

Instructions for phase 2 Demo

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Part 1 - Test Program 1

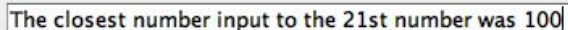
Deliverable description:

Demonstration that Program 1 works.

Demo Steps:

1. Click on “Test Program 1”
2. Randomly enter 21 numbers between 0 and 36767, such as - 10, 20, 13, 5, 1, 2, 6, 9, 11, 34, 15, 7, 16, 18, 30, 100, 36, 19, 22, 50, 101

[Expected Result] - Output “The closest number input to the 21st number was 100” in the console field.

The image shows a screenshot of a console window. The text "The closest number input to the 21st number was 100" is displayed in a monospaced font. The text is black on a light gray background. The console window has a thin border and a small vertical scrollbar on the right side.

Part 2 - Demonstrate instructions through GUI

Deliverable description:

Demonstrate that individual instructions work.

Your user interface, e.g., operator’s console should be used to test instructions, etc.

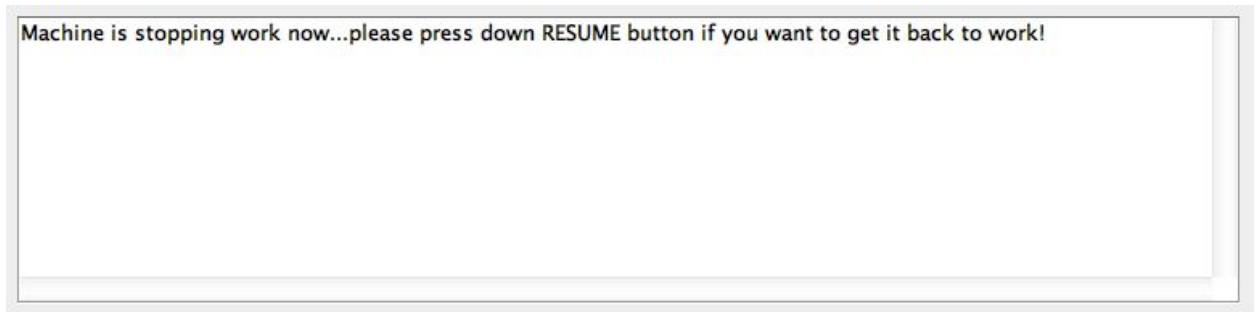
Demo Steps:

1. HLT/RESUME

s1. Click on “HALT”



[Expected Result] -> ALU stops working, no more instructions will be executed.



s2. Click on “RESUME”



[Expected Result] -> ALU gets back to work.



2. LDR

Case 1 - $IX = 0, I = 0$ -> EA = address

s1. input 10 to memory location -> accept

s2. input 100 to memory location's value -> accept

Memory

s3. select relevant values for LDR (IX = 0; GPR = 3; I = 0; Address = 10) in manual input part -> accept manual word instruction

Manual Instructions

[Expected Result] -> GPR3 is populated with 100

GPR3

Case 2 - IX != 0, I = 1 -> EA = address + c(IR)

s1. input 20 to memory location -> accept

s2. input 100 to memory location's value -> accept

Memory

s3. input 5 to IX1

IX1

s4. select relevant values for LDR (IX = 1; GPR = 3; I = 1; Address = 15) in manual input part -> accept manual word instruction

[Expected Result] -> GPR3 is populated with 100

GPR3

3. STR

Case 1 - IX = 0, I = 0 -> EA = address

s1. input 100 to GPR3 -> accept

GPR3

s2. select relevant values for STR (IX = 0; GPR = 3; I = 0; Address = 20)
in manual input part -> accept manual word instruction

Manual Instructions

[Expected Result] -> 100 is stored into memory address 20

Memory

Case 2 - IX != 0, I = 1 -> EA = address + c(IR)

s1. input 100 to GPR3 -> accept

GPR3

s2. input 5 to IX1 -> accept

IX1

s3. select relevant values for STR (IX = 1; GPR = 3; I = 1; Address = 15)
in manual input part -> accept manual word instruction

Manual Instructions

[Expected Result] -> 100 is stored into memory address 20

Memory

4. LDA

Case 1 - $IX = 0, I = 0 \rightarrow EA = \text{address}$

s1. select relevant values for LDA ($IX = 0$; $GPR = 3$; $I = 0$; $\text{Address} = 20$)
in manual input part \rightarrow accept manual word instruction

Manual Instructions

L...	No...	GPR3	IA ...	20
[0, 0, 0, 0, 1, 1]	[0, 0]	[1, 1]	[0]	[1, 0, 1, 0, 0]

Accept Manual Word Instruction

[Expected Result] \rightarrow GPR3 is populated with 20

GPR3

[0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 1, 0, 0]	20	Accept
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Case 2 - $IX \neq 0, I = 1 \rightarrow EA = \text{address} + c(IX)$

s1. input 5 to IX1 \rightarrow accept

IX1

[0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 1, 1]	5	Accept
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s2. select relevant values for LDA ($IX = 1$; $GPR = 3$; $I = 1$; $\text{Address} = 20$)
in manual input part \rightarrow accept manual word instruction

Manual Instructions

L...	No...	GPR3	IA ...	20
[0, 0, 0, 0, 1, 1]	[0, 0]	[1, 1]	[0]	[1, 0, 1, 0, 0]

