CISC SIMULATOR

Manual

V 2.0

Group 8

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Contents

1 Introduction

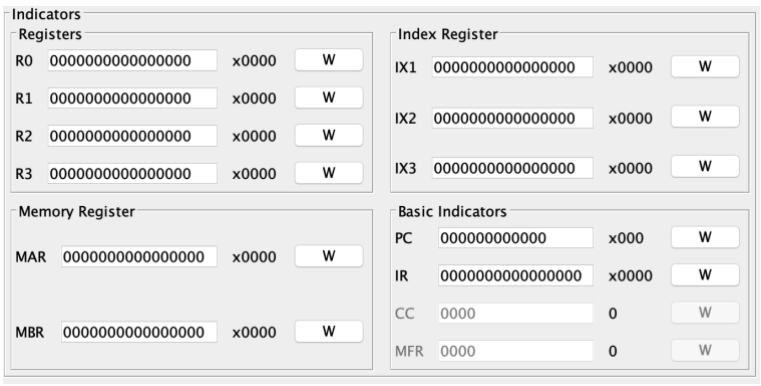
This simulator is a simulation of a Complex Instruction Set Computer (CISC). Two panels are designed for the simulator.

1.1 Debugging Panel

Debugging Panel displays all the information about the Registers, Indicators, and Memory in the computer and can be written manually.

The panel is divided into three parts:

1.1.1 Register Indicators Area

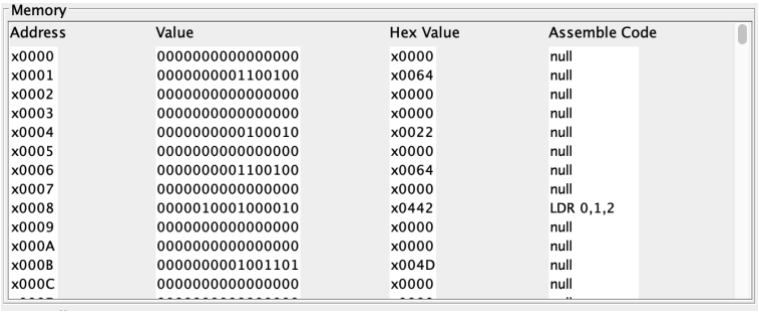


The Register Indicators display the values of all kinds of registers.

- Click the 'W' button to manually modify the value of a register.
- Hexadecimal values are shown on the right.

Type	Size(bits)	Number	Description
R0...R3	16	4	General-Purpose Register
IX1...IX3	16	3	Index Register
MAR	16	1	Memory Address Register
MBR	16	1	Memory Buffer Register
PC	12	1	Program Counter
IR	16	1	Instruction Register
CC	4	1	Condition Code
MFR	4	1	Machine Fault Register

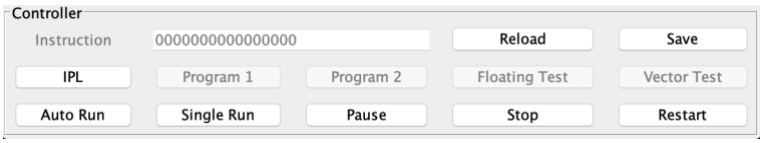
1.1.2 Memory Area



The Memory Area shows the address, the value, the Hexadecimal value, and the Assemble Code of each line on memory.

- The memory address pointed by the Program Counter will be highlighted.
- Double click to manually modify the binary value of a memory row.

1.1.3 Controller Area



The Controller Area integrates all function buttons and the instruction input box.

Button	Description
Reload	Initialize the values
Save	Save inputs
IPL	Pre-load a program
Auto Run	Run instructions automatically
Single Run	Run instructions step by step
Pause	Pause the machine
Stop	Stop the machine
Restart	Restart the machine

2.2 Classic Panel

The appearance and operational logic of the **Classic Panel** emulate the PDP-8 computer. Users will use switches to input and lights for indication.

The **Classic Panel** has not been finished yet and will be released in the next version.

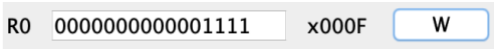
2 Operation

2.1 Writing Values to Registers

Following the steps below to write a value to a register.

