

Comp 3350: Computer Organization & Assembly Language

HW5: Theme: Addressing modes

{6 Total Questions – Each worth 16.5 points }

1. Fill in the following memory diagram with the data provided below. Please assume that the data will begin being assigned at 00404000, which is the bottom row of the grid.

```
.data
Alpha WORD 54, 76h
Beta BYTE 1h
Gamma DWORD 56789h
Delta BYTE 2h
```

<i>Address</i>	<i>Variable</i>	<i>Data</i>
00404009	<i>Delta</i>	<i>02</i>
00404008	<i>Gamma+3</i>	<i>00</i>
00404007	<i>Gamma+2</i>	<i>05</i>
00404006	<i>Gamma+1</i>	<i>67</i>
00404005	<i>Gamma</i>	<i>89</i>
00404004	<i>Beta</i>	<i>01</i>
00404003	<i>Alpha+3</i>	<i>76</i>
00404002	<i>Alpha+2</i>	<i>00</i>
00404001	<i>Alpha+1</i>	<i>54</i>
00404000	<i>Alpha</i>	<i>00</i>

2. Copy the following code into your assembly development environment and single-step through it. For those instructions referencing memory, write the linear address.

```
TITLE Homework 5, Question 1                                (main.asm)

; Description: Memory reference exercise.
; Author: Matthew J Swann
; Version: 1.0, 2012-08-02

INCLUDE Irvine32.inc

.data
alpha DWORD 1h, 2h
beta  DWORD 3h, 4h
gamma DWORD 5

.code
main PROC
```

mov eax, 0Ah;	Immediate
mov ecx, eax;	register to register
mov edi, OFFSET beta;	Immediate
mov [gamma], eax;	Indirect // 00404010 = 00000005
mov esi, [gamma];	Direct // 00404010 = 0000000A
mov esi, 4;	Immediate
mov eax, beta[esi];	Indirect-offset // 0040400C = 00000004
mov ebx, OFFSET alpha;	Immediate
mov eax, [ebx];	Indirect // 00404000 = 00000001
mov eax, 4[ebx];	Indirect-displacement
	; // 00404004 = 00000002
mov eax, 4[ebx][esi];	Base-Indirect-displacement
	; // 00404008 = 00000003
mov eax, 8[ebx][esi];	Base-Indirect-displacement
	; // 0040400C = 00000004
mov eax, 12[ebx][esi];	Base-Indirect-displacement
	; // 00404010 = 0000000A
exit	
main ENDP	
END main	

3. Draft the `.code` section of a program that subtracts each element of an array from a single value. The `.data` section of the code is provided below. The program should: 1) iterate through “*theArray*”, 2) subtracts the value at each index from “*theSource*”, and 3) stores the resulting value in “*theResult*”. Please embed your code into your homework submission along with a screenshot showing the final value. (Screenshots are in separate PDF).

```
TITLE Sum of elements of a DWORD array
; Author: Matthew J Swann
; Version 1.0, 2012-08-02
```

```
INCLUDE Irvine32.inc
```

```
.data
```

```
theArray WORD 1h, 2h, 4h, 8h, 16h, 32h, 64h, 128h, 256h
```

```
theSource WORD 0FFFFh
```

```
theResult WORD ?
```

```
.code
```

```
main PROC
```

```
    mov cx, LENGTHOF theArray ; store number of elements in theArray to loop properly
    mov dx, type theArray     ; store the number of bytes to skip in iterations
    mov eax, offset theArray   ; reference a point in theArray
    mov bx, theSource          ; store theSource for editing
```

```
L2:
```

```
    sub bx, word ptr [eax]     ; subtract current element in theArray from theSource
    add ax, dx                 ; points to the next element in theArray
    loop L2                   ; loop for all elements...ideally
```

```
    mov ax, bx                ; used only to highlight the result in screenshot
    mov theResult, bx         ; stores the result in theResult
```

```
    exit
main ENDP
END main
```

Project (Debugging) - Microsoft Visual C++ 2010 Express (Administrator)

File Edit View Project Build Debug Tools Window Help

Process: [4784] Project.exe Thread: [4624] Main Thread Stack Frame: Project.exe!main() Line 24

Solution Explorer

hw05_q4.asm hw05_q3.asm

Solution 'Project' (1 project)

Project

External Dependencies

asm hw05_q3.asm

```

.code
main PROC

    mov cx, LENGTHOF theArray    ; store the number of elements in theArray to loop properly
    mov dx, type theArray        ; store the number of bytes to skip in iterations
    mov eax, offset theArray     ; attempting to point to a point in the array
    mov bx, theSource            ; store theSource for editing

L2:
    sub bx, word ptr [eax]       ; subtract the current element in the array from theSource
    add ax, dx                   ; points to the next element in theArray
    loop L2                     ; loop for all elements...ideally

    mov ax, bx
    mov theResult, ax

    exit
main ENDP
END main

```

100 %

Registers

EAX = 0040FBBF EBX = 7EFDFFBF ECX = 00000000 EDX = 00400002
ESI = 00000000 EDI = 00000000 EIP = 0040102F ESP = 0018FF8C
EBP = 0018FF94 EFL = 00000206

CS = 0023 DS = 002B ES = 002B SS = 002B FS = 0053 GS = 002B

OV = 0 UP = 0 EI = 1 PL = 0 ZR = 0 AC = 0 PE = 1 CY = 0

00404014 = 0000

Call Stack

Name
Project.exe!main() Line 24
ntdll.dll!77659ef2()
[Frames below may be incorrect]
ntdll.dll!77659ec5()

Solution... Class Vi... Aut... Loc... Me... Me... Re... Pro... Thr... Mo... Wa... Call Stack Breakpoints

Ready Ln 24 Col 1

Note: the result is stored in EAX and EBX in this screenshot.

