May 20, 2010

COMPUTER ENGINEERING DEPARTMENT

COE 205

COMPUTER ORGANIZATION & ASSEMBLY PROGRAMMING

Major Exam II

First Semester (092)

Time: 1:00 PM-3:30 PM

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

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

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| --- | --- | --- |
| **Question** | **Max Points** | **Score** |
| **Q1** | **28** |  |
| **Q2** | **36** |  |
| **Q3** | **12** |  |
| **Q4** | **24** |  |
| **Total** | **100** |  |

Dr. Aiman El-Maleh

# **[28 Points]**

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

## Assume that ESP=00000100H and the address of TEST is 0000300AH. After executing the instruction CALL TEST, the content of ESP=ESP-4=000000FCH.

##  Assume that ESP=00000100H. After executing the instruction RET 8, the content of ESP=ESP+4+8=0000010CH.

##  The code to Jump to label L1 if regiser AL bits 3 and 6 are 1 or bit 5 is zero is:

## Test AL, 100000b

## JZ L1

## Test AL, 1000000b

## JZ Skip

## Test AL, 1000b

## JNZ L1

## Skip:

## Assuming that EAX=8765432CH and ECX=FEDBA7E4H, executing the instruction SHRD EAX, ECX, 16 will set EAX=A7E48765H and ECX= FEDBA7E4H.

##  To multiply the signed content of register EAX by 33.25 without using multiplications instructions, we use the following instructions:

## MOV EBX, EAX

## SHL EAX, 5

## ADD EAX, EBX

## SAR EBX, 2

## ADD EAX, EBX

## Assuming that all variables are 32-bit signed integers, the assembly code implementing the following equation **var3 = (-5\*var1)/(8\*var2 -10)** is:

## MOV EAX, -5

## IMUL var1

## MOV EBX, var2

## SHL EBX, 3

## SUB EBX, 10

## IDIV EBX

## MOV var3, EAX

## Suppose that we have a 64-bit number stored in memory in the variable I defined as I Qword. The assembly code to multiply this number by 8 is:

## MOV EAX, DWORD PTR I

## MOV EBX, DWORD PTR I+4

## SHLD, EBX, EAX, 3

## SHL EAX, 3

## MOV DWORD PTR I, EAX

## MOV DWORD PTR I+4, EBX

##  Given that MS-DOS packs the year, month, and day into 16 bits in register DX, where bits 0 to 4 store the day, bits 5 to 8 store the month and bits 9 to 15 store the year relative to 1980. Write assembly code to print the date in day, month and year. For example if DX=0010011001101010, it will print 10/3/1999:

## MOVZX EAX, DX

## AND EAX, 11111b

## CALL WriteDec

## MOV AL, ‘/’

## CALL WriteChar

## MOVZX EAX, DX

## SHR EAX, 5

## AND EAX, 1111b

## CALL WriteDec

## MOV AL, ‘/’

## CALL WriteChar

## MOVZX EAX, DX

## SHR EAX, 9

## AND EAX, 1111111b

## ADD EAX, 1980

## CALL WriteDec

**[36 Points]**

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

## **(i)** Given the following definition in the data segment:

## **Array DWORD 0, 1, 2, 3, 4**

## **DWORD 10,11,12,13,14**

## **DWORD 20,21,22,23,24**

## **DWORD 30,31,32,33,34**

## **DWORD 40,41,42,43,44**

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

##

 mov ecx, lengthof Array

 xor esi, esi

Next:

 mov eax, lengthof Array

 mul esi

 shl eax, 2

 mov eax, Array[eax+esi\*4]

 Call WriteDec

 Call CrLf

 inc esi

 loop Next

The program will print the diagonal of the array as follows:

0

11

22

33

44

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

 push 5

 push 4

 call MyProc

MyProc PROC

 push ebp

 mov ebp, esp

 sub esp, 4

 push eax

 mov DWORD PTR [ebp-4],10

 mov eax, [EBP + 8]

 sub [ebp-4], eax

 shl DWORD PTR [ebp-4], 2

 mov eax, [EBP + 12]

 add [ebp-4], eax

 shr DWORD PTR [ebp-4], 1

 mov eax, [ebp-4]

 call WriteDec

 pop eax

 mov esp, ebp

 pop ebp

 ret 8

MyProc ENDP

The program will display 14.

It will allocate a local variable and initialize it with 10. Then, it will copy into eax the second passed parameter 4. Then, the local variable will be 10-4=6. Then, the local variable is multiuplied by 4 i.e. its value becomes 24. The first passed parameter is moved to eax, i.e. eax=5. The content of eax is added to the local variable which becomes 29. The local variable is divided by 2 and becomes 14. The content of the local variable is then displayed.

## **(iii)** Given the following definition in the data segment:

##  **Array DWord 17,-10,30,-40,4,-5,8**

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

 xor eax, eax

 mov esi, -1

 mov ecx, lengthof Array

L1:

 inc esi

 test Array[esi\*4], 8000h

 loopz L1

 jz done

 inc eax

 cmp ecx, 0

 jnz L1

done:

 call WriteDec

The program will display 3 which the number of negative nyumbers in the array.