Step 1: Input a value into the box

Step 2: Click the 'W' button at right to write the value to the register



Step 3: Done! The value will be written to the Register.

Error handling:

- Input too long: Remove the excess bits from the left
- Input too short: Add zeros from the left
- Input is not binary: Pop up an Error window

2.2 Writing Values to Memory

Two methods are acceptable to write a value to the Memory.

2.2.1 Using Memory Address Register and Memory Buffer Register

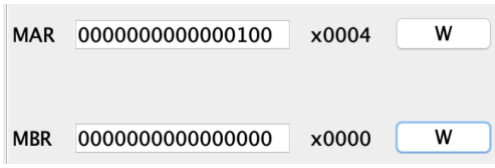
Step 1: Input a value into the MAR box

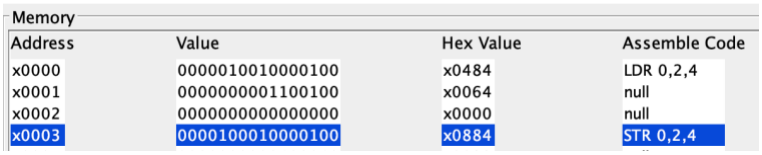
Step 2: Click the 'W' button of MAR

Step 3: Input a value into the MBR box

Step 4: Click the 'W' button of MBR

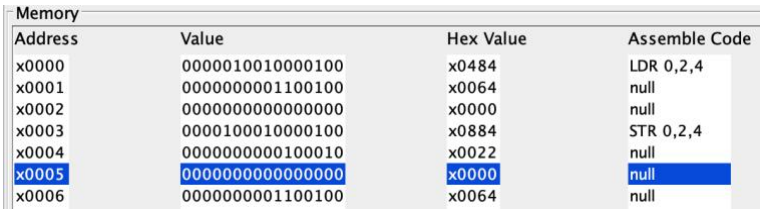
Step 5: Done! The value of MAR will be written to the Memory, and the MAR will automatically change to the next address.



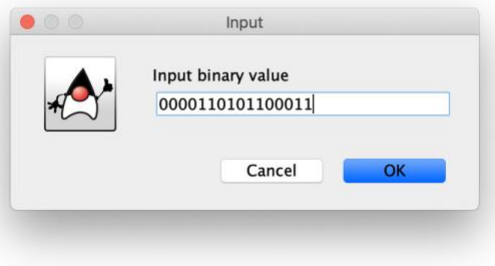


2.2.2 Modifying the Memory Area

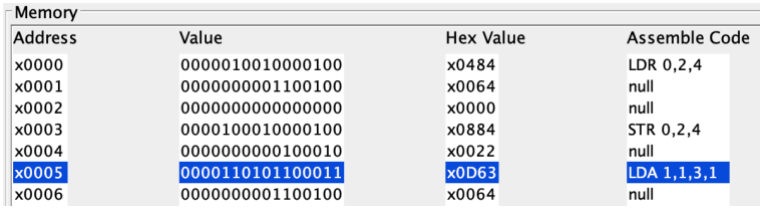
Step 1: Double click the memory row that needs to modify



Step 2: An input window as the following will pop up. Input the value that needs to write to the memory



Step 3: Click the 'OK' button, and then the value will be written to the Memory.

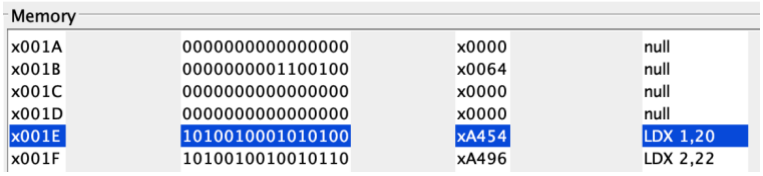


2.3 Executing Instructions

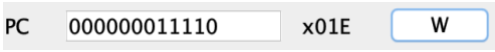
Instruction can be executed step-by-step or automatically.

