LAB 07

CONDITIONAL PROCESSING

STUDENT NAME	ROLL NO	SEC

SIGNATURE & DATE

MARKS AWARDED: ______________

NATIONAL UNIVERSITY OF COMPUTER AND EMERGING SCIENCES (NUCES), KARACHI

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EL 2003 COMP ORG & ASSEMBLY LANGUAGE LAB

LABORATORY MANUAL •Fall 2021•Instructor: Aamir Ali, Aashir Mehboob, Amin Sadiq, Qurat-ul-Ain, M Kariz, Rabia

Lab Session 07: CONDITIONAL PROCESSING

Objectives:

- Boolean Instructions
- Set Operations
- CMP Instruction
- