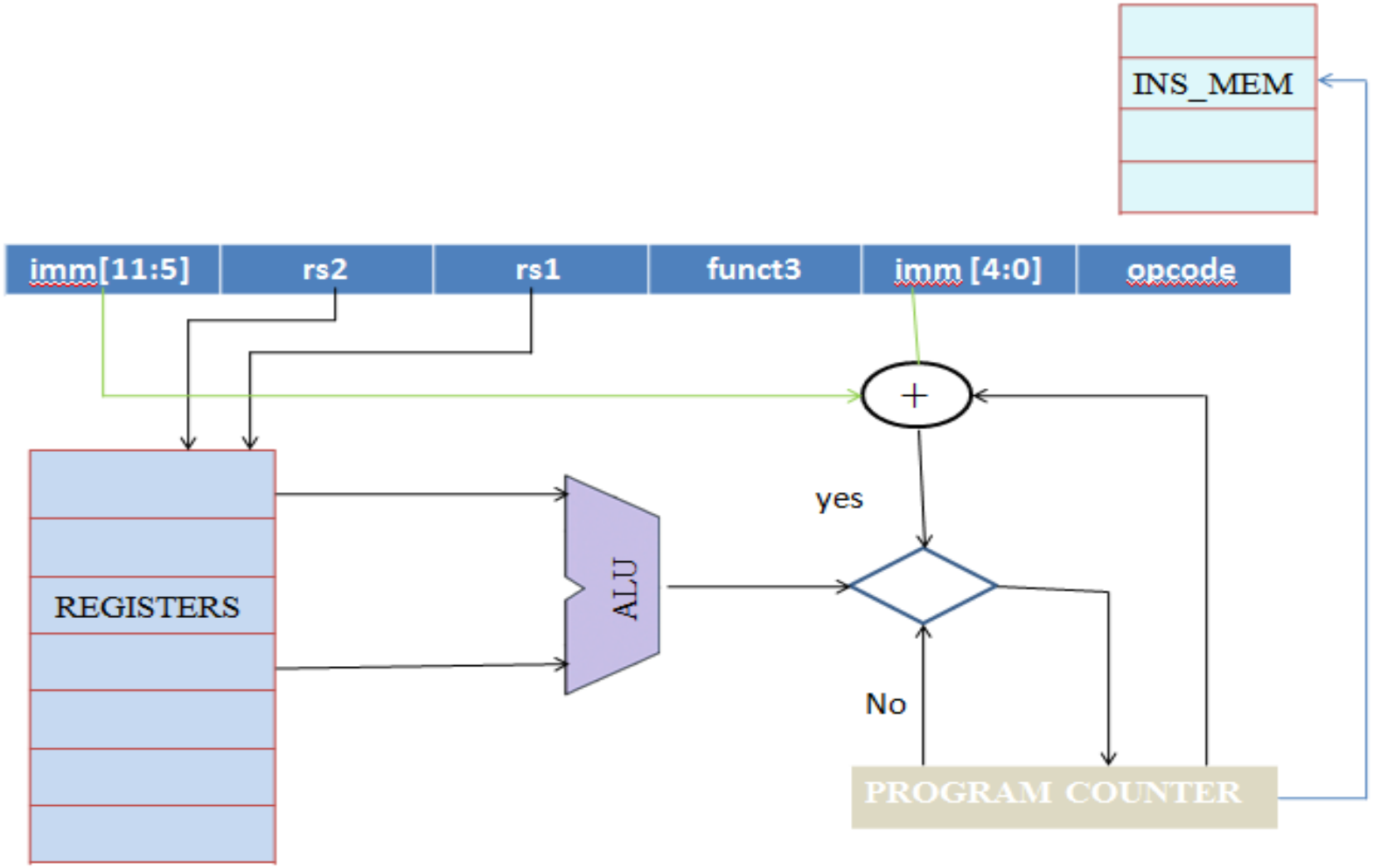
B-FORMAT



funct3=101;opcode =1100011

MAXVY Technologies Pvt Ltd