2.3.1 Executing Instructions Step-by-Step

Step 1: Store an instruction to the Memory

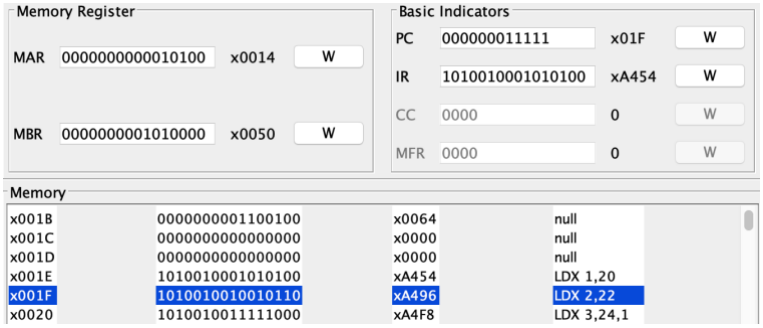


Step 2: Write the address of the instruction to the Program Counter (PC)



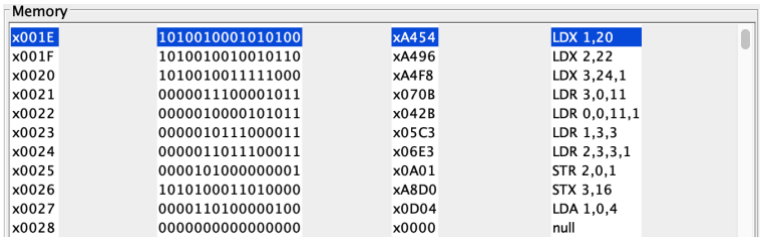
Step 3: Click the 'Single Run' button, and then the instruction will be executed.

- The Program Counter will automatically point to the next address of Memory.
- The Instruction Register will store the last executed instruction.

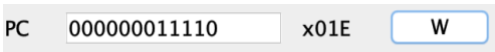


2.3.1 Executing Instructions Automatically

Step 1: Store instructions to the Memory

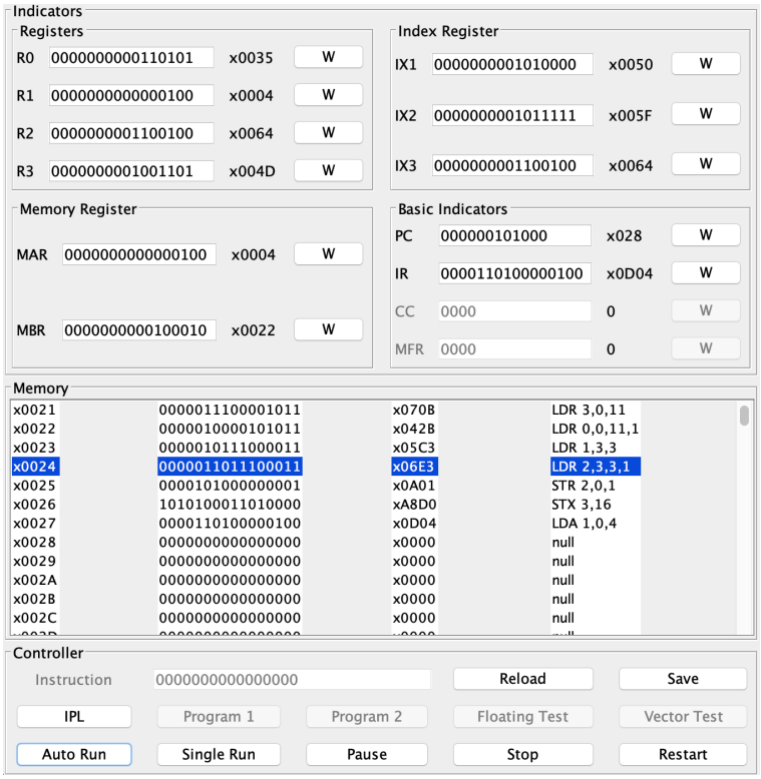


Step 2: Write the address of the **starting** instruction to the Program Counter (PC)



Step 3: Click the 'Auto Run' button, and then the instructions will be executed automatically.

- The Program Counter will automatically point to the next address of Memory after an instruction being executed.
- All the indicators will be continuously updated while the program is running.

