June 1, 2009

COMPUTER ENGINEERING DEPARTMENT

COE 205

COMPUTER ORGANIZATION & ASSEMBLY PROGRAMMING

Major Exam II

Second Semester (082)

Time: 7:00 PM-9:30 PM

Student Name : \_\_KEY\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Student ID. : \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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| --- | --- | --- |
| **Question** | **Max Points** | **Score** |
| **Q1** | **40** |  |
| **Q2** | **36** |  |
| **Q3** | **24** |  |
| **Total** | **100** |  |

Dr. Aiman El-Maleh

# **[40 Points]**

# **(Q1)** Fill the blank in each of the following:

## Assume that ESP=00000020H, EAX=12345678H and EBX=90ABCDEFH. After executing the instruction PUSH EAX, the content of ESP=ESP-4=0000001CH and EAX=12345678H.

## Assume that ESP=00000020H, EAX=12345678H and EBX=90ABCDEFH. After executing the following sequence of instructions, the content of ESP= ESP-4-4+4=0000001CH and EAX=90ABCDEFH.

PUSH EAX

PUSH EBX

POP EAX

## Assuming that ESP=00000020H, after executing the instruction RET 12, the content of ESP= ESP+4+12=00000030H.

## Assuming that ESP=00000020H, after executing the instruction Call MyProc, the content of ESP= ESP-4=0000001CH.

## Assuming thar register AL contains an alphabatic character, to convert the content of register AL to lower case, we use the following instruction OR AL, 20h.

## The code to Jump to label L1 if bits 0, 2, and 5 in AL are all set is:

## AND AL, 00100101b

CMP AL, 00100101b

JE L1

## The assembly code given below implements the high-level statement

## **if ((AL > BL) && (BL > CL)) {X = 1;}; unsigned comparison**

## CMP AL, BL

## JBE NEXT

## CMP BL, CL

## JBE NEXT

## MOV X,1

## NEXT:

## The assembly code given below implements the high-level statement

## **if ((AL > BL) || (AL > CL)) {X = 1;} ; signed comparison**

CMP AL, BL

JG L1

CMP AL,CL

JLE NEXT

L1: MOV X,1

NEXT:

## The assembly code given below implements the high-level statement

## **while (EBX <= VAR1) { ; unsigned comparison**

## **EBX = EBX + 5;**

## **VAR1 = VAR - 1**

## **}**

## CMP EBX,VAR1

JA NEXT

TOP: ADD EBX, 5

DEC VAR1

CMP EBX, VAR1

JBE TOP

NEXT:

## Assuming that AX=5678H and CL=85H, executing the instruction SHL AX, CL will set AX=CF00H and CF=0.

## 

## Assuming that AX=8678H and CL=0CH, executing the instruction SAR AX, CL will set AX=FFF8H and CF=0.

## Assuming that AX=6789H and CL=20H, executing the instruction ROL AX, CL will set AX=6789H and CF=unchanged.

## Assuming that AX=1234H and BX=5678H, executing the instruction SHRD AX, BX, 8 will set AX=7812H and BX=5678H.

## To multiply the content of register EAX by 23 without using multiplications instructions, we use the following instructions:

## MOV EBX, EAX

## SHL EBX, 3 ; EBX = 8 \* EAX

## SUB EBX, EAX ; EBX = 7 \* EAX

## SHL EAX, 4 ; EAX = 16 \* EAX

## ADD EAX, EBX ; EAX = 23 \* EAX

## Assuming that AX=02ECH and BX=0020H, executing the instruction DIV BL will result in AX=0C17.

## Assuming that AX=FFF4H and BX=FFFBH, executing the instruction IDIV BL will result in AX=FE02.

## Assuming that AX=02ECH and BX=0020H, executing the instruction MUL BX will result in AX=5D80 and CF=0.

## Assuming that AX=FFF4H and BX=FFFBH, executing the instruction IMUL BX will result in AX=003C and CF=0.

## Macros are more efficient than procedures in execution time and less efficient in code size.

## 

## We can define the macro SAVE\_REGS to save only the registers passed as arguments by pushing them on the stack as follows:

|  |
| --- |
| SAVE\_REGS MACRO REGS |
| IRP D, <REGS> |
| PUSH D |
| ENDM |
| ENDM |

**[36 Points]**

# **(Q2) Answer the following questions. Show how you obtained your answer:**

## **(i)** Given that **TABLE** is defined as: **TABLE Byte ‘Ahmad Ali Anas’**

## Determine the content of register **AH** after executing the following code:

XOR AH, AH

MOV ECX, lengthof TABLE

LEA EBX, TABLE

DEC EBX

Next: JECXZ ENL

INC EBX

MOV AL, [EBX]

OR AL, 20H

CMP AL, `a`

LOOPNE Next

JNE ENL

INC AH

JMP Next

ENL:

The content of register AH will be 5 as this program counts the number of occurrences of either character ‘a’ or character ‘A’.

## **(ii)** Determine the content of registers **EAX** and **EBX** after exeucting the following code:

MOV EAX, 7532h

MOV ECX, 32

XOR EBX, EBX

Next:

ROL EAX, 1

ADC EBX, 0

LOOP Next

The content of EBX will be 8 which is the count of the number of 1’s in EAX. However, the content of EAX will not change.