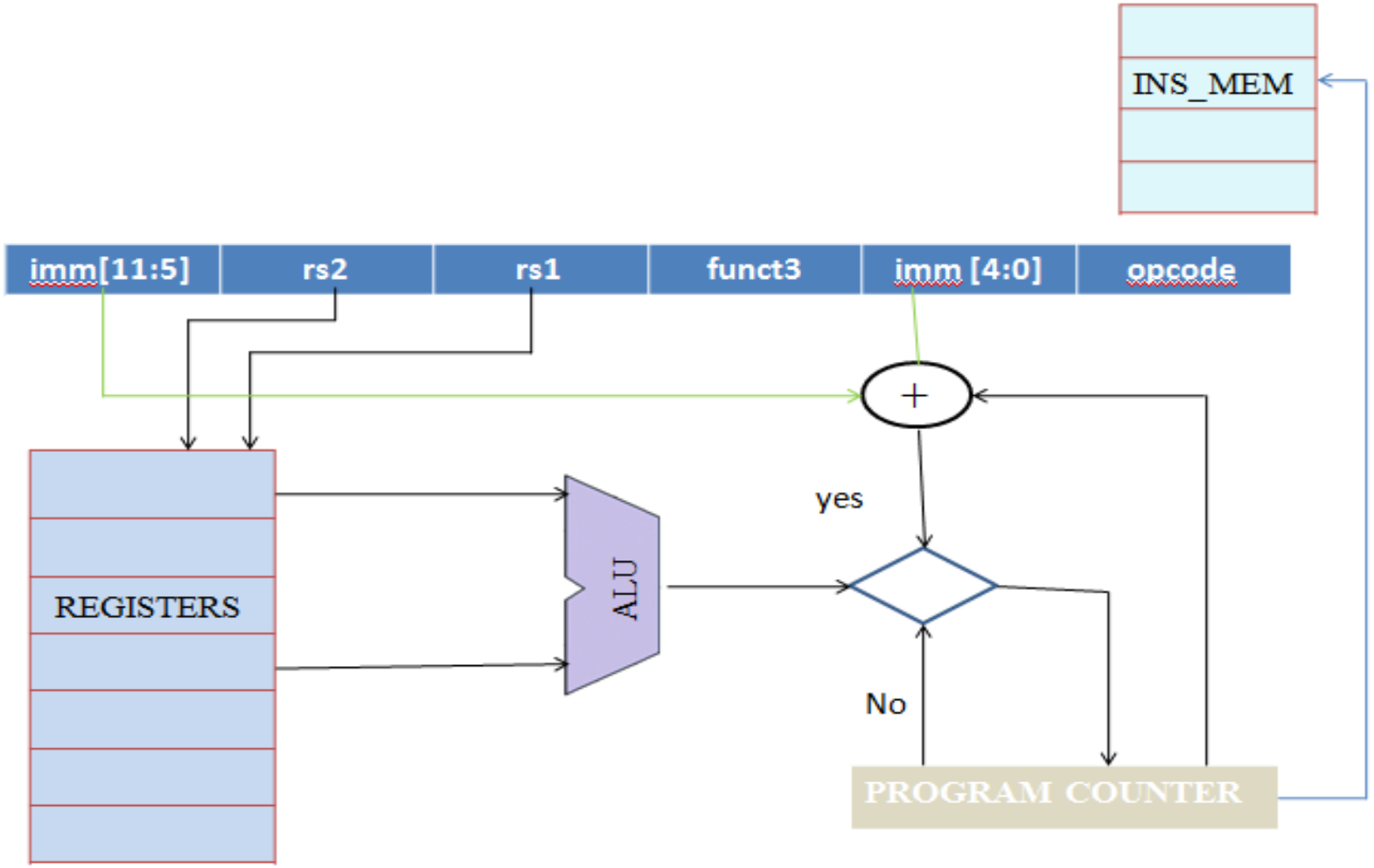
BLTU(Branch Less Than Unsigned) B-FORMAT



