BÁO CÁO THỰC HÀNH KIẾN TRÚC MÁY TÍNH – TUẦN 12

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Assignment 1:

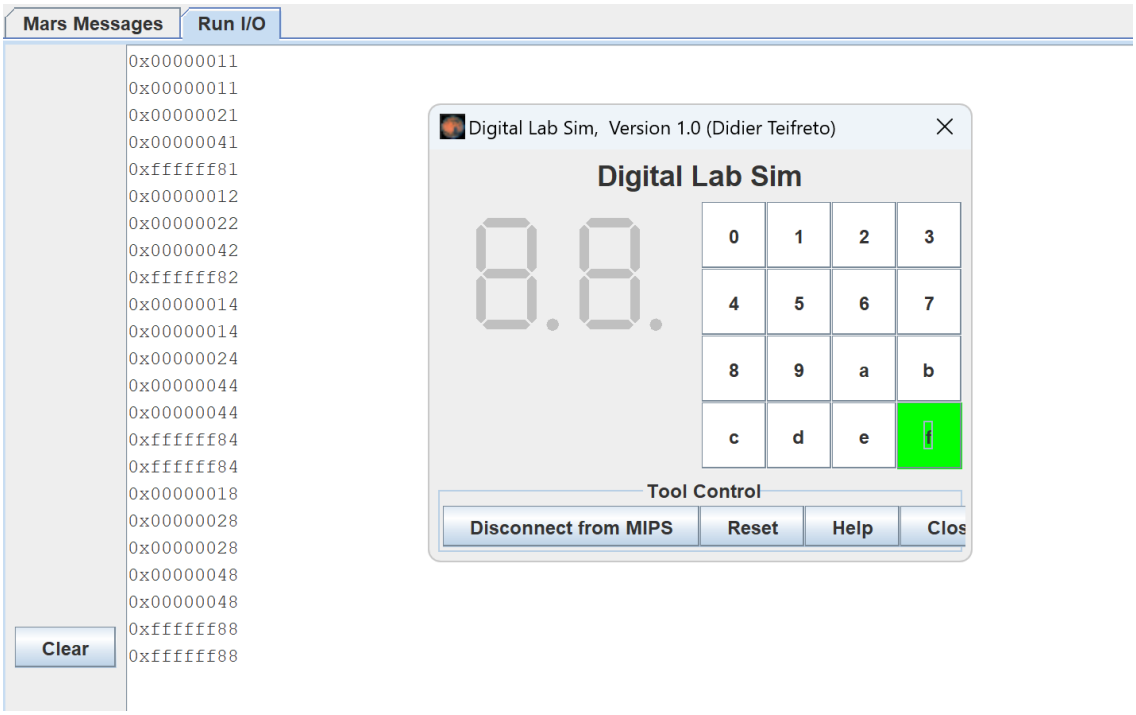
- Code:

```
.eqv IN_ADDRESS_HEXA_KEYBOARD 0xFFFF0012
.eqv OUT_ADDRESS_HEXA_KEYBOARD 0xFFFF0014
.data
msg_1: .asciiz "\n"
.text
main:
    li $t1, IN_ADDRESS_HEXA_KEYBOARD
    li $t2, OUT_ADDRESS_HEXA_KEYBOARD
    li $t3, 0x01 # check row 1
    li $t4, 0x02 # check row 2
    li $t5, 0x04 # check row 3
    li $t6, 0x08 # check row 4
polling:

    sb $t3, 0($t1 ) # must reassign expected row
    lb $a0, 0($t2) # read scan code of key button
    bne $a0, $zero, print

    sb $t4, 0($t1 ) # must reassign expected row
```

```
        lb $a0, 0($t2) # read scan code of key button
        bne $a0, $zero, print

        sb $t5, 0($t1 ) # must reassign expected row
        lb $a0, 0($t2) # read scan code of key button
        bne $a0, $zero, print

        sb $t6, 0($t1 ) # must reassign expected row
        lb $a0, 0($t2) # read scan code of key button
        bne $a0, $zero, print
print:
        beq $a0, 0, sleep
        li $v0, 34 # print integer (hexa)
        syscall
        li $v0, 4
        la $a0, msg_1
        syscall
sleep:
        li $a0, 100 # sleep 100ms
        li $v0, 32
        syscall
back_to_polling:
        j polling # continue polling
```

- Kết quả:

+ Kiểm tra hết được các button trên digital lab sim



➔ Kết quả đúng với lý thuyết.