4. A Triangular Sequence is calculated as the summation of all positive integer values up to and including n . As such, $t_n = n + (n - 1) + (n - 2) + \dots + 2 + 1$. Draft a program that:
- 1) Prompts the user for integer input,
 - 2) Takes integer input from the user,
 - 3) Stores that value in a variable called "n",
 - 4) Calculates t_n , and;
 - 5) Prints the final value to the screen.
- Use the "call WriteInt" invocation, not "call DumpRegs". Other invocations that are likely necessary include: "call ReadInt", "call WriteString." The calculation can be done numerous ways, and all submissions that evidence proper programming practice are acceptable (including loops, recursion, etc.). In your homework submission, please embed both the code and one screen shot with user input supplied as 100.

```
TITLE Triangular Sequence Calculator                                (hw05_q4.asm)

; Description: Takes an integer and sums all integers
; using the formula  $n + (n-1) + (n-2) + \dots + 2 + 1$ 
; Revision date: 2012/09/20

INCLUDE Irvine32.inc
.data
myMessage BYTE "Please input positive integer",0dh,0ah,0
n DWORD 0

.code
main PROC
    call Clrscr

    mov     edx,offset myMessage
    call WriteString                ; Write prompt to the screen

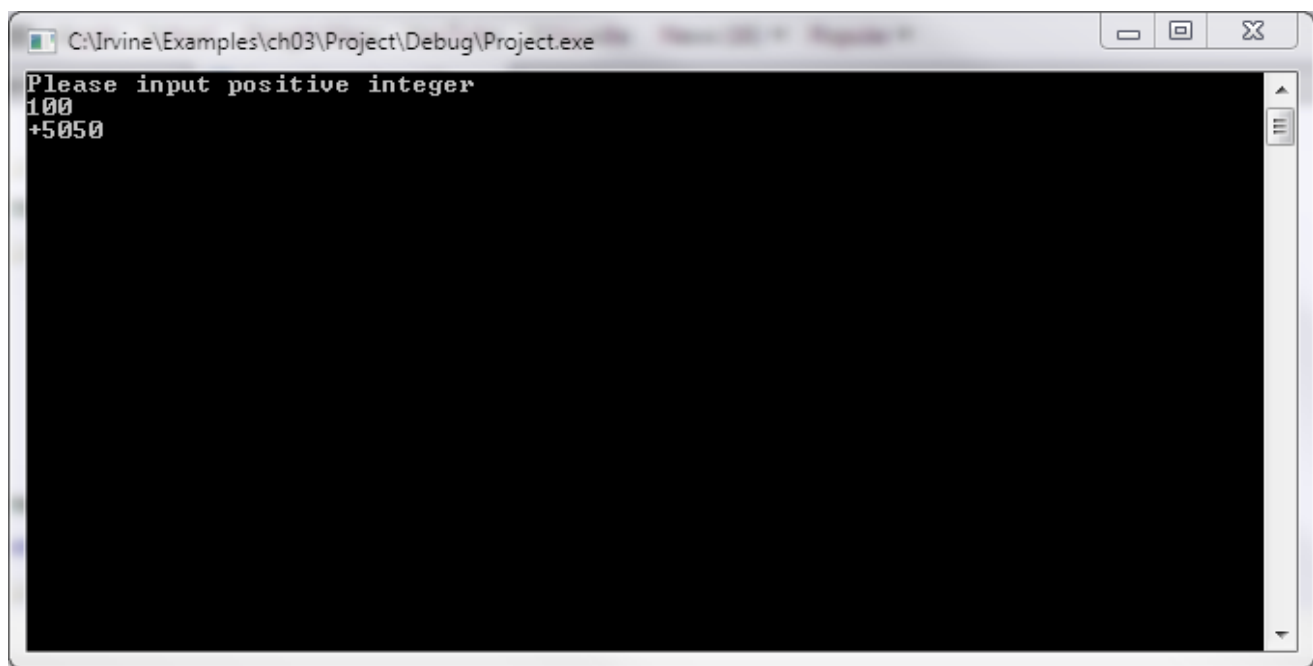
    call ReadInt                    ; Allows user to input integer
    mov n, eax                      ; writes input integer to variable n
    mov ecx, n                      ; writes variable n to ecx for loop decrement
    dec ecx                         ; decrements ecx by 1, for initial n-1 addition

L0:
    add n, ecx                      ; begin the loop here
    ; add the decremented number to the current position
    loop L0                        ; jumps for looping; ends once ecx=zero is reached

    mov eax, n                      ; copies the calculated value to edx for display
    call writeInt                   ; displays the calculated data

    exit
main ENDP

END main
```



A screenshot of a Windows command prompt window. The title bar at the top shows the file path "C:\Irvine\Examples\ch03\Project\Debug\Project.exe" and standard window controls (minimize, maximize, close). The command prompt area has a black background with white text. It displays the prompt "Please input positive integer", followed by the user input "100", and then the program's output "+5050". A vertical scrollbar is visible on the right side of the text area.

```
C:\Irvine\Examples\ch03\Project\Debug\Project.exe
Please input positive integer
100
+5050
```