ECED 3403 Computer Architecture Assignment 3 Testing Report

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https://github.com/weakbox/xm23-emu-eced3403

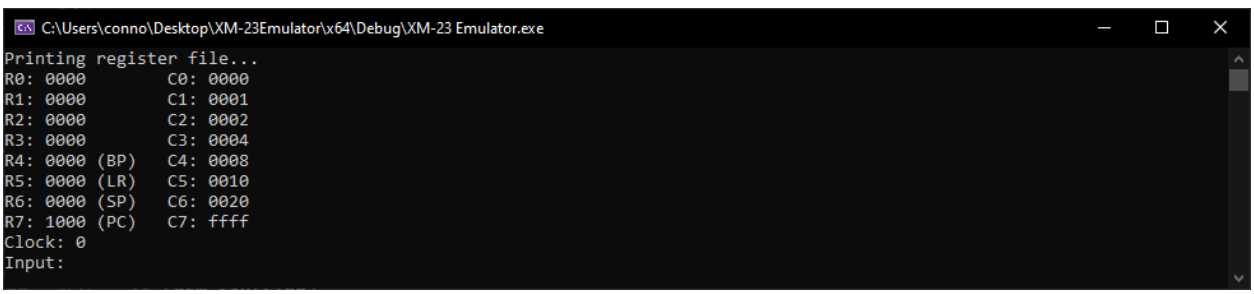
Note: For these tests, the "VERBOSE" flag is defined in the file "header.h". This flag can be enabled or disabled depending on the level of visual feedback the user would like. Relevant to these tests, the verbose flag prints the fault ID to the console when a fault is encountered.

Test 1: Test Nested Supervisory Calls

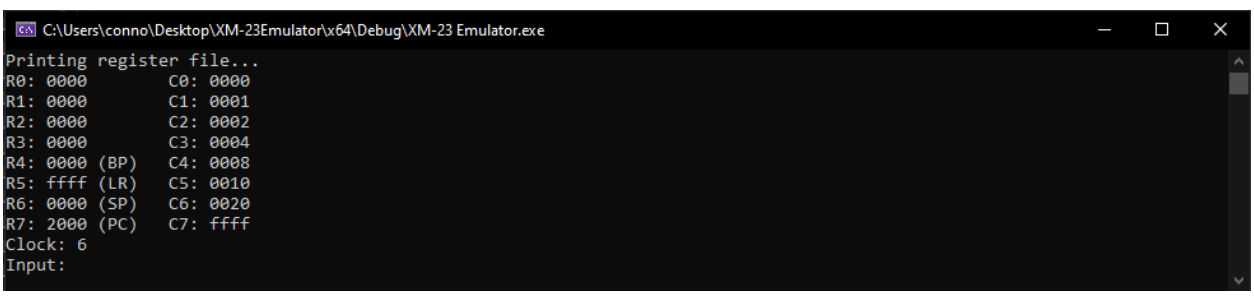
Setup: The provided "exceptions_basic.asm" assembly file was assembled using the most recent version of the provided XM-23 assembler. The resulting .xme file was then run using the XM-23 emulator.

Expected Results: We expect to see the emulator branch to and return from the correct address when an SVC instruction is called. This includes nested SVC instructions, which demonstrate the use of the stack.

Results: The emulator successfully navigates the program as expected.



The program counter is initialized to 0x1000.



After the first SVC instruction, we move to the address found in interrupt vector 2, which is 0x2000.

After the second SVC instruction, we move to the address found in interrupt vector 4, which is 0x4000.

```
C:\Users\conno\Desktop\XM-23Emulator\x64\Debug\XM-23 Emulator.exe
Printing register file...
R0: 0003        C0: 0000
R1: 0003        C1: 0001
R2: 0000        C2: 0002
R3: 0000        C3: 0004
R4: 0000 (BP)   C4: 0008
R5: ffff (LR)   C5: 0010
R6: 0000 (SP)   C6: 0020
R7: 2008 (PC)   C7: ffff
Clock: 54
Input:
```

After the second SVC instruction is completed, the program counter is restored.

```
C:\Users\conno\Desktop\XM-23Emulator\x64\Debug\XM-23 Emulator.exe
IR: 4c2f (MOV)
Clock: 60
Input: 6
Printing register file...
R0: 0003        C0: 0000
R1: 0003        C1: 0001
R2: 0000        C2: 0002
R3: 0000        C3: 0004
R4: 0000 (BP)   C4: 0008
R5: 0000 (LR)   C5: 0010
R6: 0000 (SP)   C6: 0020
R7: 1002 (PC)   C7: ffff
Clock: 60
Input:
```