Accept Manual Word Instruction

[Expected Result] \rightarrow GPR3 is populated with 25

GPR3

[0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 1, 0, 0, 1]	25	Accept
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5. LDX

s1. input 10 to memory location \rightarrow accept

s2. input 100 to memory location's value -> accept

Memory	<input type="text" value="10"/>	<input type="button" value="Accept"/>	<input type="text" value="0, 0, 0, 0, 0, 0, 0, 0, 1, 1, 0, 0, 1, 0, 0"/>	<input type="text" value="100"/>	<input type="button" value="Accept"/>
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s3. select relevant values for LDX (IX = 1; GPR = 3; I = 0; Address = 10)
in manual input part -> accept manual word instruction

[Expected Result] -> IX1 is populated with 100 (please only check the binary part). Please note that the text input fields here are only used to accept input data when we use Index Register to represent GPR in the operations between registers. We are not intending to display the decimal number here for LDX.

IX1	<input type="text" value="0, 0, 0, 0, 0, 0, 0, 0, 1, 1, 0, 0, 1, 0, 0"/>
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6. STX

s1. input 100 to IX1 -> accept

IX1	<input type="text" value="0, 0, 0, 0, 0, 0, 0, 0, 1, 1, 0, 0, 1, 0, 0"/>	<input type="text" value="100"/>	<input type="button" value="Accept"/>
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s2. select relevant values for STX (IX = 1; GPR = 3; I = 0; Address = 31)
in manual input part -> accept manual word instruction

Manual Instructions	<input type="button" value="STX"/>	<input type="button" value="IX..."/>	<input type="button" value="GPR3"/>	<input type="button" value="IA ..."/>	<input type="button" value="31"/>
	<input type="text" value="1, 0, 0, 0, 1, 0"/>	<input type="text" value="[0, 1]"/>	<input type="text" value="[1, 1]"/>	<input type="text" value="[0]"/>	<input type="text" value="[1, 1, 1, 1, 1]"/>
<input type="button" value="Accept Manual Word Instruction"/>					

[Expected Result] -> 100 is stored into memory location 31

Memory	<input type="text" value="31"/>	<input type="button" value="Accept"/>	<input type="text" value="0, 0, 0, 0, 0, 0, 0, 0, 1, 1, 0, 0, 1, 0, 0"/>	<input type="text" value="100"/>	<input type="button" value="Accept"/>
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7. JZ

Case 1 - If $c(r) = 0$, then $PC \leftarrow EA(\text{address})$

s1. select relevant values for JZ (IX = 0; GPR = 2; I = 0; Address = 15)

in manual input part -> accept manual word instruction

GPR2	<input type="text" value="0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0"/>	<input type="text" value="0"/>	<input type="button" value="Accept"/>
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Manual Instructions	<input type="text" value="JZ"/>	<input type="text" value="No..."/>	<input type="text" value="GPR2"/>	<input type="text" value="IA ..."/>	<input type="text" value="15"/>
	<input type="text" value="0, 0, 1, 0, 0, 0"/>	<input type="text" value="[0, 0]"/>	<input type="text" value="[1, 0]"/>	<input type="text" value="[0]"/>	<input type="text" value="[0, 1, 1, 1, 1]"/>
<input type="button" value="Accept Manual Word Instruction"/>					

[Expected Result] -> PC is populated with address 15

PC	<input type="text" value="0, 0, 0, 0, 0, 0, 0, 0, 1, 1, 1, 1"/>	<input type="text" value="15"/>
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Case 2 - If $c(r) \neq 0$, then $PC \leftarrow PC + 1$

s1. input 10 to GPR2

GPR2	<input type="text" value="0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 1, 0"/>	<input type="text" value="10"/>
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s2. PC is populated with 15

PC	<input type="text" value="0, 0, 0, 0, 0, 0, 0, 0, 1, 1, 1, 1"/>	<input type="text" value="15"/>
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s3. select relevant values for JZ (IX = 0; GPR = 2; I = 0; Address = 15)

in manual input part -> accept manual word instruction

Manual Instructions	<input type="text" value="JZ"/>	<input type="text" value="No..."/>	<input type="text" value="GPR2"/>	<input type="text" value="IA ..."/>	<input type="text" value="15"/>
	<input type="text" value="0, 0, 1, 0, 0, 0"/>	<input type="text" value="[0, 0]"/>	<input type="text" value="[1, 0]"/>	<input type="text" value="[0]"/>	<input type="text" value="[0, 1, 1, 1, 1]"/>
<input type="button" value="Accept Manual Word Instruction"/>					

[Expected Result] -> PC is populated with address 16

PC	<input type="text" value="0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0"/>	<input type="text" value="16"/>
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8. JNE

Case 1 - If $c(r) \neq 0$, then $PC \leftarrow EA(\text{address})$

s1. input 100 to GPR0

GPR0	<input type="text" value="0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 1, 0, 0, 1, 0, 0"/>	<input type="text" value="100"/>	<input type="button" value="Accept"/>
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s2. select relevant values for JNZ (IX = 0; GPR = 0; I = 0; Address = 15)
in manual input part -> accept manual word instruction