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

 mov ecx, 5

 mov eax, 12

Next:

 cmp eax, 7

 ja default

 jmp jumptable[eax\*4]

case01:

 add eax, 9

 jmp done

case23:

 add eax, 7

 jmp done

case45:

 add eax, 3

 jmp done

case67:

 add eax, 4

 jmp done

default:

 inc eax

done:

 shr eax, 1

 loop Next

 call WriteDec

exit

jumptable DWORD case01, case01, case23, case23, case45, case45, case67, case67

The program will display 5.

First, since EAX=12, the program will jump to default and EAX becomes 13. Then, EAX is divided by 2 and becomes 6. The loop then goes for the 2nd iteration as ECX is 4 and then it jumps to case67. EAX then becomes 10. It then gets divided by 2 and becomes 5. The loop is repeated as ECX becomes 3. The program then jumps to case45 and EAX becomes 8. EAX is then divided by 2 and becomes 4. The loop is continued as ECX is 2. The program then jumps to case45 and EAX becomes 7. After that it gets divided by 2 and becomes 3 and the loop is repeated as ECX is 1. The program then jumps to case23 and eax becomes 10. Then, EAX becomes 5 and it gets displayed.

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

 mov eax, 3

 call MyProc

 call WriteDec

MyProc Proc

 push ebx

 cmp eax, 0

 je done

 cmp eax, 1

 je done

 dec eax

 mov ebx, eax

 call MyProc

 xchg ebx, eax

 dec eax

 call MyProc

 add eax, ebx

done:

 pop ebx

 ret

MyProc Endp

The program wuill display 2 which is the fibonacci sequence of 3.

## **(vi)** Given the following declaration in the data segment:

##  MyNumber Byte 9 dup(0)

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

 mov ax, 0ABCDh

 xor esi, esi

 mov ecx, 8

L1: rol ax, 2

 mov bx, ax

 and bx, 3

 add bl, '0'

 mov MyNumber[esi], bl

 inc esi

 loop L1

 lea edx, MyNumber

 call WriteString

The program will display the content of register ax in base 4 which is 22233031.

## **(vii)** Given the following declaration in the data segment:

##  MyNumber Byte '1','2','3',0

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

 xor esi, esi

 mov eax, 0

L1: imul eax, 16

 movzx edx, MyNumber[esi]

 sub edx, '0'

 add eax, edx

 inc esi

 cmp MyNumber[esi],0

 jne L1

 dec esi

 mov ecx, 0

 mov ebx, 8

L2: mov edx, 0

 div ebx

 add dl, '0'

 mov MyNumber[esi], dl

 dec esi

 cmp eax, 0

 jnz L2

 lea edx, MyNumber

 call WriteString

The program will convert the hexadecimal number 123H into octal and will display the number 443.

**[12 Points]**

#  **(Q3)** Write a macro, **CMul**, to multiply the signed content of register EAX by a constant **n** passed as a aparmeter to the macro. The macro should be based on using shift and add instructions and should not use MUL or IMUL instructions. The macro should preserve the content of all temporary registers used.

CMul Macro n

Local Next, Skip

 PUSH EBX

 PUSH ECX

MOV EBX, n

XOR ECX, ECX

Next:

SHR EBX, 1

JNC Skip

ADD ECX, EAX

Skip:

SHL EAX, 1

CMP EBX, 0

JNE Next

MOV EAX, ECX

POP ECX

POP EBX

ENDM

**[24 Points]**

#  **(Q4)**

# **(i)** Write a procedure, **BubbleSort**, to sort an array of integers 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.

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

 **BubbleSort** (ArrayPointer, ArraySize)

 pass = 1

 **do** {

swap\_occurs = 0

 **for** (i= 1 to ArraySize-pass)

 **if** (Array[i-1] > Array[i])

 swap i*th* and (i-1)*th* elements of the array

 swap\_occurs = 1

 **end if**

 **end for**

pass = pass+1

 **while** (swap\_occurs && pass <= ArraySize -1)

 **end BubbleSort**

# **(ii)** Write a complete program, showing the place of procedure definition, to use the procedure **BubbleSort** 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

 .DATA

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

.code

main PROC

 MOV EAX, offset Array

 PUSH offset Array

 PUSH lengthof Array

 CALL BubbleSort

exit

main ENDP

BubbleSort PROC

 PUSHAD

 MOV EBP, ESP

 MOV ECX, [EBP+36]

 MOV EBX, [EBP+40]

 MOV EAX, 1 ; pass = 1

do\_while:

 XOR EDX, EDX ; swap\_occurs = 0

 PUSH ECX

 SUB ECX, EAX

 MOV ESI, 1

for\_loop:

 MOV EDI, [EBX+ESI\*4-4]

 CMP EDI, [EBX+ESI\*4]

 JNG NoSwap ; if (Array[i-1] > Array[i])

 XCHG EDI,[EBX+ESI\*4] ; swap ith and (i-1)th elements of the array

 MOV [EBX+ESI\*4-4], EDI

 MOV EDX, 1 ; swap\_occurs = 1

NoSwap:

 INC ESI

 LOOP for\_loop

 POP ECX

 INC EAX ; pass = pass+1

 CMP EDX, 0 ; while (swap\_occurs && pass <= ArraySize -1)

 JE Done

 CMP EAX, ECX

 JL do\_while

Done:

 POPAD

 RET 8

BubbleSort ENDP

END main