

Lab 3 - Debugging Utilities

This lab implements several debugging utilities to the XM23P Emulator:

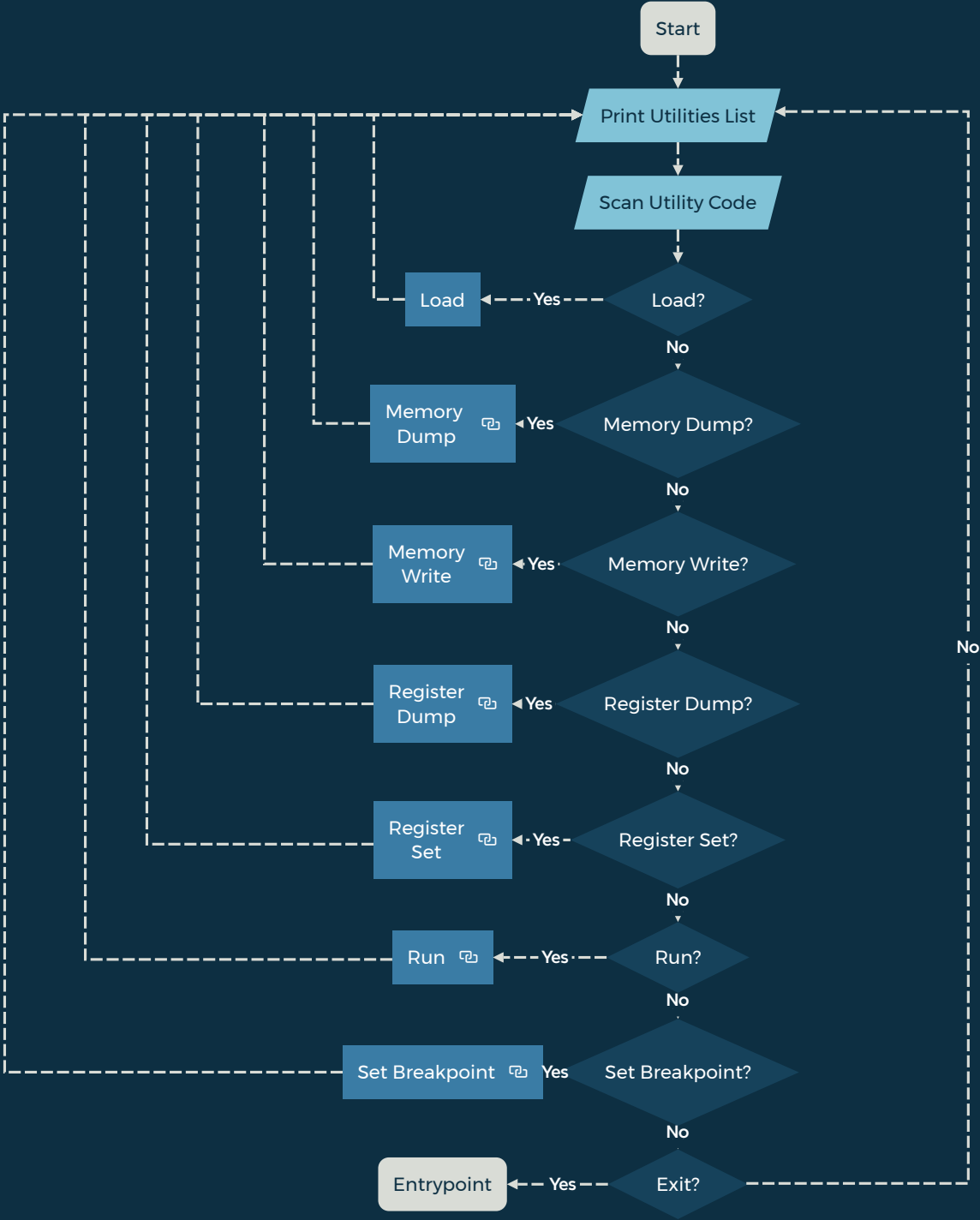
- Memory Read/Write
- Register Read/Write
- Breakpoint Insertion

