جامعة بيرزيت
BIRZEIT UNIVERSITY
Electrical and Computer Engineering

ENCS238 - Computer Organization
Second Exam

Summer Semester 2016 Date: Monday 15/8/2016

Name: Key ID: .

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Instructions:

- You have 90 minutes (1.5 hours), budget your time carefully!
- Turn off your mobile.
- To make sure you receive credit, please write clearly and show your work.

Question	Maximum	Mark	ABET SO
1	10		
2	10		C
3	10		E
4	10		A
5	10		A
Total	50		

Question 1 (10 marks)

Write a program that reads two numbers (N1 , N2) from the user and displays the result of the calculation:

R = N1/4 + N2*10

- The program should read the numbers from the user and display the result on the screen.
- The input numbers are one-digit hexadecimal (i.e. 0-9,A-F).
- The result must be calculated using addition and shift operations only (no multiplication or division instructions!)
- You must write the following procedures and use them:

- readNumber : to read a number from the user
- displayNumber : to display a number on the screen
- calculateResult: to calculate the result

- The input should allow for any of the following characters

Character	0 -> 9	A	B	C	D	E	F
ASCII Code	30H –> 39	41H	42H	43H	44H	45H	46H

```
.Model small
.Stack 100H
.Data
N1 DB ?
N2 DB ?
R  DB ?
.Code
.Startup
Call readNumber
Mov N1, AL
Call readNumber
Mov N2, AL

Call CalculateResult
Mov AL, R
Call displayNumber

.Exit
ENP
```

[3]

```
readNumber Proc Near
  Mov AH, 01
  Int 21H
  Cmp AL, '9'
  JLE num1
  Sub AL, 11H
num1: Sub AL, 30H
  Ret
readNumber ENDP
```

[2]

```
CalculateResult Proc Near
  Mov AL, N1
  SAR AL, 2
  Mov BL, N2
  SAL BL, 3
  Mov DL, N2
  ADD AL, BL
  Mov R, AL
  RET
CalculateResult ENDP
```

[2]

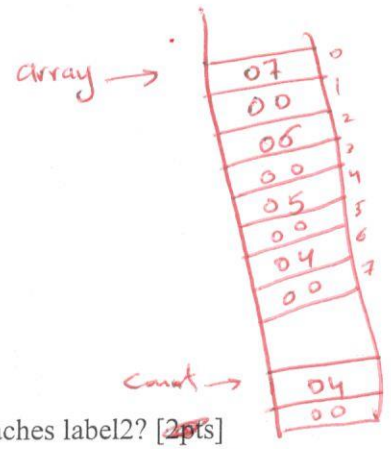
```
displayNumber Proc Near
  Mov DL, AL
  AND DL, 0F0H
  SHR DL, 4
  Cmp DL, 9
  JLE Num2
  ADD DL, 11H
Num2: ADD DL, 30H
      Mov AH, 02
      Int 21H
  Mov DL, AL
  AND DL, 0FH
  Cmp DL, 9
  JLE num3
  ADD DL, 11H
num3: ADD DL, 30H
  Mov AH, 02
  Int 21H
displayNumber ENDP
```

[3]

Question 2: (10 points)

Consider the following fragment of assembly code:

```
.data
array dw 7,6,5,4
count dw 4
...
.code
xor ax,ax
stc
mov cx,count
mov si,offset array
label1: adc ax,word ptr [si]
add si,2
loop label1
label2
```



a) What will be the value in AX when control reaches label2? [2pts]

[4]

AX = 23

b) What is the purpose of the line? [1pt]

```
xor ax,ax
```

[3]

Clear AX, i.e. Make AX=0

c) Write an efficient and functionally equivalent code segment for the line: [2pt]

```
loop label1
```

[3]

```
Dec Cx
Cmp Cx,0
JNZ label1
```

Question 3(10 points)

Use the minimum number of bits to represent (-24) using the following signed number representations:

(1) Sign magnitude: 6 bits

[2]

1 11000

(2) Bias representation: 6 bits ⇒ Bias = $2^{5}-1 = 31$

[2] $-24+31 = 7 \Rightarrow$ 000111

(3) 1's complement: 6 bit ⇒ 011000 = 24 ⇒

[2] 1's comp 100111 → -24

(4) 2's complement 6 bits 101000

[2]

(5) An 8-bit floating-point format as shown in the figure below: [8pts]

Sign=1bit	Exponent=4bits	Significant= 3bits

[2] $11000.0 = 1.1 * 2^{4}$

Bias = $2^{3}-1 = 7$

Exp. = $4+7 = 11 \Rightarrow 1011$

1 1011 100

Question 4(10 marks)

The content of PC in the basic accumulator computer is 3AF (all numbers are in hexadecimal). The content of AC is 7EC3. The content of memory at address 3AF is 932E. The content of memory at address 32E is 09AC. The content of memory at address 9AC is 8B9F. [6pts]

Instruction Format:

Opcode – 4bits	Memory address – 12bits

Opcode Symbol	Code [Hex]	Description
AND	8xxx	AND memory word to AC
ADD	9xxx	ADD memory word to AC
Load	Axxx	Load memory word to AC
Store	Bxxx	Store content of AC to memory
BR	Cxxx	Branch unconditionally
BSA	Dxxx	Branch and save return address
ISA	Exxx	Branch and skip if zero

a) What is the instruction that will be fetched and executed next?

[3] Next instruction is 932EF which is ADD memory content at address 32E to AC Register. i.e. AC = AC + [32EF]

b) Show the binary operation that will be performed in the AC when the instruction is executed

[2] 7EC3 + 09AC = 886F , AC = 886F

c) Give the contents of registers PC, MAR, MBR, AC and IR in hexadecimal at the end of the instruction cycle.

PC = 3B0

[5] MAR = 32E

MBR = 09AC

AC = 886F

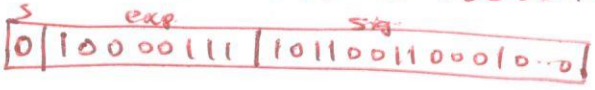
IR = 932E

Question 5(10 marks)

a) Express the value 435.0625 in IEEE 754 32-bit floating-point format, in Hexadecimal (show all steps)

435.0625 = 110110011.0001 $\Rightarrow$ $1.10110011000 1 \times 2^{8}$

Exp. = 8 + 127 = 135 = 10000111



[8] in Hex:

43D98800H

b) What is the maximum absolute value (in decimal) that can be represented in 32-bit floating-point?

[1] $1.111\ldots1 \times 2^{127}$

$\approx 2 \times 2^{127}$

c) What is the minimum absolute value (in decimal) that can be represented in 32-bit floating-point?

[1] Min. Normalized form = 1.0×2^{-126}

Min De-normalized form = 1×2^{-150}