## **(iii)** Determine what will be displayed after executing the following code**:**

MOV EAX, 0F5h

XOR ECX, ECX

MOV EBX, 10

L1: XOR EDX, EDX

DIV EBX

ADD DL, '0'

PUSH EDX

INC ECX

CMP EAX, 0

JNZ L1

L2: POP EAX

Call WriteChar

LOOP L2

The code displays the decimal content of register EAX which is 245.

## Determine what will be displayed after executing the following code**:**

MOV EAX, 1

JMP MT[EAX\*4]

L1: MOV AL, 'C'

JMP EL

L2: MOV AL, 'O'

JMP EL

L3: MOV AL, 'E'

EL: Call WriteChar

exit

MT DWORD L1, L2, L3

The code will display character ‘O’.

## **(v)** Determine what will be displayed after executing the following code**:**

PUSH 4

PUSH 3

CALL MYPROC

exit

MYPROC:

JMP SKIP

MSG BYTE 10, 13, "Greater!!", 0

BYTE 10, 13, "Smaller!!", 0

Skip:

MOV EBP, ESP

LEA EDX, MSG

MOV ESI, [EBP+4]

MOV EDI, [EBP+8]

CMP ESI, EDI

JG Display

ADD EDX, lengthof MSG

Display:

Call WriteString

RET 8

The procedure MYPROC gets the two parameters passed from the stack i.e. 3 and 4 and compares the second parameter with the first. If the second parameter is greater than the first, it will print in a new line Greater!!, otherwise it will print in a new line Smaller!!. In this case, since 3 is less than 4, it will print: Smaller!!.

## **(vi)** Determine what will be displayed after executing the following code**:**

DDIV MACRO X, Y

MOV EAX, X

MOV EBX, Y

XOR EDX, EDX

DIV EBX

CALL WriteDec

MOV AL, '.'

CALL WriteChar

MOV EAX, 10

MUL EDX

DIV EBX

CALL WriteDec

ENDM

DDIV 15, 6

This macro dispalys the result of dividing X by Y within a single decimal fraction digit. Thus, it will display 2.5.

**[24 Points]**

# **(Q3)**

# **(i)** Write a procedure, **SelectionSort**, to sort an array of integers (i.e. 32-bit signed numbers) in an **ascending** order. The number of integers to be sorted and the address of the array to be sorted are assumed to be passed on the stack. The procedure should maintain the content of all registers to their state before its execution. **Do not use the USE directive, local directive, pusha and popa instructions in your solution**.

The pseudocode for the **SelectionSort** procedure is given below:

**SelectionSort** (Array, Size)

**for** (position= 0 to Size-2)

MinValue = Array[position]

MinPosition = position

**for** (j=position+1 to Size-1)

**if** (Array[j] < MinValue) **then**

MinValue = Array[j]

MinPosition = j

**end if**

**end for**

**if** (position ≠ MinPosition) **then**

Array[MinPosition] = Array[Position]

Array[Position] = MinValue

**end if**

**end for**

**end SelectionSort**

# **(ii)** Write a complete program, showing the place of procedure definition, to use the procedure **SelectionSort** to sort the Array given below:

Array Dword 10, 2, 0, 15, 25, 30, 7, 22

Note that the Content of Array after sorting will be:

Array Dword 0, 2, 7, 10, 15, 22, 25, 30

.686

.MODEL FLAT, STDCALL

.STACK

INCLUDE Irvine32.inc

.DATA

Array DD 10, 2, 0, 15, 25, 30, 7, 22

.CODE

main PROC

PUSH offset Array

PUSH lengthof Array

CALL SelectionSort

exit ; exit to operating system

main ENDP

SelectionSort PROC

PUSH EBP ; save registers

MOV EBP, ESP

PUSH EAX

PUSH EBX

PUSH ECX

PUSH EDX

PUSH ESI

PUSH EDI

MOV ESI, [EBP+8] ; size of array

MOV EBX, [EBP+12] ; address of array

DEC ESI ; ESI=size-1

MOV EDI, ESI

DEC EDI ; EDI=size-2

XOR ECX, ECX ; position

FOR\_LOOP: ; for (position= 0 to Size-2)

CMP ECX, EDI

JG END\_FOR\_LOOP

MOV EAX, [EBX+ECX\*4] ; EAX= MinValue

MOV EDX, ECX ; EDX= MinPosition

PUSH ECX ; save postion

INC ECX ; 2nd for loop ECX=j

FOR\_LOOP2: ; for (j=position+1 to Size-1)

CMP ECX, ESI

JG END\_FOR\_LOOP2

CMP [EBX+ECX\*4], EAX

JGE END\_IF

MOV EAX, [EBX+ECX\*4] ; MinValue=Array[j]

MOV EDX, ECX ; MinPosition=j

END\_IF:

INC ECX

JMP FOR\_LOOP2

END\_FOR\_LOOP2:

POP ECX ; restore position

CMP ECX, EDX ; if (position != MinPosition)

JE END\_IF2

MOV EBP, [EBX+ECX\*4] ; Array[MinPosition] =

; Array[Position]

MOV [EBX+EDX\*4], EBP

MOV [EBX+ECX\*4], EAX ; Array[Position] = MinValue

END\_IF2:

INC ECX

JMP FOR\_LOOP

END\_FOR\_LOOP:

POP EDI ; restore registers

POP ESI

POP EDX

POP ECX

POP EBX

POP EAX

POP EBP

RET 8

SelectionSort ENDP

END main