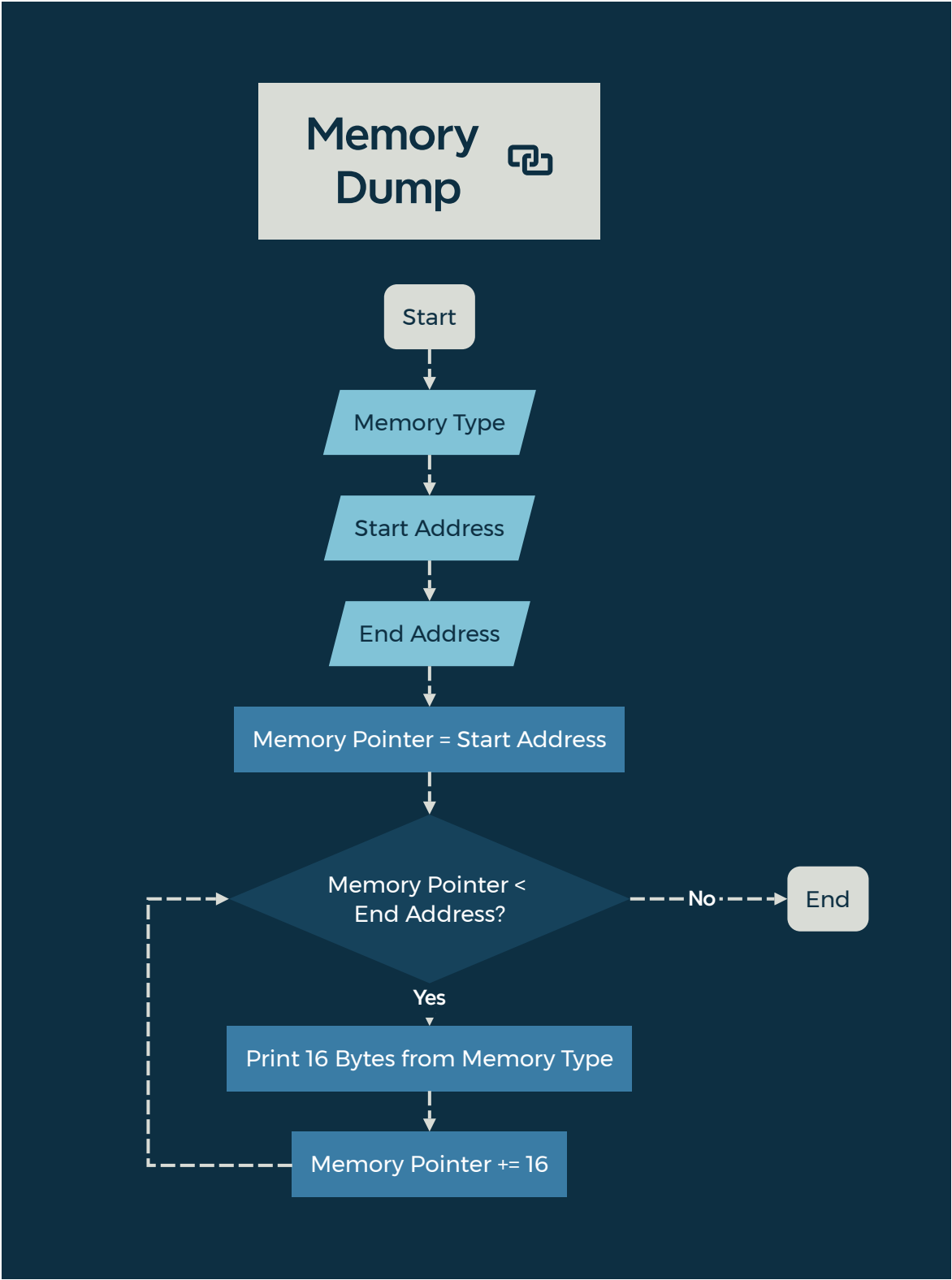
Design

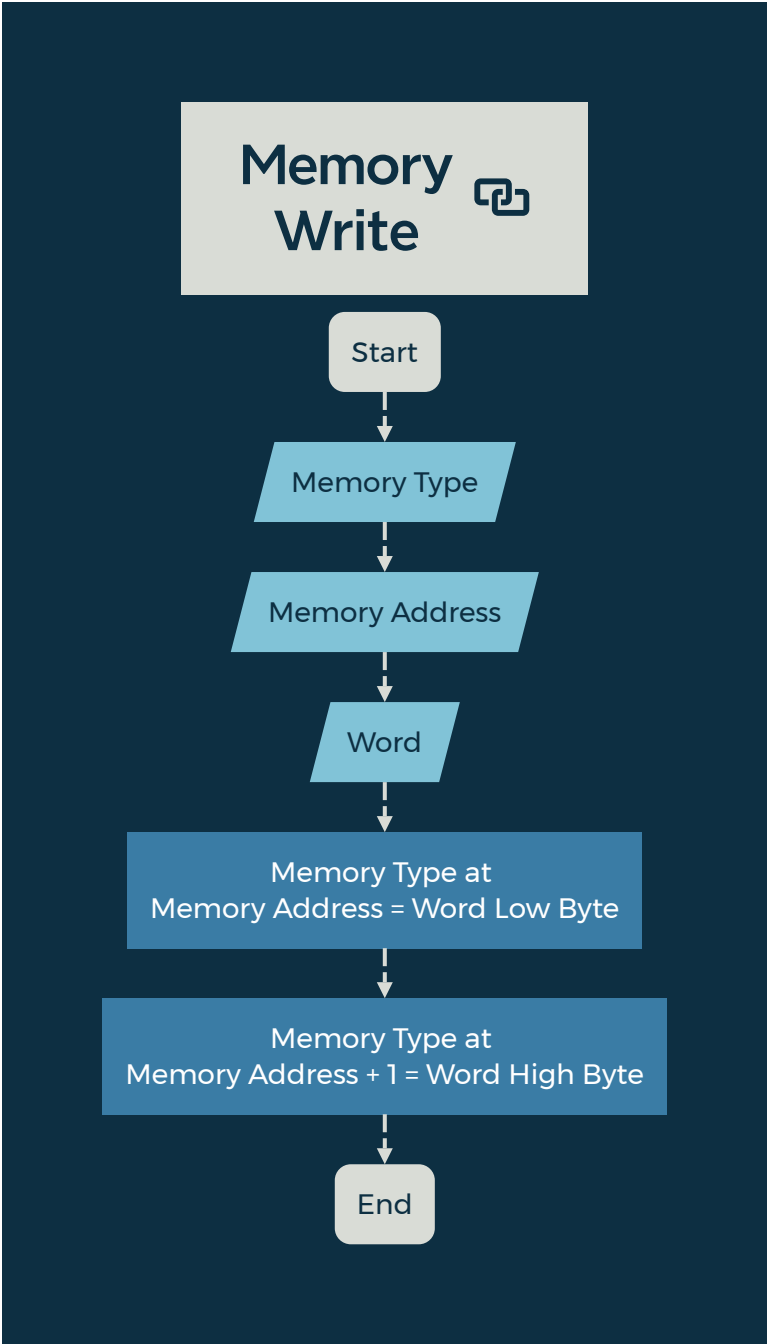
The design contains logic flowcharts detailing the implementation of a more robust "operating system", as well as the utilities.