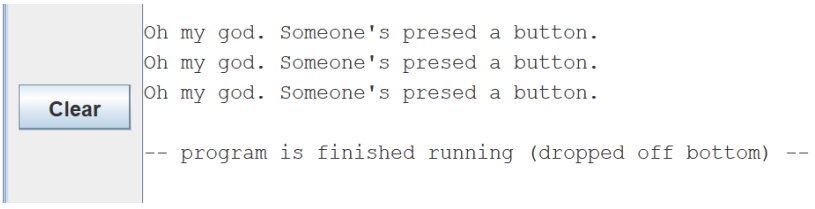
Assignmet 2:

- Code:

```
.eqv IN_ADDRESS_HEXA_KEYBOARD 0xFFFF0012
.data
Message: .asciiz "Oh my god. Someone's presed a button.\n"
.text
main:
    li $t1, IN_ADDRESS_HEXA_KEYBOARD
    li $t3, 0x80 # bit 7 of = 1 to enable interrupt
    sb $t3, 0($t1)
Loop:
    nop
```

```
        nop
        addi $v0, $zero, 32
        li $a0, 200
        syscall
        nop
        nop
        b Loop # Wait for interrupt
end_main:


.ktext 0x80000180
IntSR:
        addi $v0, $zero, 4 # show message
        la $a0, Message
        syscall
next_pc:
        mfc0 $at, $14 # $at <= Coproc0.$14 = Coproc0.epc
        addi $at, $at, 4 # $at = $at + 4 (next instruction)
        mtc0 $at, $14 # Coproc0.$14 = Coproc0.epc <= $at
return:
        eret # Return from exception
```

- Kết quả:



➔ Kết quả đúng theo lý thuyết.

Assignment 3:

- Code:

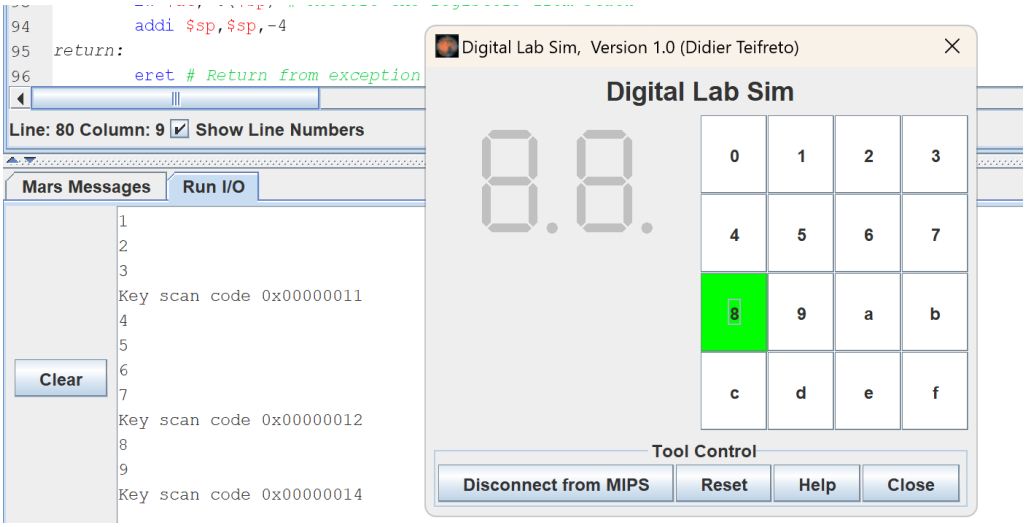
```
.eqv IN_ADDRESS_HEXA_KEYBOARD 0xFFFF0012
.eqv OUT_ADDRESS_HEXA_KEYBOARD 0xFFFF0014
.data
Message: .asciiz "Key scan code "

.text
main:
    li $t1, IN_ADDRESS_HEXA_KEYBOARD
    li $t3, 0x80 # bit 7 = 1 to enable
    sb $t3, 0($t1)
    xor $s0, $s0, $s0 # count = $s0 = 0
Loop:
    addi $s0, $s0, 1 # count = count + 1
prn_seq:
    addi $v0,$zero,1
    add $a0,$s0,$zero # print auto sequence number
    syscall
prn_eol:
    addi $v0,$zero,11
    li $a0,'\n' # print endofline
    syscall
sleep:
    addi $v0,$zero,32
    li $a0,300 # sleep 300 ms
```

```
        syscall
        nop # WARNING: nop is mandatory here.
        b Loop # Loop
end_main:

.ktext 0x80000180
IntSR:
        addi $sp,$sp,4 # Save $at because we may change it later
        sw $at,0($sp)
        addi $sp,$sp,4 # Save $sp because we may change it later
        sw $v0,0($sp)
        addi $sp,$sp,4 # Save $a0 because we may change it later
        sw $a0,0($sp)
        addi $sp,$sp,4 # Save $t1 because we may change it later
        sw $t1,0($sp)
        addi $sp,$sp,4 # Save $t3 because we may change it later
        sw $t3,0($sp)
prn_msg:
        addi $v0, $zero, 4
        la $a0, Message
        syscall
get_cod:
        li $t1, IN_ADDRESS_HEXA_KEYBOARD
        li $t3, 0x81 # check row 4 and re-enable bit 7
        sb $t3, 0($t1) # must reassign expected row
        li $t1, OUT_ADDRESS_HEXA_KEYBOARD
```

```
        lb $a0, 0($t1)
        bne $a0, $zero, prn_cod

        li $t1, IN_ADDRESS_HEXA_KEYBOARD
        li $t3, 0x82 # check row 4 and re-enable bit 7
        sb $t3, 0($t1) # must reassign expected row
        li $t1, OUT_ADDRESS_HEXA_KEYBOARD
        lb $a0, 0($t1)
        bne $a0, $zero, prn_cod

        li $t1, IN_ADDRESS_HEXA_KEYBOARD
        li $t3, 0x84 # check row 4 and re-enable bit 7
        sb $t3, 0($t1) # must reassign expected row
        li $t1, OUT_ADDRESS_HEXA_KEYBOARD
        lb $a0, 0($t1)
        bne $a0, $zero, prn_cod

        li $t1, IN_ADDRESS_HEXA_KEYBOARD
        li $t3, 0x88 # check row 4 and re-enable bit 7
        sb $t3, 0($t1) # must reassign expected row
        li $t1, OUT_ADDRESS_HEXA_KEYBOARD
        lb $a0, 0($t1)
        bne $a0, $zero, prn_cod
prn_cod:
        li $v0,34
        syscall
```

```
        li $v0,11
        li $a0,'\n' # print end of line
        syscall
next_pc:
        mfc0 $at, $14 # $at <= Coproc0.$14 = Coproc0.epc
        addi $at, $at, 4 # $at = $at + 4 (next instruction)
        mtc0 $at, $14 # Coproc0.$14 = Coproc0.epc <= $at
restore:
        lw $t3, 0($sp) # Restore the registers from stack
        addi $sp,$sp,-4
        lw $t1, 0($sp) # Restore the registers from stack
        addi $sp,$sp,-4
        lw $a0, 0($sp) # Restore the registers from stack
        addi $sp,$sp,-4
        lw $v0, 0($sp) # Restore the registers from stack
        addi $sp,$sp,-4
        lw $at, 0($sp) # Restore the registers from stack
        addi $sp,$sp,-4
return:
        eret # Return from exception
```

- Kết quả:



➔ Nhận được tất cả các button trên digital lab sim, kết quả đúng với lí thuyết.