After the first SVC instruction is completed, the program counter is restored.

```
exceptions_basic.lis - Notepad
File  Edit  Format  View  Help

                    org #1000

                    ; Try to execute an interrupt from the interrupt vector table.

                    Start

    1000    4D92    svc $2          ; We should move to address #2000.

    1002    3FFE    bra Start

                    ; Create a primitive interrupt handler.

                    org #2000

                    Interrupt_Handler

    2000    4088    add $1,R0
    2002    4088    add $1,R0
    2004    4088    add $1,R0
    2006    4D94    svc $4          ; We should move to address #4000.
    2008    4C2F    mov R5,R7       ; Move LR into PC (interrupt return).

                    org #4000

    4000    4089    add $1,R1
    4002    4089    add $1,R1
    4004    4089    add $1,R1
    4006    4C2F    mov R5,R7       ; Move LR into PC (interrupt return).

                    end Start

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```

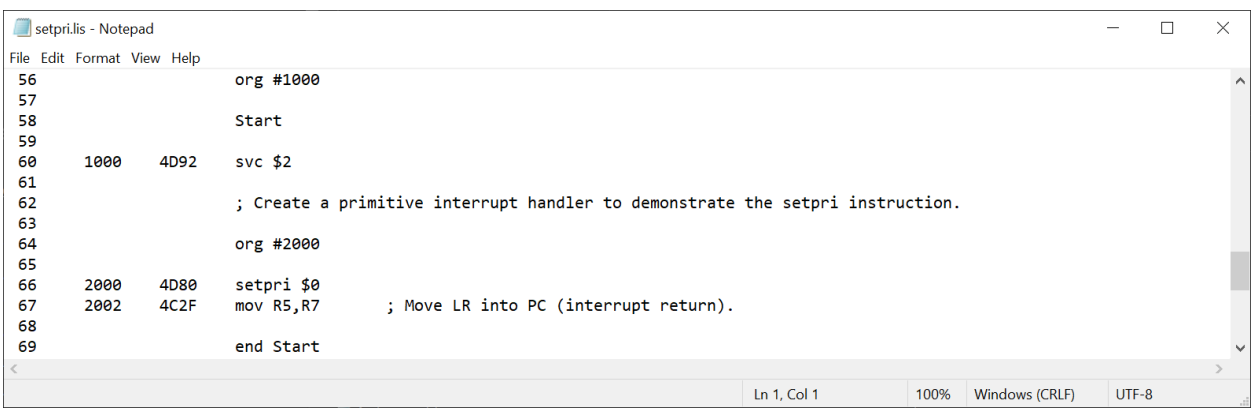
Pass/Fail: Pass. The emulator performs as expected.

Test 2: Test SETPRI Instruction

Setup: The provided "setpri.asm" assembly file was assembled using the most recent version of the provided XM-23 assembler. The resulting .xme file was then run using the XM-23 emulator.

Expected Results: We expect to see that after the program has trapped to an interrupt vector with priority 2, we can change that interrupts priority with the SETPRI instruction. In this case, we will change it to 0.

Results: The emulator correctly modifies the priority of the interrupt.



Pass/Fail: Pass. The emulator performs as expected.

Test 3: Test Illegal Instruction Fault

Setup: The provided "fault_ill_inst.asm" assembly file was assembled using the most recent version of the provided XM-23 assembler. The resulting .xme file was then run using the XM-23 emulator.

Expected Results: We expect to see that the emulator correctly identifies the illegal instruction and calls the correct fault handler. The fault handler will put a value of 0xFFFF into R0, indicating that an illegal instruction fault has occurred. While this isn't a very robust fault handler, it at least tells us that a programmer could theoretically create a much more feature-packed fault handler in their own code.

Results: The emulator correctly identifies the illegal instruction and executes the proper fault handler (8).

```
C:\Users\conno\Desktop\XM-23Emulator\x64\Debug\XM-23 Emulator.exe
Input: 2
IR: 4da0
Instruction not found!
Fault triggered!
ID: 8
Clock: 18
Input: 6
Printing register file...
R0: 0000        C0: 0000
R1: 0000        C1: 0001
R2: 0000        C2: 0002
R3: 0000        C3: 0004
R4: 0000 (BP)   C4: 0008
R5: ffff (LR)   C5: 0010
R6: 0000 (SP)   C6: 0020
R7: 8000 (PC)   C7: ffff
Clock: 18
Input: 2
IR: 4288 (SUB)
Clock: 24
Input: 6
Printing register file...
R0: ffff        C0: 0000
R1: 0000        C1: 0001
R2: 0000        C2: 0002
R3: 0000        C3: 0004
R4: 0000 (BP)   C4: 0008
R5: ffff (LR)   C5: 0010
R6: 0000 (SP)   C6: 0020
R7: 8002 (PC)   C7: ffff
Clock: 24
Input:
```

```
fault_ill_inst.lis - Notepad
File  Edit  Format  View  Help

                    org #1004

    1004    4DA0    word #4DA0      ; Put an illegal instruction at address 1004.

                    org #1000

                    Start

    1000    4080    add $0,R0
    1002    4080    add $0,R0
                    ; Bad instruction.

                    ; Create a primitive interrupt handler to document an illegal instruction.

                    org #8000

                    Interrupt_Handler

    8000    4288    sub $1,R0       ; When we encounter the illegal instruction we should see #FFFF in R0.
    8002    4C2F    mov R5,R7       ; Move LR into PC (interrupt return).

                    end Start

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```

Pass/Fail: Pass. The emulator performs as expected.