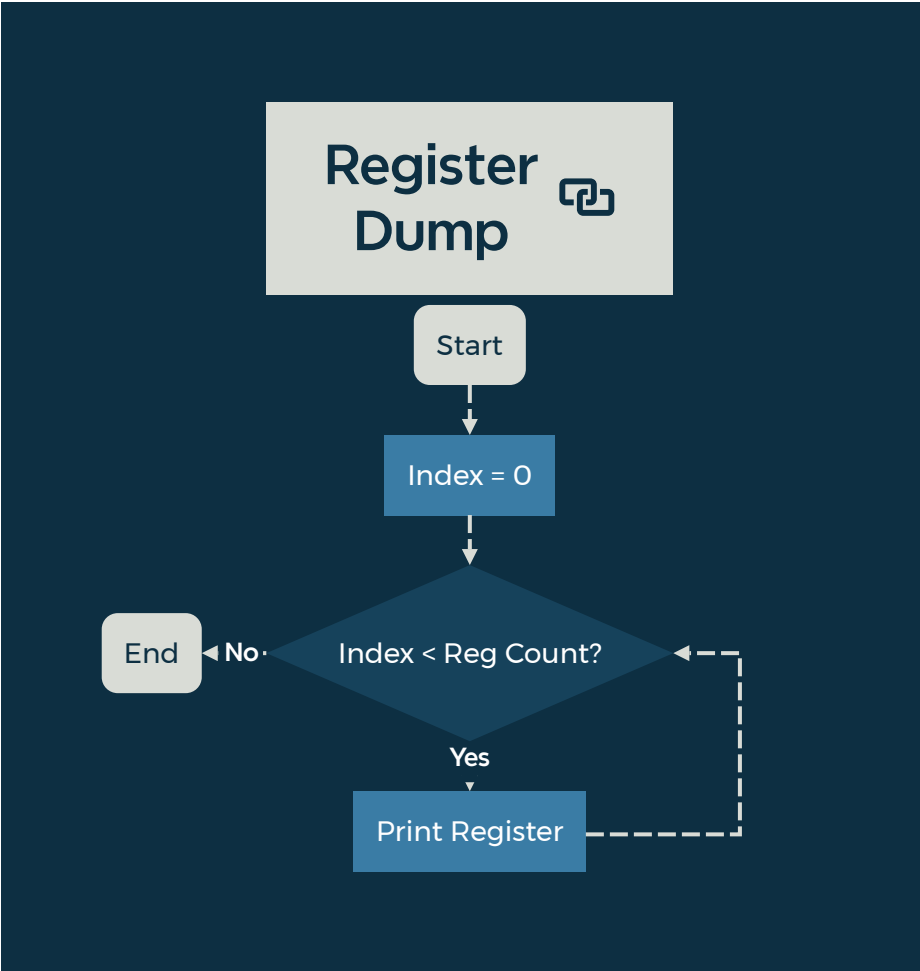
A Data Dictionary for the current state of the emulator is included.