Assignment 4:

- Code:

```
.eqv IN_ADDRESS_HEXA_KEYBOARD 0xFFFF0012
.eqv COUNTER 0xFFFF0013 # Time Counter
.eqv MASK_CAUSE_COUNTER 0x00000400 # Bit 10: Counter interrupt
.eqv MASK_CAUSE_KEYMATRIX 0x00000800 # Bit 11: Key matrix interrupt
.data
msg_keypress: .asciiz "Someone has pressed a key!\n"
msg_counter: .asciiz "Time inteval!\n"

.text
main:
    li $t1, IN_ADDRESS_HEXA_KEYBOARD
    li $t3, 0x80 # bit 7 = 1 to enable
```

```
        sb $t3, 0($t1)
        # Enable the interrupt of TimeCounter of Digital Lab Sim
        li $t1, COUNTER
        sb $t1, 0($t1)
Loop:
        nop
        nop
        nop
sleep:
        addi $v0,$zero,32 # BUG: must sleep to wait for Time Counter
        li $a0,200 # sleep 200 ms
        syscall
        nop # WARNING: nop is mandatory here.
        b Loop
end_main:

.ktext 0x80000180
IntSR:
dis_int:
        li $t1, COUNTER # BUG: must disable with Time Counter
        sb $zero, 0($t1)
get_caus:
        mfc0 $t1, $13 # $t1 = Coproc0.cause
IsCount:
        li $t2, MASK_CAUSE_COUNTER# if Cause value confirm Counter..
        and $at, $t1,$t2
```

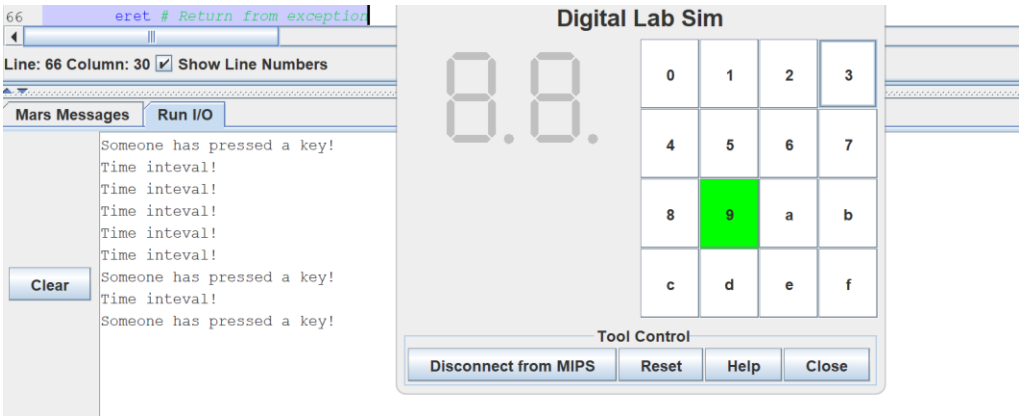
```
        beq $at,$t2, Counter_Intr
IsKeyMa:
        li $t2, MASK_CAUSE_KEYMATRIX # if Cause value confirm Key..
        and $at, $t1,$t2
        beq $at,$t2, Keymatrix_Intr
others:
        j end_process # other cases
Keymatrix_Intr:
        li $v0, 4 # Processing Key Matrix Interrupt
        la $a0, msg_keypress
        syscall
        j end_process
Counter_Intr:
        li $v0, 4 # Processing Counter Interrupt
        la $a0, msg_counter
        syscall
        j end_process
end_process:
        mtc0 $zero, $13 # Must clear cause reg
en_int:
        li $t1, COUNTER
        sb $t1, 0($t1)
next_pc:
        mfc0 $at, $14 # $at <= Coproc0.$14 = Coproc0.epc
        addi $at, $at, 4 # $at = $at + 4 (next instruction)
        mtc0 $at, $14 # Coproc0.$14 = Coproc0.epc <= $at
```

return:

eret # Return from exception

- Kết quả:

+ Khi không nhấn button, sẽ có thông báo Time inteval! Để có thể nhấn button thì cần reset lại sigital lab sim



➔ Kết quả đúng với lý thuyết.

Assignment 5:

- Code:

.eqv KEY_CODE 0xFFFF0004 # ASCII code from keyboard, 1 byte

.eqv KEY_READY 0xFFFF0000 # =1 if has a new keycode ?