Manual Instructions	<input type="button" value="JNE"/>	<input type="button" value="No..."/>	<input type="button" value="GPR0"/>	<input type="button" value="IA ..."/>	<input type="button" value="15"/>
	<input type="text" value="0, 0, 1, 0, 0, 1"/>	<input type="text" value="[0, 0]"/>	<input type="text" value="[0, 0]"/>	<input type="text" value="[0]"/>	<input type="text" value="[0, 1, 1, 1, 1]"/>
<input type="button" value="Accept Manual Word Instruction"/>					

[Expected Result] -> PC is populated with address 15

PC	<input type="text" value="0, 0, 0, 0, 0, 0, 0, 0, 1, 1, 1, 1"/>	<input type="text" value="15"/>
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Case 2 - If $c(r) \neq 0$, $IX \neq 0$ and $I = 1$ then $PC \leftarrow \text{address} + c(IX)$

s1. input 100 to GPR0

GPR0	<input type="text" value="0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 1, 0, 0, 1, 0, 0"/>	<input type="text" value="100"/>	<input type="button" value="Accept"/>
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s2. input 5 to IX1

IX1	<input type="text" value="0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 1"/>	<input type="text" value="5"/>	<input type="button" value="Accept"/>
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s3. select relevant values for JNZ (IX = 1; GPR = 0; I = 1; Address = 15)
in manual input part -> accept manual word instruction

Manual Instructions	<input type="button" value="JNE"/>	<input type="button" value="IX..."/>	<input type="button" value="GPR0"/>	<input type="button" value="IA ..."/>	<input type="button" value="15"/>
	<input type="text" value="0, 0, 1, 0, 0, 1"/>	<input type="text" value="[0, 1]"/>	<input type="text" value="[0, 0]"/>	<input type="text" value="[1]"/>	<input type="text" value="[0, 1, 1, 1, 1]"/>
<input type="button" value="Accept Manual Word Instruction"/>					

[Expected Result] -> PC is populated with address 20

PC	<input type="text" value="0, 0, 0, 0, 0, 0, 0, 1, 0, 1, 0, 0"/>	<input type="text" value="20"/>
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Case 3 - If $c(r) = 0$, then $PC \leftarrow PC + 1$

s1. input 0 to GPR1

GPR1	<input type="text" value="0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0"/>	<input type="text" value="0"/>
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s2. PC is populated with 20

PC	<input type="text" value="0, 0, 0, 0, 0, 0, 0, 1, 0, 1, 0, 0"/>	<input type="text" value="20"/>
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s1. select relevant values for JNZ (IX = 0; GPR = 1; I = 0; Address = 15)
in manual input part -> accept manual word instruction

Manual Instructions	<input type="text" value="JNE"/>	<input type="text" value="No..."/>	<input type="text" value="GPR1"/>	<input type="text" value="IA ..."/>	<input type="text" value="15"/>
	<input type="text" value="0, 0, 1, 0, 0, 1"/>	<input type="text" value="[0, 0]"/>	<input type="text" value="[0, 1]"/>	<input type="text" value="[0]"/>	<input type="text" value="[0, 1, 1, 1, 1]"/>
<input type="button" value="Accept Manual Word Instruction"/>					

[Expected Result] -> PC is populated with 21

PC	<input type="text" value="0, 0, 0, 0, 0, 0, 0, 1, 0, 1, 0, 1"/>	<input type="text" value="21"/>
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9. JCC

Case 1 - If cc bit = 1, $PC \leftarrow EA(\text{address})$

s1. input 15 to Condition Code

CC	<input type="text" value="[1, 1, 1, 1]"/>	<input type="text" value="15"/>	<input type="button" value="Accept Input"/>
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s2. select relevant values for JCC (IX = 0; GPR = 1; I = 0; Address = 15)
in manual input part -> accept manual word instruction

Manual Instructions	<input type="text" value="JCC"/>	<input type="text" value="No..."/>	<input type="text" value="GPR1"/>	<input type="text" value="IA ..."/>	<input type="text" value="15"/>
	<input type="text" value="0, 0, 1, 0, 1, 0"/>	<input type="text" value="[0, 0]"/>	<input type="text" value="[0, 1]"/>	<input type="text" value="[0]"/>	<input type="text" value="[0, 1, 1, 1, 1]"/>
<input type="button" value="Accept Manual Word Instruction"/>					

[Expected Result] -> PC is populated with 15

PC	<input type="text" value="[0, 0, 0, 0, 0, 0, 0, 0, 1, 1, 1, 1]"/>	<input type="text" value="15"/>
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Case 2 - If cc bit = 0, $PC \leftarrow PC + 1$

s1. input 15 to PC

PC	<input type="text" value="[0, 0, 0, 0, 0, 0, 0, 0, 1, 1, 1, 1]"/>	<input type="text" value="15"/>
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s2. input 0 to Condition Code

CC	<input type="text" value="[0, 0, 0, 0]"/>	<input type="text" value="0"/>
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s3. select relevant values for JCC (IX = 0; GPR = 1; I = 0; Address = 15)

in manual input part -> accept manual word instruction

Manual Instructions	<input type="text" value="JCC"/>	<input type="text" value="No..."/>	<input type="text" value="GPR1"/>	<input type="text" value="IA ..."/>	<input type="text" value="15"/>
	<input type="text" value="0, 0, 1, 0, 1, 0]"/>	<input type="text" value="[0, 0]"/>	<input type="text" value="[0, 1]"/>	<input type="text" value="[0]"/>	<input type="text" value="[0, 1, 1, 1, 1]"/>
<input type="button" value="Accept Manual Word Instruction"/>					