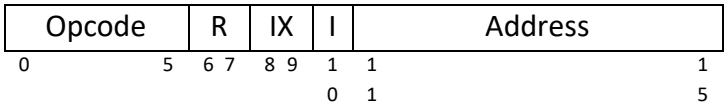


Step 4: Click the 'Pause' button or the 'Stop' button to stop the program.

3 Instructions Reference

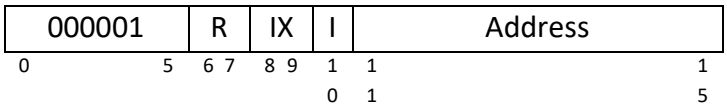
3.1 Load/Store Instructions

The instructions to load/store values from/to Registers or Memory. The binary instruction code format of Load/Store Instructions is as follows:



Opcode:	6 bits	Specifies the instruction
R:	2 bits	Specifies the General-Purpose Register
IX:	2 bits	Specifies the Index Register
I:	1 bit	Specifies Indirect Addressing If I =1, indirect addressing; otherwise, no indirect addressing.
Address:	5 bits	Specifies the location

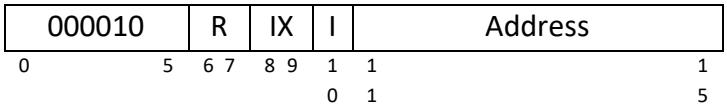
3.1.1 LDR



Instruction: LDR r, x, address[, I]

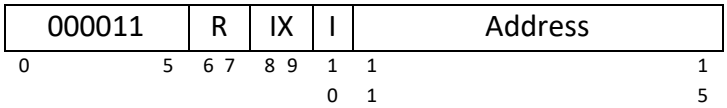
Octal-Opcode: 01
Binary-Opcode: 000001
Function: Loads Register from Memory

3.1.2 STR



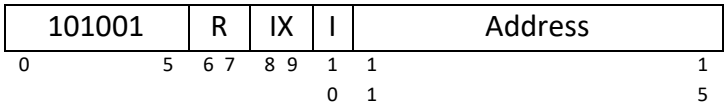
Instruction: STR r, x, address[, I]
Octal-Opcode: 02
Binary-Opcode: 000010
Function: Stores Register to Memory

3.1.3 LDA



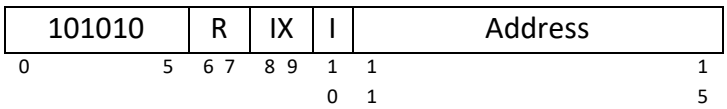
Instruction: LDA r, x, address[, I]
Octal-Opcode: 03
Binary-Opcode: 000011
Function: Loads Register with Address

3.1.4 LDX



Instruction: LDX x, address[, I]
Octal-Opcode: 41
Binary-Opcode: 101001
Function: Loads Index Register from Memory

3.1.5 STX

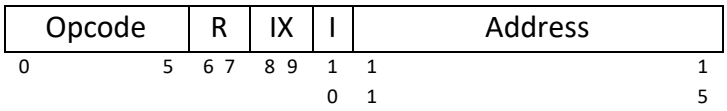


Instruction: STX x, address[, I]
Octal-Opcode: 42

Binary-Opcode: 101010
Function: Stores Index Register to Memory

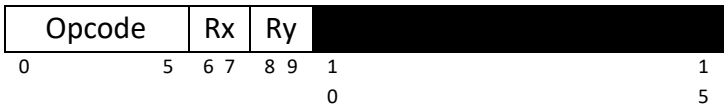
3.2 Arithmetic and Logical Instructions

The instructions to perform most of the computational works in the machine. The binary instruction code format of basic Arithmetic and Logical Instructions is as follows:



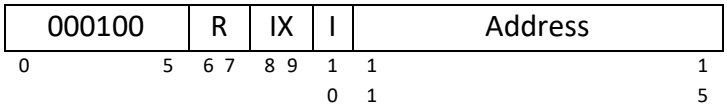
Opcode:	6 bits	Specifies the instruction
R:	2 bits	Specifies the General-Purpose Register
IX:	2 bits	Specifies the Index Register
I:	1 bit	Specifies Indirect Addressing If I =1, indirect addressing; otherwise, no indirect addressing.
Address:	5 bits	Specifies the location