funct3=110;opcode =1100011

MAXVY Technologies Pvt Ltd

BGEU(Branch Greater Than Unsigned) B-FORMAT



funct3=111;opcode =1100011

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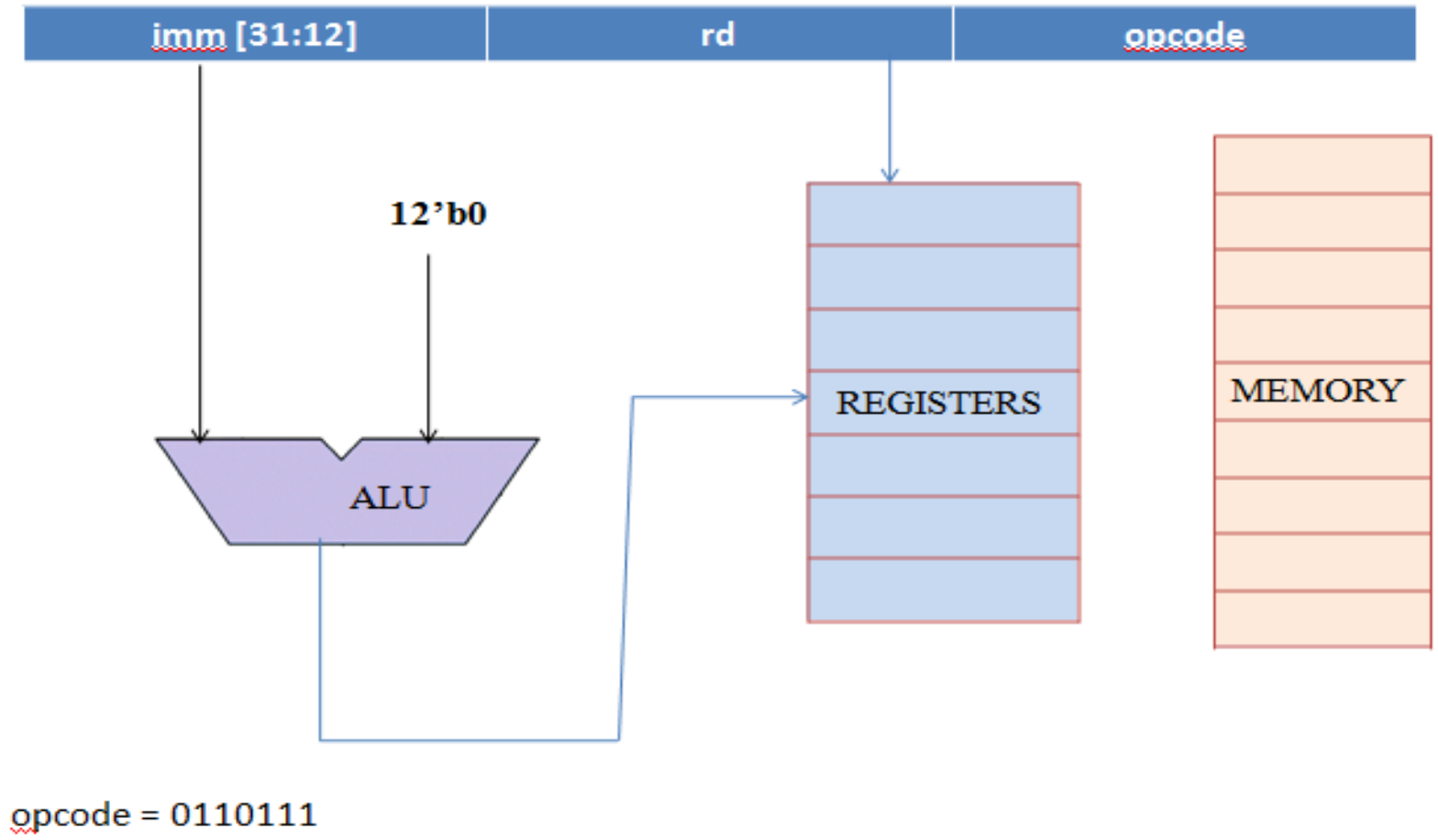
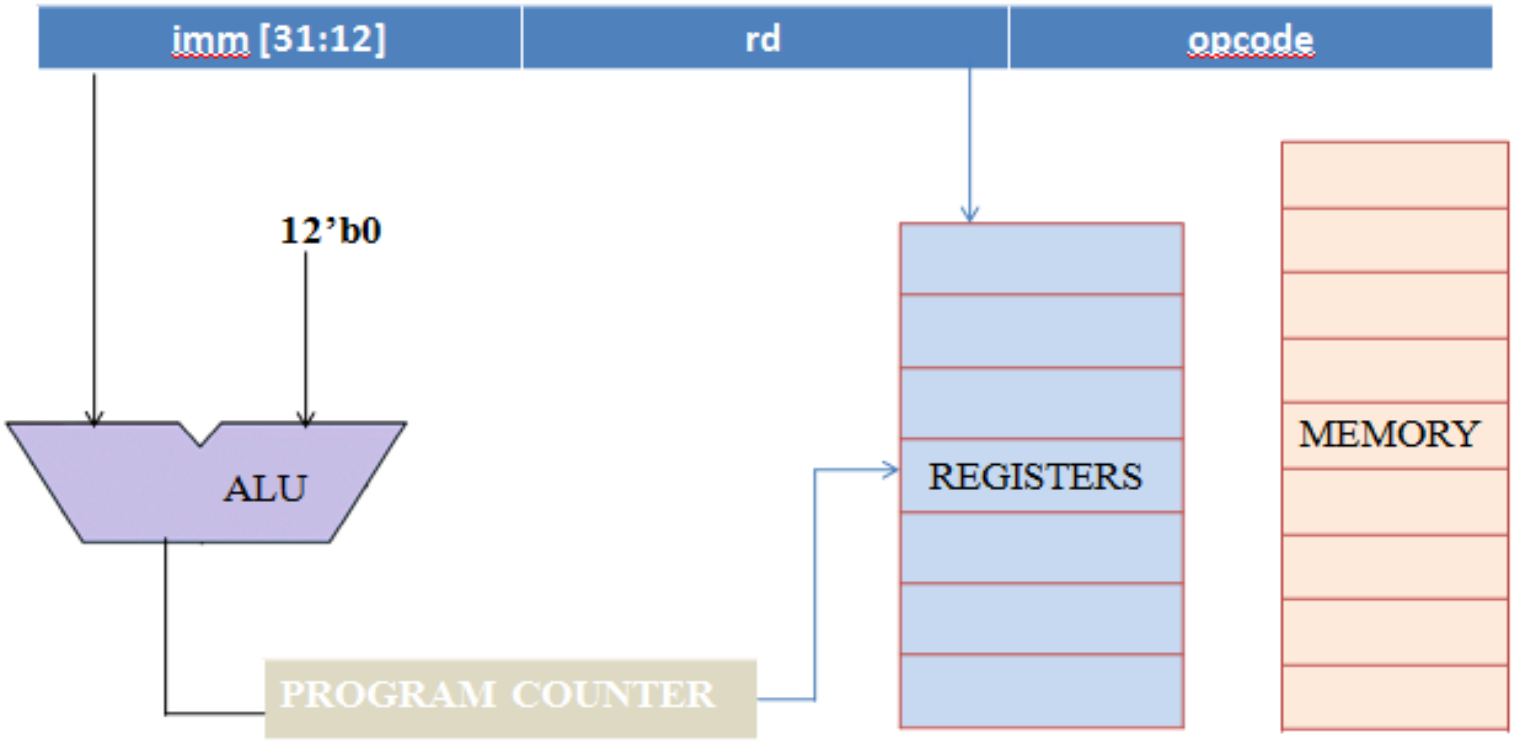
EXECUTION OF INSTRUCTIONS IN U-FORMAT