[Expected Result] -> PC is populated with 16

PC	<input type="text" value="[0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0]"/>	<input type="text" value="16"/>
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10. JMA

Case 1 - $PC \leftarrow EA(\text{address})$, if I bit not set

s1. select relevant values for JMA (IX = 0; GPR = 1; I = 0; Address = 15)

in manual input part -> accept manual word instruction

Manual Instructions	<input type="text" value="J..."/>	<input type="text" value="No..."/>	<input type="text" value="GPR1"/>	<input type="text" value="IA ..."/>	<input type="text" value="15"/>
	<input type="text" value="0, 0, 1, 0, 1, 1]"/>	<input type="text" value="[0, 0]"/>	<input type="text" value="[0, 1]"/>	<input type="text" value="[0]"/>	<input type="text" value="[0, 1, 1, 1, 1]"/>
<input type="button" value="Accept Manual Word Instruction"/>					

[Expected Result] -> PC is populated with 15

PC	<input type="text" value="[0, 0, 0, 0, 0, 0, 0, 0, 1, 1, 1, 1]"/>	<input type="text" value="15"/>
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Case 2 - $PC \leftarrow \text{Address} + c(\text{IX})$, if I bit set

s1. input 5 to IX1

IX1	<input type="text" value="[0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 1]"/>	<input type="text" value="5"/>	<input type="button" value="Accept"/>
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s2. select relevant values for JMA (IX = 1; GPR = 1; I = 1; Address = 15)
in manual input part -> accept manual word instruction

Manual Instructions	<input type="button" value="J..."/>	<input type="button" value="IX..."/>	<input type="button" value="GPR1"/>	<input type="button" value="IA ..."/>	<input type="button" value="15"/>
	<input type="text" value="[0, 0, 1, 0, 1, 1]"/>	<input type="text" value="[0, 1]"/>	<input type="text" value="[0, 1]"/>	<input type="text" value="[1]"/>	<input type="text" value="[0, 1, 1, 1, 1]"/>
<input type="button" value="Accept Manual Word Instruction"/>					

[Expected Result] -> PC is populated with 20

PC	<input type="text" value="[0, 0, 0, 0, 0, 0, 0, 1, 0, 1, 0, 0]"/>	<input type="text" value="20"/>
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11. JSR

s1. input 20 to PC

PC	<input type="text" value="[0, 0, 0, 0, 0, 0, 0, 1, 0, 1, 0, 0]"/>	<input type="text" value="20"/>
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s2. select relevant values for JSR (IX = 0; GPR = 3; I = 0; Address = 10)
in manual input part -> accept manual word instruction

Manual Instructions	<input type="button" value="JSR"/>	<input type="button" value="No..."/>	<input type="button" value="GPR3"/>	<input type="button" value="IA ..."/>	<input type="button" value="10"/>
	<input type="text" value="[0, 0, 1, 1, 0, 0]"/>	<input type="text" value="[0, 0]"/>	<input type="text" value="[1, 1]"/>	<input type="text" value="[0]"/>	<input type="text" value="[0, 1, 0, 1, 0]"/>
<input type="button" value="Accept Manual Word Instruction"/>					

[Expected Result] -> GPR3 is populated with 21 (PC + 1), GPR0 is populated with 10 (address)

GPR0	<input type="text" value="0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 1, 0"/>	<input type="text" value="10"/>	<input type="button" value="Accept"/>
GPR1	<input type="text" value="0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0"/>	<input type="text" value="0"/>	<input type="button" value="Accept"/>
GPR2	<input type="text" value="0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0"/>	<input type="text" value="0"/>	<input type="button" value="Accept"/>
GPR3	<input type="text" value="0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 1, 0, 1"/>	<input type="text" value="21"/>	<input type="button" value="Accept"/>

12. RFS - $R0 \leftarrow \text{Immed}$; $PC \leftarrow c(R3)$

s1. input 20 to GPR3

GPR3	<input type="text" value="0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 1, 0, 0"/>	<input type="text" value="20"/>	<input type="button" value="Accept"/>
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s2. select relevant values for RFS (IX = 0; GPR = 3; I = 0; Address = 10)
in manual input part -> accept manual word instruction

Manual Instructions	<input type="button" value="RFS"/>	<input type="button" value="No..."/>	<input type="button" value="GPR3"/>	<input type="button" value="IA ..."/>	<input type="button" value="10"/>
	<input type="text" value="0, 0, 1, 1, 0, 1"/>	<input type="text" value="[0, 0]"/>	<input type="text" value="[1, 1]"/>	<input type="text" value="[0]"/>	<input type="text" value="[0, 1, 0, 1, 0]"/>
<input type="button" value="Accept Manual Word Instruction"/>					

[Expected Result] -> GPR0 is populated with 10, PC is populated with 20

GPR0	<input type="text" value="0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 1, 0"/>	<input type="text" value="10"/>	<input type="button" value="Accept"/>
PC	<input type="text" value="0, 0, 0, 0, 0, 0, 0, 1, 0, 1, 0, 0, 0"/>	<input type="text" value="20"/>	