Test 4: Test Invalid Address Fault

Setup: The provided "fault_inv_addr.asm" assembly file was assembled using the most recent version of the provided XM-23 assembler. The resulting .xme file was then run using the XM-23 emulator.

Expected Results: We expect to see that the emulator correctly identifies the invalid address while fetching the program counter and calls the correct fault handler. The fault handler will put a value of 0xFFFF into R0, indicating that an illegal instruction fault has occurred.

Results: The emulator correctly identifies the invalid address and executes the proper fault handler (9).

C:\Users\conno\Desktop\XM-23Emulator\x64\Debug\XM-23 Emulator.exe

```
Input: 6
Printing register file...
R0: 0000        C0: 0000
R1: 1001        C1: 0001
R2: 0000        C2: 0002
R3: 0000        C3: 0004
R4: 0000 (BP)   C4: 0008
R5: 0000 (LR)   C5: 0010
R6: 0000 (SP)   C6: 0020
R7: 1001 (PC)   C7: ffff
Clock: 18
Input: 2
Fault triggered!
ID: 9
IR: 4288 (SUB)
Clock: 24
Input: 6
Printing register file...
R0: ffff        C0: 0000
R1: 1001        C1: 0001
R2: 0000        C2: 0002
R3: 0000        C3: 0004
R4: 0000 (BP)   C4: 0008
R5: ffff (LR)   C5: 0010
R6: 0000 (SP)   C6: 0020
R7: 9002 (PC)   C7: ffff
Clock: 24
Input:
```

fault_inv_addr.lis - Notepad

File Edit Format View Help

```
                    org #1000

                    Start

     1000    6009   movl BAD_ADDR,R1
     1002    7881   movh BAD_ADDR,R1
     1004    4C0F   mov R1,R7       ; Move an odd-numbered address into the program counter.

                    ; Create a primitive interrupt handler to document an illegal instruction.

                    org #9000

                    Interrupt_Handler

     9000    4288   sub $1,R0       ; When we encounter the invalid address we should see #FFFF in R0.
     9002    4C2F   mov R5,R7       ; Move LR into PC (interrupt return).

                    end Start
```

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Pass/Fail: Pass. The emulator performs as expected.

Test 5: Test Priority Fault

Setup: The provided “fault_pri.asm” assembly file was assembled using the most recent version of the provided XM-23 assembler. The resulting .xme file was then run using the XM-23 emulator.

Expected Results: We expect to see that the emulator correctly identifies the priority faults while executing the SETPRI and SVC instructions and calls the correct fault handler. The fault handler will put a value of 0xFFFF into R0, indicating that an illegal instruction fault has occurred.

Results: The emulator correctly identifies the priority faults and executes the proper fault handler (10).

```
C:\Users\conno\Desktop\XM-23Emulator\x64\Debug\XM-23 Emulator.exe
Input: 2
IR: 4d87 (SETPRI)
Fault triggered!
ID: 10
Clock: 6
Input: 2
IR: 4288 (SUB)
Clock: 12
Input: 2
IR: 4c2f (MOV)
Clock: 18
Input: 6
Printing register file...
R0: ffff        C0: 0000
R1: 0000        C1: 0001
R2: 0000        C2: 0002
R3: 0000        C3: 0004
R4: 0000 (BP)   C4: 0008
R5: 0000 (LR)   C5: 0010
R6: 0000 (SP)   C6: 0020
R7: 1002 (PC)   C7: ffff
Clock: 18
Input: 2
IR: 4d96 (SVC)
Clock: 24
Input: 2
IR: 4d92 (SVC)
Fault triggered!
ID: 10
Clock: 30
Input: 2
IR: 4288 (SUB)
Clock: 36
Input: 2
IR: 4c2f (MOV)
Clock: 42
Input: 6
Printing register file...
R0: fffe        C0: 0000
R1: 0000        C1: 0001
R2: 0000        C2: 0002
R3: 0000        C3: 0004
R4: 0000 (BP)   C4: 0008
R5: ffff (LR)   C5: 0010
R6: 0000 (SP)   C6: 0020
R7: 2000 (PC)   C7: ffff
Clock: 42
Input:
```

fault_pri.lis - Notepad

File Edit Format View Help

```
                    org #1000

                    Start

    1000    4D87    setpri $7
    1002    4D96    svc $6

                    ; Create a primitive interrupt handler to document a priority fault.

                    org #2000

                    ;       Nothing here!

                    org #6000

    6000    4D92    svc $2  ; This will trigger a priority fault as we are trying to trap to a process with lower priority.

                    org #A000

                    Interrupt_Handler

    A000    4288    sub $1,R0       ; When we encounter the priority fault we should see #FFFF in R0.
    A002    4C2F    mov R5,R7       ; Move LR into PC (interrupt return).

                    end Start
```

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Pass/Fail: Pass. The emulator performs as expected.