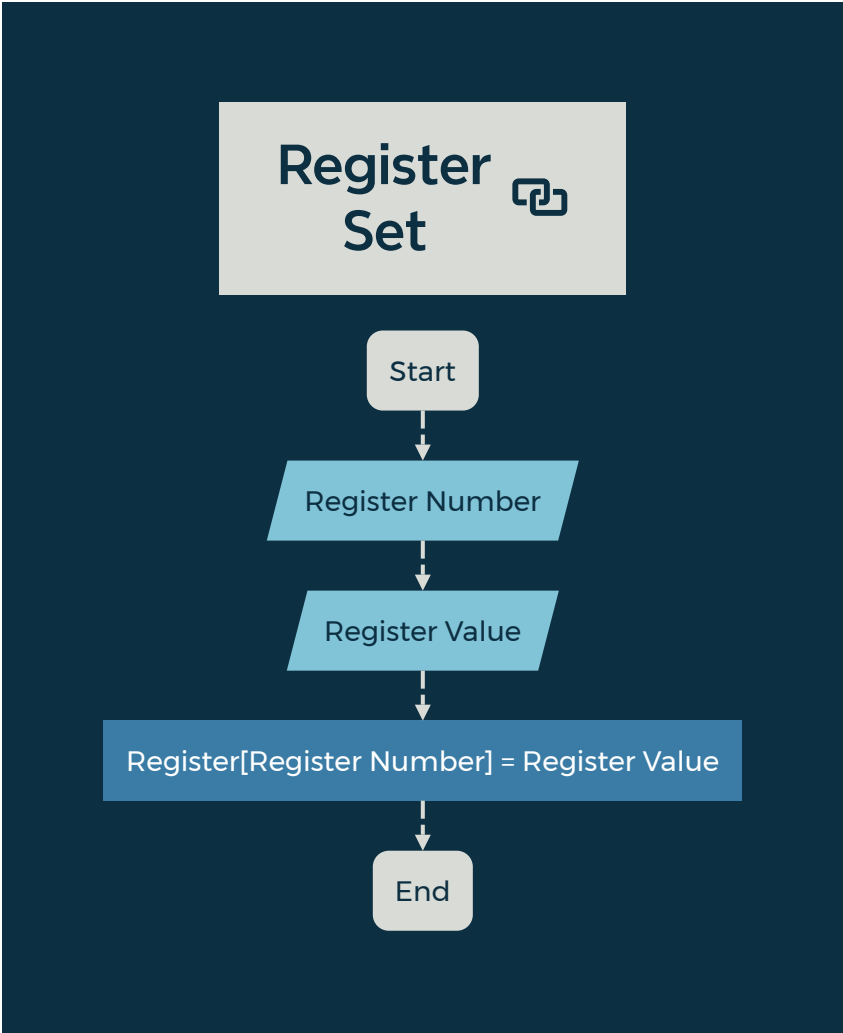
Operating System

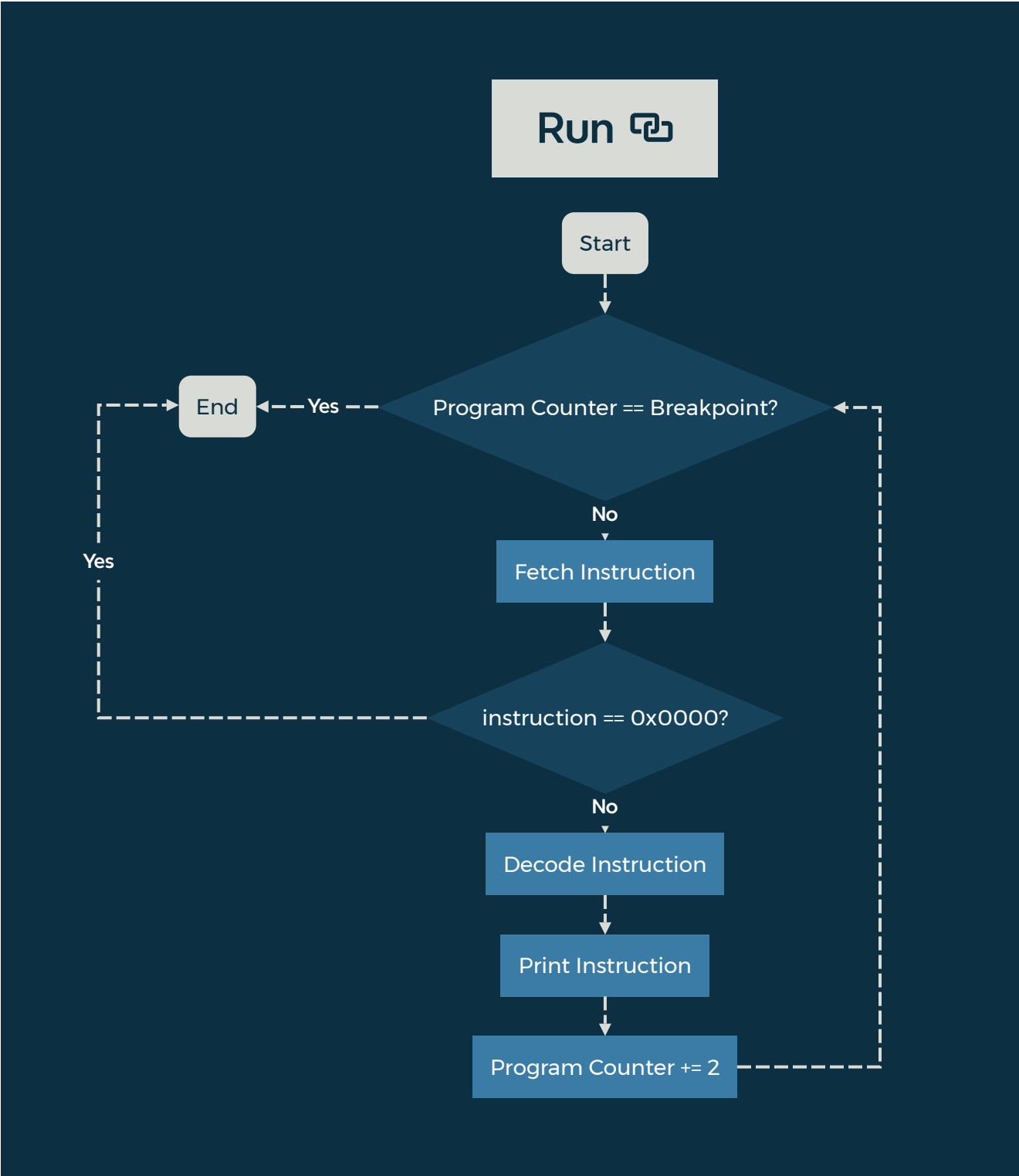




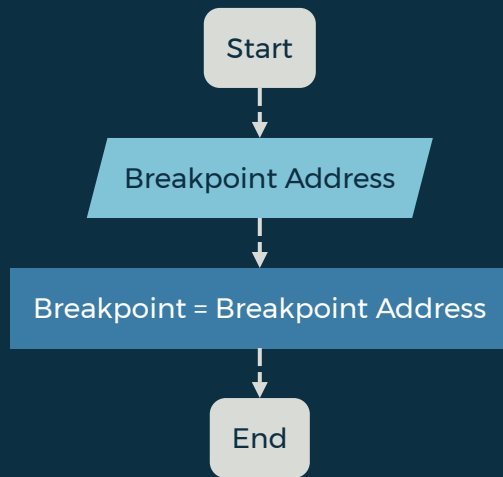








Set Breakpoint



Data Dictionary

PROGRAM	=	IMEM + DMEM + REGFILE + BREAKPOINT + START_ADDRESS + IR
IMEM	=	64*2^10{BYTE}64*2^10
DMEM	=	64*2^10{BYTE}64*2^10
REGFILE	=	8{WORD}8
BREAKPOINT	=	ADDRESS
START_ADDRESS	=	ADDRESS
IR	=	WORD
INSTRUCTION	=	CODE + 1{PARAMETER}4
CODE	=	[0-20] *Contiguous encoding of instructions*
PARAMETER	=	[RC WB SOURCE DESTINATION BYTE]
RC	=	BIT
WB	=	BIT
SOURCE	=	3{BIT}3
DESTINATION	=	3{BIT}3
ADDRESS	=	WORD
WORD	=	2{BYTE}2
BYTE	=	8{BIT}8
BIT	=	[0 1]
S_REC	=	'S' + REC_TYPE + LENGTH + ADDRESS + DATA
REC_TYPE	=	['0' '1' '2' '9']
LENGTH	=	BYTE_PAIR
ADDRESS	=	2{BYTE_PAIR}2
DATA	=	1{BYTE_PAIR}30
BYTE_PAIR	=	2{CHAR}2
CHAR	=	['0'-'F']

Testing

The following tests were implemented:

- Test_10: Instruction Memory Dump
- Test_11: Data Memory Dump
- Test_12: Instruction Memory Write
- Test_13: Data Memory Write
- Test_14: Register Dump
- Test_15: Register Set
- Test_16: Breakpoint Set

Test_10: Instruction Memory Dump

Purpose

Test the printing of memory from instruction memory.