13. SOB

Case 1 - $r \leftarrow c(r) - 1$ If $c(r) > 0$, $PC \leftarrow EA(\text{address})$

s1. input 10 to GPR0

GPR0	<input type="text" value="0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 1, 0"/>	<input type="text" value="10"/>	<input type="button" value="Accept"/>
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s2. select relevant values for SOB (IX = 0; GPR = 0; I = 0; Address = 10)
in manual input part -> accept manual word instruction

Manual Instructions

SOB No... GPR0 IA ... 10

[Expected Result] -> GPR0 = 9; PC = 10

GPR0

PC

Case 2 - $r \leftarrow c(r) - 1$ If $c(r) > 0$, $PC \leftarrow \text{Address} + c(\text{IX})$ if $\text{IX} \neq 0$ and $I = 1$

s1. input 10 to GPR0

GPR0

s2. input 5 to IX1

IX1

s3. select relevant values for SOB ($\text{IX} = 1$; $\text{GPR} = 0$; $I = 1$; $\text{Address} = 10$)
in manual input part -> accept manual word instruction

[Expected Result] -> GPR0 = 9; PC = 15

GPR0

PC

Case 3 - If $c(r) = 0$, $PC \leftarrow PC + 1$

s1. input 0 to GPR0

GPR0

s2. input 20 to PC

PC	[0, 0, 0, 0, 0, 0, 0, 1, 0, 1, 0, 0]	20
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s2. select relevant values for SOB (IX = 0; GPR = 0; I = 0; Address = 10)
in manual input part -> accept manual word instruction

Manual Instructions	SOB	No...	GPR0	IA ...	10
	[0, 0, 1, 1, 1, 0]	[0, 0]	[0, 0]	[0]	[0, 1, 0, 1, 0]
Accept Manual Word Instruction					

[Expected Result] -> PC = 21

PC	[0, 0, 0, 0, 0, 0, 0, 1, 0, 1, 0, 1]	21
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14. JGE

Case 1 - If $c(r) \geq 0$, then $PC \leftarrow EA(\text{address})$ if $IX = 0$ and $I = 0$

s1. input 10 to GPR0

GPR0	[0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 1, 0]	10	Accept
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s2. select relevant values for JGE (IX = 0; GPR = 0; I = 0; Address = 10)
in manual input part -> accept manual word instruction

Manual Instructions	JGE	No...	GPR0	IA ...	10
	[0, 0, 1, 1, 1, 1]	[0, 0]	[0, 0]	[0]	[0, 1, 0, 1, 0]
Accept Manual Word Instruction					

[Expected Result] -> PC = 10

PC	[0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 1, 0]	10
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Case 2 - If $c(r) \geq 0$, $IX \neq 0$ and $I = 1$, then $PC \leftarrow \text{Address} + c(IX)$

s1. input 10 to GPR0

GPR0	[0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 1, 0]	10	Accept
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s2. input 5 to IX1

IX1	<input type="text" value="0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 1"/>	<input type="text" value="5"/>
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s3. select relevant values for JGE (IX = 1; GPR = 0; I = 1; Address = 10)
in manual input part -> accept manual word instruction

Manual Instructions	JGE	IX...	GPR0	IA ...	10
	<input type="text" value="0, 0, 1, 1, 1, 1"/>	<input type="text" value="[0, 1]"/>	<input type="text" value="[0, 0]"/>	<input type="text" value="[1]"/>	<input type="text" value="[0, 1, 0, 1, 0]"/>
<input type="button" value="Accept Manual Word Instruction"/>					

[Expected Result] -> PC = 15

PC	<input type="text" value="0, 0, 0, 0, 0, 0, 0, 0, 1, 1, 1, 1"/>	<input type="text" value="15"/>
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15. AMR

s1. input 20 to memory location -> accept

s2. input 100 to memory location's value -> accept

Memory	<input type="text" value="20"/>	<input type="button" value="Accept"/>	<input type="text" value="0, 0, 0, 0, 0, 0, 0, 0, 1, 1, 0, 0, 1, 0, 0"/>	<input type="text" value="100"/>
--------	---------------------------------	---------------------------------------	--	----------------------------------

s3. input 100 to GPR0

GPR0	<input type="text" value="0, 0, 0, 0, 0, 0, 0, 0, 1, 1, 0, 0, 1, 0, 0"/>	<input type="text" value="100"/>
------	--	----------------------------------

s4. select relevant values for AMR (IX = 0; GPR = 0; I = 0; Address = 20)
in manual input part -> accept manual word instruction

Manual Instructions	A...	No...	GPR0	IA ...	20
	<input type="text" value="0, 0, 0, 1, 0, 0"/>	<input type="text" value="[0, 0]"/>	<input type="text" value="[0, 0]"/>	<input type="text" value="[0]"/>	<input type="text" value="[1, 0, 1, 0, 0]"/>
<input type="button" value="Accept Manual Word Instruction"/>					

[Expected Result] -> GPR0 = 200

GPR0	<input type="text" value="0, 0, 0, 0, 0, 0, 0, 0, 1, 1, 0, 0, 1, 0, 0, 0"/>	<input type="text" value="200"/>
------	---	----------------------------------