The binary instruction code format of register-to-register Arithmetic and Logical Instructions is as follows:



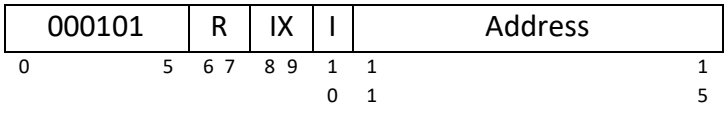
Opcode:	6 bits	Specifies the instruction
Rx:	2 bits	Specifies the General-Purpose Register x
Ry:	2 bits	Specifies the General-Purpose Register y

3.2.1 AMR



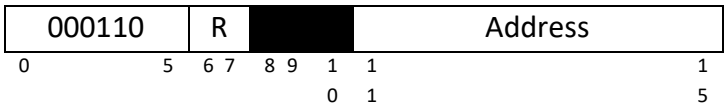
Instruction: AMR r, x, address[, I]
Octal-Opcode: 04
Binary-Opcode: 000100
Function: Add Memory to Register

3.2.2 SMR



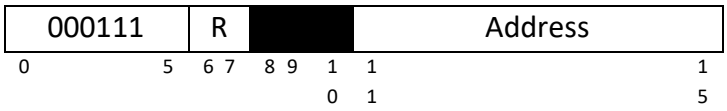
Instruction: SMR r, x, address[, I]
Octal-Opcode: 05
Binary-Opcode: 000101
Function: Subtract Memory from Register

3.2.3 AIR



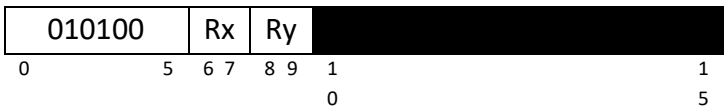
Instruction: AIR r, immed
Octal-Opcode: 06
Binary-Opcode: 000110
Function: Add Immediate to Register

3.2.4 SIR



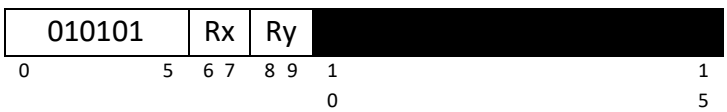
Instruction: SIR r, immed
Octal-Opcode: 07
Binary-Opcode: 000111
Function: Subtract Immediate from Register

3.2.5 MLT



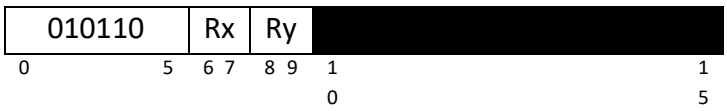
Instruction: MLT rx, ry
Octal-Opcode: 20
Binary-Opcode: 010100
Function: Multiply Register by Register

3.2.6 DVD



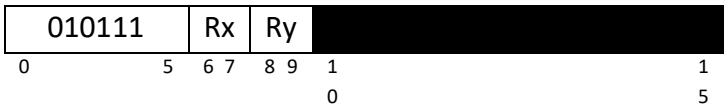
Instruction: DVD rx, ry
Octal-Opcode: 21
Binary-Opcode: 010101
Function: Divide Register by Register

3.2.7 TRR



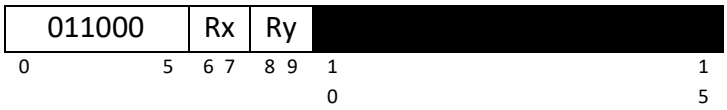
Instruction: TRR rx, ry
Octal-Opcode: 22
Binary-Opcode: 010110
Function: Test the Equality of Register and Register

3.2.8 AND



Instruction: AND rx, ry
Octal-Opcode: 23
Binary-Opcode: 010111
Function: Logical AND of Register and Register

3.2.9 ORR



Instruction: ORR rx, ry
Octal-Opcode: 24
Binary-Opcode: 011000
Function: Logical OR of Register and Register