Configuration

1. Test10_Program_Debugging.xme was loaded into the emulator.
2. `m` was entered to start the Memory Dumping Utility.
3. `0` was entered to select Instruction Memory.
4. Start Address of `0x0100` was entered.
5. End Address of `0x0180` was entered.

Expected Results

The program should print the contents of memory between address `#0100` and `#0180`.

Results

The contents were correctly printed:

#0100	f0	65	79	7f	d2	6f	73	76	01	40	d3	40	25	41	f7	41
#0110	01	42	d3	42	25	43	f7	43	01	44	d3	44	25	45	f7	45
#0120	01	46	d3	46	25	47	f7	47	01	48	d3	48	25	49	f7	49
#0130	01	4a	d3	4a	25	4b	f7	4b	01	4c	53	4c	a5	4c	06	4d
#0140	47	4d	08	4d	49	4d	1a	4d	23	4d	0c	00	0b	20	0a	20
#0150	09	24	08	24	07	28	06	28	05	2c	04	2c	03	30	02	34
#0160	01	38	00	3c	81	4d	92	4d	bf	4d	df	4d	48	50	01	58
#0170	01	5c	82	80	81	c0	00	00	00	00	00	00	00	00	00	00

Pass/Fail

Pass.

Test_11: Data Memory Dump

Purpose

Test the printing of memory from data memory.

Configuration

1. Test10_Program_Debugging.xme was loaded into the emulator.
2. `m` was entered to start the Memory Dumping Utility.
3. `1` was entered to select Data Memory.
4. Start Address of `0x0800` was entered.
5. End Address of `0x0810` was entered.

Expected Results

The program should print the contents of memory between address `#0800` and `#0810`.

Results

The contents were correctly printed:

```
Memory Dump Utility
Select Memory Type:
0 - Program Memory | 1 - Data Memory
1
Enter Memory Start Address: 800
Enter Memory End Address: 810
#0800  fe ed be ef 00 00 00 00 00 00 00 00 00 00 00 00
```

Pass/Fail

Pass.

Test_12: Instruction Memory Write

Purpose

Test the writing of memory to instruction memory.

Configuration

1. Test10_Program_Debugging was loaded into the emulator.
2. `w` was entered to start the Memory Writing Utility.
3. `0` was entered to select Instruction Memory.
4. Start Address of `0x0100` was entered.
5. Data `0x1234` was entered.
6. `m` was entered to start the Memory Dumping Utility.
7. `0` was entered to select Instruction Memory.
8. Start Address of `0x0100` was entered.
9. End Address of `0x0180` was entered.

Expected Results

The program should write the data `0x1234` to memory address `#0100`.

Results

The data was successfully written to memory in little endian format:

```
Memory Dump Utility
Select Memory Type:
0 - Program Memory | 1 - Data Memory
0
Enter Memory Start Address: 100
Enter Memory End Address: 180
#0100  34 12 79 7f d2 6f 73 76 01 40 d3 40 25 41 f7 41
#0110  01 42 d3 42 25 43 f7 43 01 44 d3 44 25 45 f7 45
#0120  01 46 d3 46 25 47 f7 47 01 48 d3 48 25 49 f7 49
#0130  01 4a d3 4a 25 4b f7 4b 01 4c 53 4c a5 4c 06 4d
#0140  47 4d 08 4d 49 4d 1a 4d 23 4d 0c 00 0b 20 0a 20
#0150  09 24 08 24 07 28 06 28 05 2c 04 2c 03 30 02 34
#0160  01 38 00 3c 81 4d 92 4d bf 4d df 4d 48 50 01 58
#0170  01 5c 82 80 81 c0 00 00 00 00 00 00 00 00 00 00
```

Pass/Fail

Pass.