16. SMR

s1. input 200 to GPR0

GPR0	<input type="text" value="0, 0, 0, 0, 0, 0, 0, 0, 1, 1, 0, 0, 1, 0, 0, 0"/>	<input type="text" value="200"/>
------	---	----------------------------------

s2. input 20 to memory location -> accept

s3. input 100 to memory location's value -> accept

Memory	<input type="text" value="20"/>	<input type="button" value="Accept"/>	<input type="text" value="0, 0, 0, 0, 0, 0, 0, 0, 1, 1, 0, 0, 1, 0, 0, 0"/>	<input type="text" value="100"/>
--------	---------------------------------	---------------------------------------	---	----------------------------------

s4. select relevant values for SMR (IX = 0; GPR = 0; I = 0; Address = 20)

in manual input part -> accept manual word instruction

Manual Instructions	<input type="button" value="S..."/>	<input type="button" value="No..."/>	<input type="button" value="GPR0"/>	<input type="button" value="IA ..."/>	<input type="button" value="20"/>
	<input type="text" value="0, 0, 0, 1, 0, 1"/>	<input type="text" value="[0, 0]"/>	<input type="text" value="[0, 0]"/>	<input type="text" value="[0]"/>	<input type="text" value="[1, 0, 1, 0, 0]"/>
<input type="button" value="Accept Manual Word Instruction"/>					

[Expected Result] -> GPR0 = 100

GPR0	<input type="text" value="0, 0, 0, 0, 0, 0, 0, 0, 1, 1, 0, 0, 1, 0, 0, 0"/>	<input type="text" value="100"/>
------	---	----------------------------------

17. AIR

Case 1 - $r \leftarrow c(r) + \text{Immed}$, do nothing if Immed = 0

s1. input 100 to GPR0

GPR0	<input type="text" value="0, 0, 0, 0, 0, 0, 0, 0, 1, 1, 0, 0, 1, 0, 0, 0"/>	<input type="text" value="100"/>
------	---	----------------------------------

s2. select relevant values for AIR (IX = 0; GPR = 0; I = 0; Address = 0)

in manual input part -> accept manual word instruction

Manual Instructions

AIR	No...	GPR0	IA ...	0
0, 0, 0, 1, 1, 0]	[0, 0]	[0, 0]	[0]	[0, 0, 0, 0, 0]

Accept Manual Word Instruction

[Expected Result] -> GPR0 = 100

GPR0

0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 1, 0, 0, 1, 0, 0]	100
---	-----

Case 2 - $r \leftarrow c(r) + \text{Immed}$, loads r with Immed, if $c(r) = 0$

s1. input 0 to GPR0

GPR0

0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0]	0
---	---

s2. select relevant values for AIR (IX = 0; GPR = 0; I = 0; Address = 20)

in manual input part -> accept manual word instruction

Manual Instructions

AIR	No...	GPR0	IA ...	20
0, 0, 0, 1, 1, 0]	[0, 0]	[0, 0]	[0]	[1, 0, 1, 0, 0]

Accept Manual Word Instruction

[Expected Result] -> GPR0 = 20

GPR0

0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 1, 0, 0]	20
---	----

Case 3 - $r \leftarrow c(r) + \text{Immed}$

s1. input 100 to GPR0

GPR0

0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 1, 0, 0, 1, 0, 0]	100
---	-----

s2. select relevant values for AIR (IX = 0; GPR = 0; I = 0; Address = 20)

in manual input part -> accept manual word instruction

Manual Instructions

AIR	No...	GPR0	IA ...	20
0, 0, 0, 1, 1, 0]	[0, 0]	[0, 0]	[0]	[1, 0, 1, 0, 0]

Accept Manual Word Instruction

[Expected Result] -> GPR0 = 120

GPR0

0, 0, 0, 0, 0, 0, 0, 0, 1, 1, 1, 1, 0, 0, 0]	120
--	-----

18. SIR

Case 1 - $r \leftarrow c(r)$ - Immed, do nothing if Immed = 0

s1. input 100 to GPR0

GPR0

0, 0, 0, 0, 0, 0, 0, 0, 1, 1, 0, 0, 1, 0, 0]	100
--	-----

s2. select relevant values for SIR (IX = 0; GPR = 0; I = 0; Address = 0)

in manual input part -> accept manual word instruction

Manual Instructions

SIR	No...	GPR0	IA ...	0
0, 0, 0, 1, 1, 1]	[0, 0]	[0, 0]	[0]	[0, 0, 0, 0, 0]

Accept Manual Word Instruction

[Expected Result] -> GPR0 = 100

GPR0

0, 0, 0, 0, 0, 0, 0, 0, 1, 1, 0, 0, 1, 0, 0]	100
--	-----

Case 2 - $r \leftarrow c(r)$ - Immed

s1. input 100 to GPR0

GPR0

0, 0, 0, 0, 0, 0, 0, 0, 1, 1, 0, 0, 1, 0, 0]	100
--	-----

s2. select relevant values for SIR (IX = 0; GPR = 0; I = 0; Address = 20)

in manual input part -> accept manual word instruction

Manual Instructions

SIR [dropdown] No... [dropdown] GPR0 [dropdown] IA ... [dropdown] 20 [dropdown]

[0, 0, 0, 1, 1, 1] [0, 0] [0, 0] [0] [1, 0, 1, 0, 0]