3.2.10 NOT

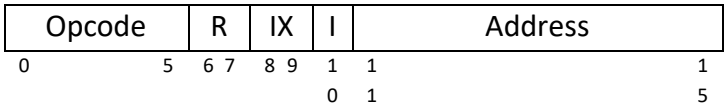
Instruction: NOT rx

Octal-Opcode: 25
Binary-Opcode: 011001
Function: Logical NOT of Register to Register

3.3 Transfer Instructions

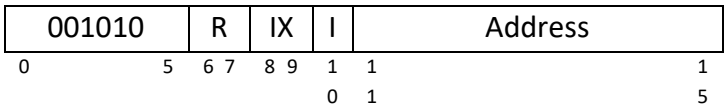
The instructions to check the value of a register and then change the control of program execution.

The binary instruction code format of Transfer Instructions is as follows:



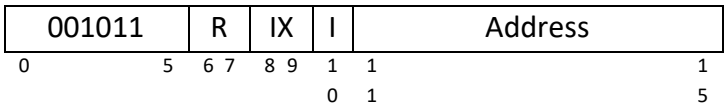
Opcode:	6 bits	Specifies the instruction
R:	2 bits	Specifies the General-Purpose Register
IX:	2 bits	Specifies the Index Register
I:	1 bit	Specifies Indirect Addressing If I =1, indirect addressing; otherwise, no indirect addressing.
Address:	5 bits	Specifies the location

3.3.1 JZ



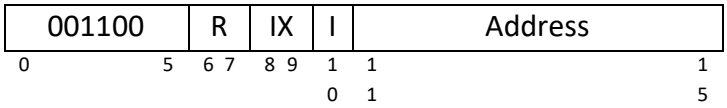
Instruction: JZ r, x, address[, I]
Octal-Opcode: 10
Binary-Opcode: 001010
Function: Jump if Zero

3.3.2 JNE



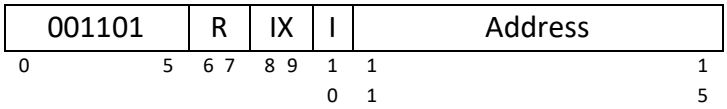
Instruction: JNE r, x, address[, I]
Octal-Opcode: 11
Binary-Opcode: 001011
Function: Jump if Not Equal

3.3.3 JCC



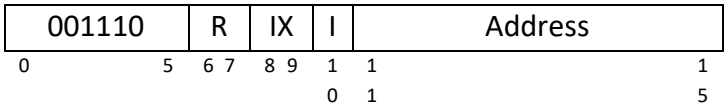
Instruction: JCC cc, x, address[, I]
Octal-Opcode: 12
Binary-Opcode: 001100
Function: Jump if Condition Code

3.3.4 JMA



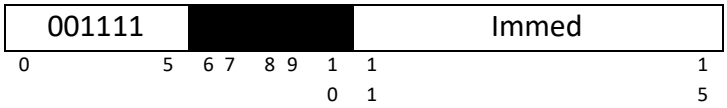
Instruction: JMA x, address[, I]
Octal-Opcode: 13
Binary-Opcode: 001101
Function: Unconditional Jump to Address

3.3.5 JSR



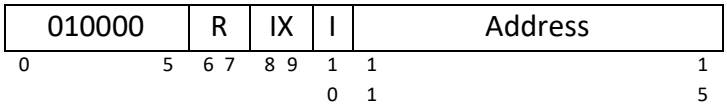
Instruction: JSR x, address[, I]
Octal-Opcode: 14
Binary-Opcode: 001110
Function: Jump and Save Return Address

3.3.6 RFS



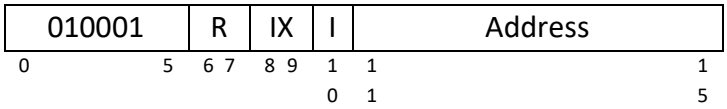
Instruction: RFS immed
Octal-Opcode: 15
Binary-Opcode: 001111
Function: Return from Subroutine with Return Code as Immediate Portion (optional) Stored in the Instruction's Address Field