 # Auto clear after lw

.eqv DISPLAY_CODE 0xFFFF000C # ASCII code to show, 1 byte

.eqv DISPLAY_READY 0xFFFF0008 # =1 if the display has already to do

 # Auto clear after sw

.eqv MASK_CAUSE_KEYBOARD 0x0000034 # Keyboard Cause

.text

li $k0, KEY_CODE

li $k1, KEY_READY

```
        li $s0, DISPLAY_CODE
        li $s1, DISPLAY_READY
loop:
        nop
WaitForKey:
        lw $t1, 0($k1) # $t1 = [$k1] = KEY_READY
        beq $t1, $zero, WaitForKey # if $t1 = 0 then Polling
MakeIntR:
        teqi $t1, 1 # if $t1 = 1 then raise an Interrupt
        j loop


.ktext 0x80000180
get_caus:
        mfc0 $t1, $13 # $t1 = Coproc0.cause
IsCount:
        li $t2, MASK_CAUSE_KEYBOARD# if Cause value confirm Keyboard..
        and $at, $t1,$t2
        beq $at,$t2, Counter_Keyboard
        j end_process
Counter_Keyboard:
ReadKey:
        lw $t0, 0($k0) # $t0 = [$k0] = KEY_CODE
WaitForDis:
        lw $t2, 0($s1) # $t2 = [$s1] = DISPLAY_READY
        beq $t2, $zero, WaitForDis # if $t2 == 0 then Polling
Encrypt:
```

addi $t0, $t0, 1 # change input key

ShowKey:

sw $t0, 0($s0) # show key

nop

end_process:

next_pc:

mfc0 $at, $14 # $at <= Coproc0.$14 = Coproc0.epc

addi $at, $at, 4 # $at = $at + 4 (next instruction)

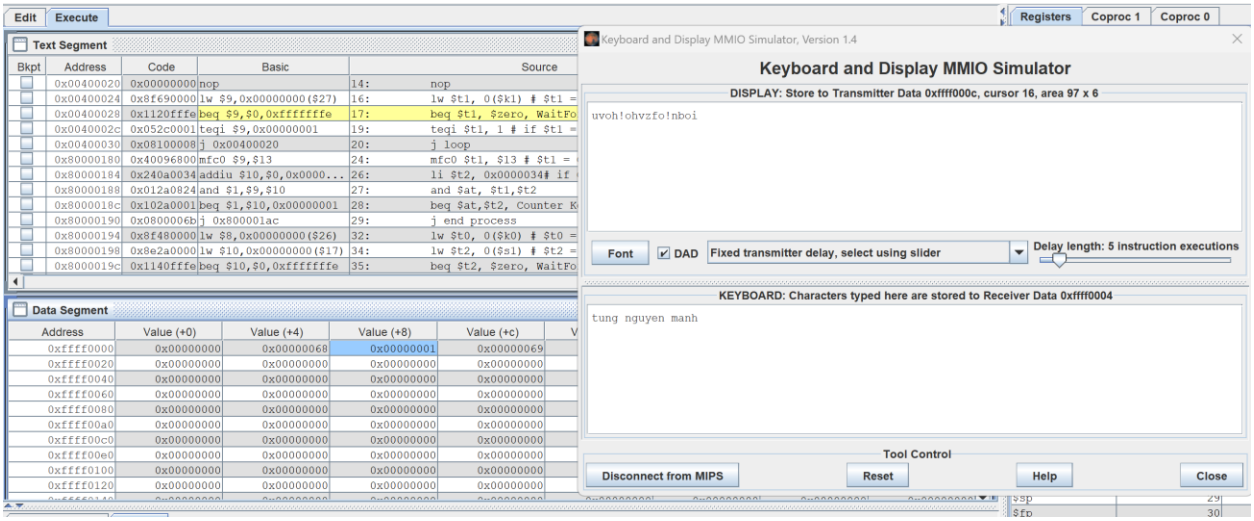
mtc0 $at, $14 # Coproc0.$14 = Coproc0.epc <= $at

return:

eret # Return from exception

- Kết quả:

+ Khi dừng nhập dữ liệu từ bàn phím, chương trình sẽ lặp vô tận để đợi dữ liệu mới được nhập vào và tiếp tục thực hiện.



➔ Kết quả đúng với lý thuyết