Accept Manual Word Instruction

[Expected Result] -> GPR0 = 80

GPR0 [0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 1, 0, 0, 0, 0] 80

19. MLT

(one General Purpose Register and one Index Register are used here)

Case 1 - no overflow

s1. input 20 to GPR0

GPR0 [0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 1, 0, 0, 0] 20

s2. input 50 to IX1

IX1 [0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 1, 0, 0, 1, 0] 50

s3. select relevant values for MLT (IX = 1; GPR = 0; I = 0; Address = 0)
in manual input part -> accept manual word instruction

Manual Instructions

M... [dropdown] IX... [dropdown] GPR0 [dropdown] IA ... [dropdown] 0 [dropdown]

[0, 1, 0, 0, 0, 0] [0, 1] [0, 0] [0] [0, 0, 0, 0, 0]

Accept Manual Word Instruction

[Expected Result] -> GPR0 = 1000

GPR0 [0, 0, 0, 0, 0, 0, 1, 1, 1, 1, 1, 0, 1, 0, 0, 0] 1000

Case 2 - overflow happens, set cc(0) to 1

s1. input 1000 to GPR0

GPR0

s2. input 1000 to IX1

IX1

s3. select relevant values for MLT (IX = 1; GPR = 0; I = 0; Address = 0)
in manual input part -> accept manual word instruction

Manual Instructions

[Expected Result] -> cc(0) = 1

CC

20. DVD

(one General Purpose Register and one Index Register are used here)

Case 1 - no exception

s1. input 1000 to GPR0

GPR0

s2. input 50 to IX1

IX1

s3. select relevant values for DVD (IX = 1; GPR = 0; I = 0; Address = 0)
in manual input part -> accept manual word instruction

Manual Instructions

[Expected Result] -> GPR0 = 20

GPR0	<input type="text" value="0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 1, 0, 0]"/>	<input type="text" value="20"/>
------	---	---------------------------------

Case 2 - division by zero, set cc(2) to 1

s1. input 1000 to GPR0

GPR0	<input type="text" value="0, 0, 0, 0, 0, 0, 1, 1, 1, 1, 1, 0, 1, 0, 0]"/>	<input type="text" value="1000"/>
------	---	-----------------------------------

s2. input 0 to IX1

IX1	<input type="text" value="0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0]"/>	<input type="text" value="0"/>
-----	---	--------------------------------

s3. select relevant values for DVD (IX = 1; GPR = 0; I = 0; Address = 0)
in manual input part -> accept manual word instruction

Manual Instructions	<input type="text" value="D..."/>	<input type="text" value="IX..."/>	<input type="text" value="GPR0"/>	<input type="text" value="IA ..."/>	<input type="text" value="0"/>
	<input type="text" value="0, 1, 0, 0, 0, 1]"/>	<input type="text" value="[0, 1]"/>	<input type="text" value="[0, 0]"/>	<input type="text" value="[0]"/>	<input type="text" value="[0, 0, 0, 0, 0]"/>
<input type="button" value="Accept Manual Word Instruction"/>					

[Expected Result] -> cc(2) = 1

CC	<input type="text" value="[0, 1, 0, 0]"/>
----	---

21. TRR

Case 1 - If $c(rx) = c(ry)$, set $cc(3) \leftarrow 1$

(one General Purpose Register and one Index Register are used here)

s1. input 20 to GPR0

GPR0	<input type="text" value="0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 1, 0, 0]"/>	<input type="text" value="20"/>
------	---	---------------------------------

s2. input 20 to IX1

IX1	<input type="text" value="0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 1, 0, 0]"/>	<input type="text" value="20"/>
-----	---	---------------------------------

s3. select relevant values for TRR (IX = 1; GPR = 0; I = 0; Address = 0)
in manual input part -> accept manual word instruction

[Expected Result] -> $cc(3) = 1$

Case 2 - If $c(rx) \neq c(ry)$, set $cc(3) \leftarrow 0$

(one General Purpose Register and one Index Register are used here)

s1. input 20 to GPR0

s2. input 10 to IX1

s3. select relevant values for TRR (IX = 1; GPR = 0; I = 0; Address = 0)
in manual input part -> accept manual word instruction

[Expected Result] -> $cc(3) = 0$

22. AND

(one General Purpose Register and one Index Register are used here)

s1. input 10 to GPR0

GPR0	<input type="text" value="0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 1, 0"/>	<input type="text" value="10"/>
------	---	---------------------------------

s1. input 8 to IX1

IX1	<input type="text" value="0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0"/>	<input type="text" value="8"/>
-----	---	--------------------------------

s3. select relevant values for AND (IX = 1; GPR = 0; I = 0; Address = 0)
in manual input part -> accept manual word instruction

Manual Instructions	<input type="text" value="A..."/>	<input type="text" value="IX..."/>	<input type="text" value="GPR0"/>	<input type="text" value="IA ..."/>	<input type="text" value="0"/>
	<input type="text" value="0, 1, 0, 0, 1, 1"/>	<input type="text" value="[0, 1]"/>	<input type="text" value="[0, 0]"/>	<input type="text" value="[0]"/>	<input type="text" value="[0, 0, 0, 0, 0]"/>
<input type="button" value="Accept Manual Word Instruction"/>					

[Expected Result] -> GPR0 = 8

GPR0	<input type="text" value="0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0"/>	<input type="text" value="8"/>
------	---	--------------------------------