Test_13: Data Memory Write

Purpose

Test the writing of memory to data memory.

Configuration

1. Test10_Program_Debugging was loaded into the emulator.
2. `w` was entered to start the Memory Writing Utility.
3. `1` was entered to select Data Memory.
4. Start Address of `0x0200` was entered.
5. Data `0xABCD` was entered.
6. `m` was entered to start the Memory Dumping Utility.
7. `1` was entered to select Data Memory.
8. Start Address of `0x0200` was entered.
9. End Address of `0x0210` was entered.

Expected Results

The program should write the data `0xABCD` to memory address `#0200`.

Results

The data was successfully written to memory in little endian format:

```
Memory Dump Utility
Select Memory Type:
0 - Program Memory | 1 - Data Memory
1
Enter Memory Start Address: 200
Enter Memory End Address: 210
#0200  cd ab 00 00 00 00 00 00 00 00 00 00 00 00 00 00
```

Pass/Fail

Pass.

Test_14: Register Dump

Purpose

Test the printing of register values.

Configuration

1. Test10_Program_Debugging was loaded into the emulator.
2. `g` was entered to run the program and load the Program Counter.
3. `r` was entered to start the Register Dumping Utility.

Expected Results

The program should print the values of all registers, the program counter (register 7) should hold a non-zero value.

Results

The register values were correctly printed:

```
Register Dump Utility
R0: 0000
R1: 0000
R2: 0000
R3: 0000
R4: 0000
R5: 0000
R6: 0000
R7: 0178
```

Pass/Fail

Pass.

Test_15: Register Set

Purpose

Test the setting of register values.

Configuration

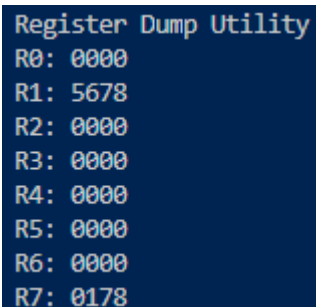
1. Test10_Program_Debugging was loaded into the emulator.
2. `s` was entered to start the Register Setting Utility.
3. Register `1` was selected.
4. Data `0x5678` was entered.
5. `r` was entered to start the Register Dumping Utility.

Expected Results

The program should set the value of register `R1` to `0x5678`.

Results

The value of register `R1` was successfully set:



```
Register Dump Utility
R0: 0000
R1: 5678
R2: 0000
R3: 0000
R4: 0000
R5: 0000
R6: 0000
R7: 0178
```

Pass/Fail

Pass.

Test_16: Breakpoint Set

Purpose

Test the setting of breakpoints.

Configuration

1. Test10_Program_Debugging was loaded into the emulator.
2. **b** was entered to start the Breakpoint Setting Utility.
3. Breakpoint address **0x0110** was entered.
4. **g** was entered to Run the program.

Expected Results

The program should set a breakpoint at address **0x0110**, and execution should stop at this point.

Results

The breakpoint was successfully set, and execution stopped at **0x0110**:

```
Run Utility
Program Counter: 0100
Breakpoint: 0110
0100: 1234
0102: 7f79 - MOVH RC: 0 WB: 0 Source: ef Destination: 01
0104: 6fd2 - MOVLZ RC: 0 WB: 0 Source: fa Destination: 02
0106: 7673 - MOVL S RC: 0 WB: 0 Source: ce Destination: 03
0108: 4001 - ADD RC: 0 WB: 0 Source: 00 Destination: 01
010a: 40d3 - ADD RC: 1 WB: 1 Source: 02 Destination: 03
010c: 4125 - ADDC RC: 0 WB: 0 Source: 04 Destination: 05
010e: 41f7 - ADDC RC: 1 WB: 1 Source: 06 Destination: 07
```

Pass/Fail

Pass