LUI (Load Upper Immediate) U-FORMAT



opcode = 0110111

AUIPC(Add Upper Immediate With PC) U-FORMAT



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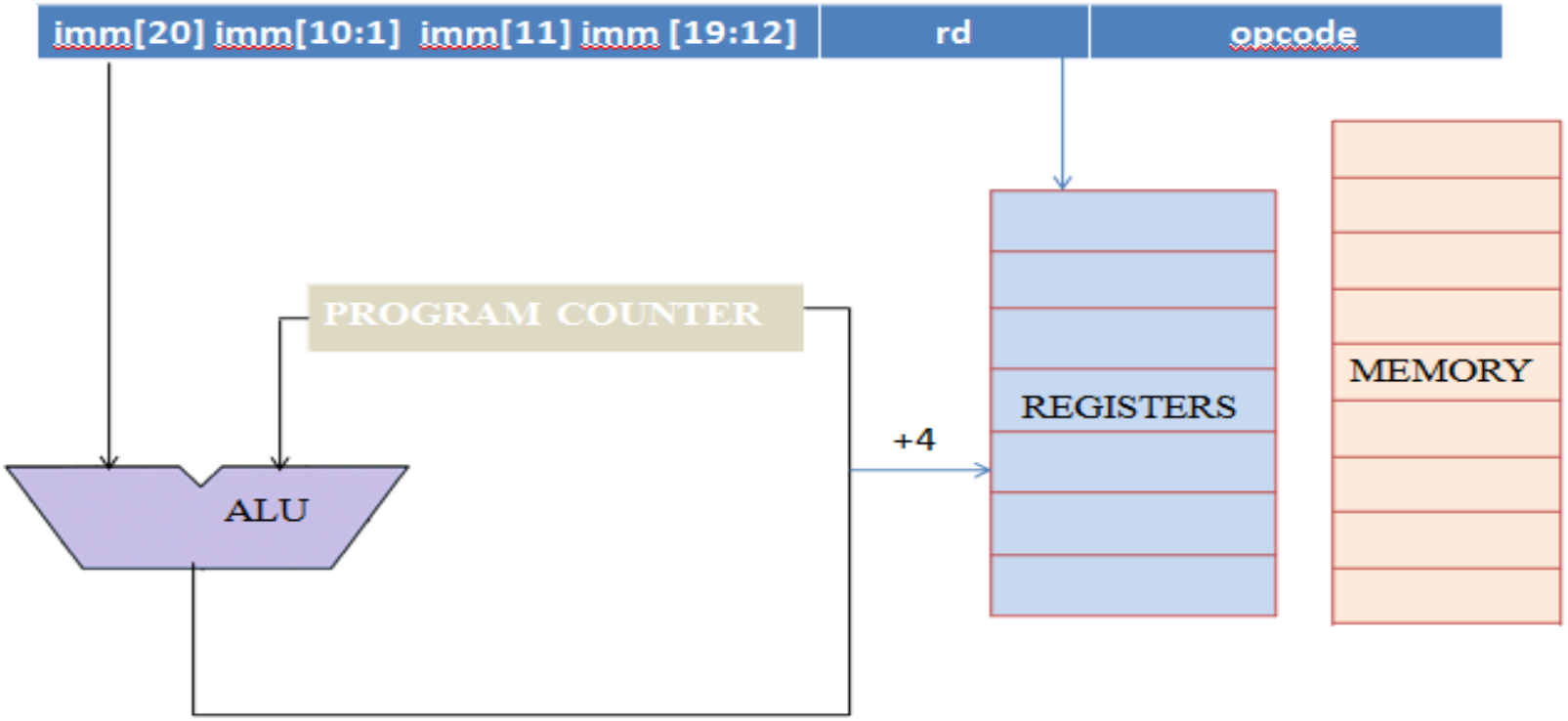
EXECUTION OF INSTRUCTIONS IN J-FORMAT

JAL (Jump and Link)

J-FORMAT



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