23. ORR

(one General Purpose Register and one Index Register are used here)

s1. input 0 to GPR0

GPR0	<input type="text" value="0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0"/>	<input type="text" value="0"/>
------	---	--------------------------------

s2. input 8 to IX1

IX1	<input type="text" value="0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0"/>	<input type="text" value="8"/>
-----	---	--------------------------------

s3. select relevant values for ORR (IX = 1; GPR = 0; I = 0; Address = 0)
in manual input part -> accept manual word instruction

Manual Instructions	<input type="text" value="O..."/>	<input type="text" value="IX..."/>	<input type="text" value="GPR0"/>	<input type="text" value="IA ..."/>	<input type="text" value="0"/>
	<input type="text" value="0, 1, 0, 1, 0, 0"/>	<input type="text" value="[0, 1]"/>	<input type="text" value="[0, 0]"/>	<input type="text" value="[0]"/>	<input type="text" value="[0, 0, 0, 0, 0]"/>
<input type="button" value="Accept Manual Word Instruction"/>					

[Expected Result] -> GPR0 = 8

GPR0	0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0]	8
------	--	---

24. NOT

s1. input 8 to GPR0

GPR0	0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0]	8
------	---	---

s2. select relevant values for NOT (IX = 0; GPR = 0; I = 0; Address = 0)
in manual input part -> accept manual word instruction

Manual Instructions	N...	No...	GPR0	IA ...	0
	0, 1, 0, 1, 0, 1]	[0, 0]	[0, 0]	[0]	[0, 0, 0, 0, 0]
<button>Accept Manual Word Instruction</button>					

[Expected Result] -> GPR0 = ~8

GPR0	1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 0, 1, 1, 1]	-9
------	---	----

25. SRC

(Index Register is used to decide left/right shift, address value is used to decide the bits to shift)

Case 1 - left shift

s1. input 10 to GPR0

GPR0	0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 1, 0]	10
------	---	----

s2. input 1 to IX1

IX1	0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1]	1
-----	--	---

s3. select relevant values for SRC (IX = 1; GPR = 0; I = 0; Address = 1)

in manual input part -> accept manual word instruction

Manual Instructions

SRC	IX...	GPR0	IA ...	1
0, 1, 1, 0, 0, 1]	[0, 1]	[0, 0]	[0]	[0, 0, 0, 0, 1]

Accept Manual Word Instruction

[Expected Result] -> GPR0 = 20

[illegible]

Case 2 - right shift

s1. input 20 to GPR0

GPR0	[0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 1, 0, 0]	20
------	--	----

s2. select relevant values for SRC (IX = 0; GPR = 0; I = 0; Address = 1)

in manual input part -> accept manual word instruction

Manual Instructions

SRC	No...	GPR0	IA ...	1
0, 1, 1, 0, 0, 1]	[0, 0]	[0, 0]	[0]	[0, 0, 0, 0, 1]

Accept Manual Word Instruction

[Expected Result] -> GPR0 = 10

GPR0	[0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 1, 0]	10
------	--	----

26. RRC

(Index Register is used to decide left/right shift, address value is used to decide the bits to shift)

Case 1 - left shift

s1. input 10 to GPR0

[illegible]

s2. input 1 to IX1

IX1	<input type="text" value="0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1"/>	<input type="text" value="1"/>
-----	--	--------------------------------

s3. select relevant values for RRC (IX = 1; GPR = 0; I = 0; Address = 1)
in manual input part -> accept manual word instruction

Manual Instructions	<input type="text" value="RRC"/>	<input type="text" value="IX..."/>	<input type="text" value="GPR0"/>	<input type="text" value="IA ..."/>	<input type="text" value="1"/>
	<input type="text" value="0, 1, 1, 0, 1, 0"/>	<input type="text" value="[0, 1]"/>	<input type="text" value="[0, 0]"/>	<input type="text" value="[0]"/>	<input type="text" value="[0, 0, 0, 0, 1]"/>
<input type="button" value="Accept Manual Word Instruction"/>					

[Expected Result] -> GPR0 = 20

GPR0	<input type="text" value="0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 1, 0, 0"/>	<input type="text" value="20"/>
------	---	---------------------------------

Case 2 - left shift

s1. input 10 to GPR0

GPR0	<input type="text" value="0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 1, 0"/>	<input type="text" value="10"/>
------	---	---------------------------------

s2. select relevant values for RRC (IX = 0; GPR = 0; I = 0; Address = 1)
in manual input part -> accept manual word instruction

Manual Instructions	<input type="text" value="RRC"/>	<input type="text" value="No..."/>	<input type="text" value="GPR0"/>	<input type="text" value="IA ..."/>	<input type="text" value="1"/>
	<input type="text" value="0, 1, 1, 0, 1, 0"/>	<input type="text" value="[0, 0]"/>	<input type="text" value="[0, 0]"/>	<input type="text" value="[0]"/>	<input type="text" value="[0, 0, 0, 0, 1]"/>
<input type="button" value="Accept Manual Word Instruction"/>					

[Expected Result] -> GPR0 = 5

GPR0	<input type="text" value="0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 1"/>	<input type="text" value="5"/>
------	--	--------------------------------

27. IN/OUT

Our test program 1 has covered these two instructions, so not intended to demonstrate them again through this step.

End of Document