

Comp 3350: Computer Organization & Assembly Language
HW # 8. Theme: Integer Arithmetic

All main questions carry equal weight.

Points will be awarded to only those answers which have work clearly shown

1. In the following code sequence, show the value of AL after each shift or rotate instruction has executed. This question is to be done **by hand**, not programmatically.

```
mov cl, 3
mov al, 45h
rol al, cl ; al = 2Ah
```

01000101	
10001010	CF = 0
00010101	CF = 1
00101010	CF = 0

```
mov al, 7Ah
mov cl, 1
ror al, cl ; al = 3Dh
```

01111010	
00111101	CF = 0

```
stc
mov al, 64h
mov cl, 2
rcl al, cl ; al = 92h
```

01100100	CF = 1
11001001	CF = 0
10010010	CF = 1

```
stc
mov al, 3Dh
mov cl, 1
rcr al, cl ; al =
```

00111101	CF = 1
10011110	CF = 0

2. (a) Write a program that calculates $EAX * 17_{10}$ using binary multiplication.

```
1 ; Author: Zejian Zhong
2 ; UserID: zzz0065
3
4 INCLUDE Irvine32.inc
5 .code
6 main PROC
7     mov eax, 2h
8     push eax
9     mov ebx, eax
10    shl eax, 5
11    shl ebx, 1
12    add eax, ebx
13    shr eax, 1
14    EXIT
15 main ENDP
16 END main
```

- (b) Consider the following value: **A24E6C8D**. Let this value be stored in register EAX. Write a program that will extract the decimal digits from this value using shifts and logical instructions.

Place the first two **decimal numeric** digits in DH and the other two into DL. Submit a print out of [the run](#) of the program and the [list file](#).

```

C:\WINDOWS\system32\cmd.exe
The value is: A24E6C8D
The numeric digits: 00002468
Press any key to continue . . .

```

3. (a) What will be the contents of AX and DX after the following operation? You must work this problem [by hand, not by a program run](#). What may happen if you do not set dx to 0 in the beginning?

```

mov dx, 0
mov ax, 1234h
mov cx, 4213h
mul cx

```

			1	2	3	4
			4	2	1	3
			3	6	9	C
		1	2	3	4	
	2	4	6	8		
4	8	D	0			
4	B	2	C	1	D	C

DX = 04B2
AX = C1DC

DX may be different value.

- (b) When does an IDIV instruction cause an overflow? Provide an example.

```

Mov ax, 4000h
Mov dx, 500h
Mov bx, 10h
Idiv bx

```

OF = 1

- (c) What will be the values of DX:AX after the following instructions execute? What might be the use of such a sequence of instructions in a 16-bit computer?

```

mov ax, 0h
mov dx, 0h
sub ax, 1h
sbb dx, 0

```

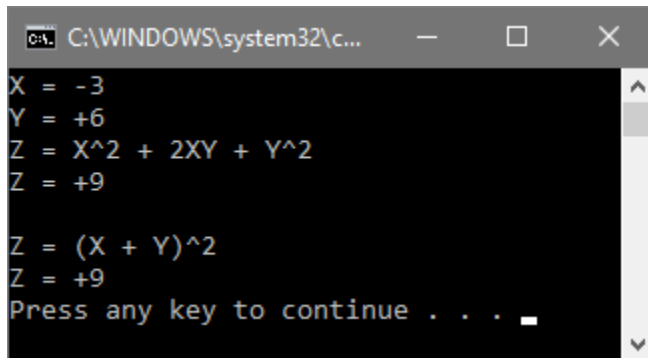
DX:AX = FFFF:FFFF

To subtract numbers larger than 16 bits.

4. Implement the following two expressions in assembly language, using 32-bit signed operands. Demonstrate the equivalence of the two using some test values for X and Y. Show the runs of the programs using both positive and negative test values. Which of the two implementations is preferable?

$$Z = X^2 + 2XY + Y^2$$

$$Z = (X+Y)^2$$



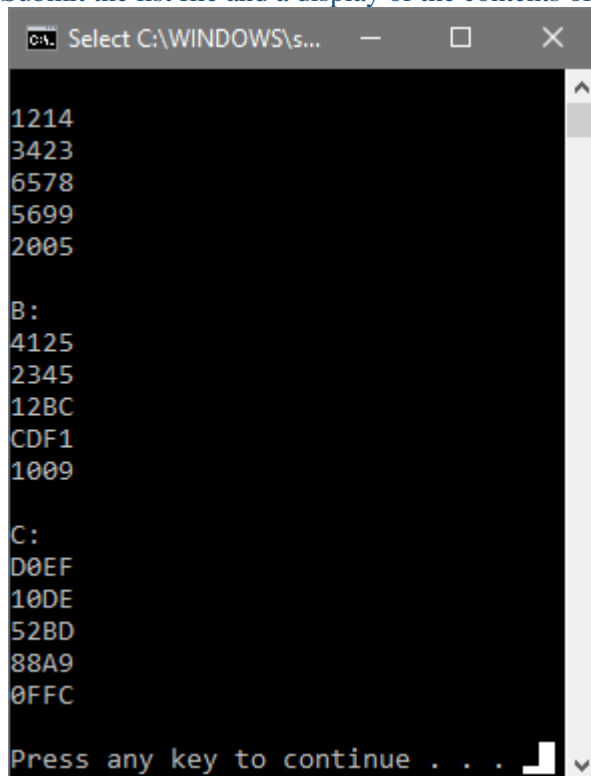
```
C:\WINDOWS\system32\c...  
X = -3  
Y = +6  
Z = X^2 + 2XY + Y^2  
Z = +9  
  
Z = (X + Y)^2  
Z = +9  
Press any key to continue . . .
```

The second one is preferable because of less code.

5. Write a program that performs $C = A - B$ using extended subtraction. See textbook pg. 270-271. Use the following:

Apple WORD 1214h, 3423h, 6578h, 5699h, 2005h
Berry WORD 4125h, 2345h, 12BCh, 0CDF1h, 1009h
Cherry WORD 5dup(0)

Submit the list file and a display of the contents of all the arrays after the run.



```
Select C:\WINDOWS\s...  
1214  
3423  
6578  
5699  
2005  
  
B:  
4125  
2345  
12BC  
CDF1  
1009  
  
C:  
D0EF  
10DE  
52BD  
88A9  
0FFC  
Press any key to continue . . .
```