3.3.7 SOB



Instruction: SOB r, x, address[, I]
Octal-Opcode: 16
Binary-Opcode: 010000
Function: Subtract One and Branch

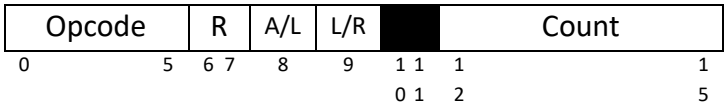
3.3.8 JGE



Instruction: JGE r, x, address[, I]
Octal-Opcode: 17
Binary-Opcode: 010001
Function: Jump Greater than or Equal to

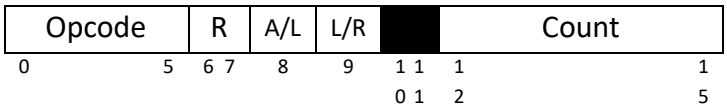
3.4 Shift/Rotate Instructions

The instructions to manipulate a datum in a register. The binary instruction code format of Shift and Rotate Instructions is as follows:



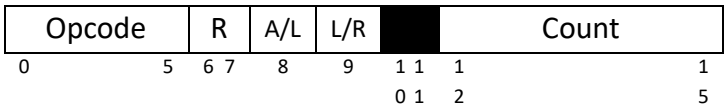
Opcode:	6 bits	Specifies the instruction
R:	2 bits	Specifies the General-Purpose Register
A/L:	2 bits	Arithmetic Shift (A/L = 0); Logical Shift (A/L = 1)
L/R:	2 bits	Logical Rotate (L/R = 1)
Count:	4 bits	Specifies the Count for Operation

3.4.1 SRC



Instruction: SRC r, count, L/R, A/L
Octal-Opcode: 31
Binary-Opcode: 011111
Function: Shift Register by Count

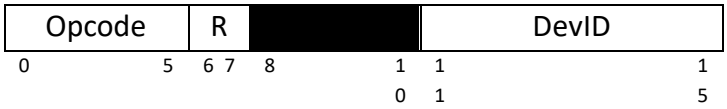
3.4.2 RRC



Instruction:	RRC r, count, L/R, A/L
Octal-Opcode:	32
Binary-Opcode:	100000
Function:	Rotate Register by Count

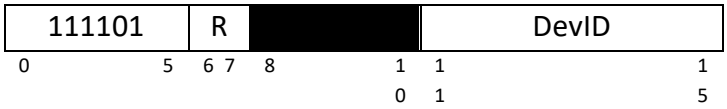
3.5 I/O Instructions

The instructions to communicate with the peripherals attached to the computer system. The binary instruction code format of I/O Instructions is as follows:



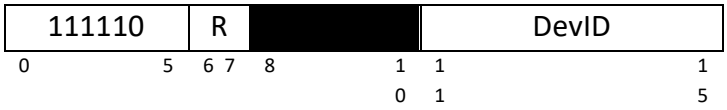
Opcode:	6 bits	Specifies the instruction
R:	2 bits	Specifies the General-Purpose Register
DevID:	5 bits	Device ID:
		0 Console Keyboard
		1 Console Printer
		2 Card Reader
		3-31 Console Registers, Switches, etc.

3.5.1 IN



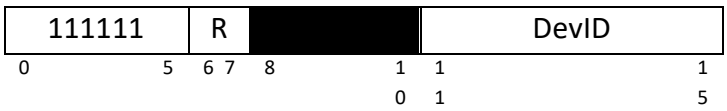
Instruction:	IN r, devid
Octal-Opcode:	61
Binary-Opcode:	111101
Function:	Input Character to Register from Device

3.5.2 OUT



Instruction:	OUT r, devid
Octal-Opcode:	62
Binary-Opcode:	111110
Function:	Output Character to Device from Register

3.5.3 CHK



Instruction:	CHK r, devid
Octal-Opcode:	63
Binary-Opcode:	111111
Function:	Check Device Status to Register

3.6 Other Instructions

3.6.1 HALT

Instruction:	HALT
Octal-Opcode:	00
Binary-Opcode:	000000
Function:	Stop the machine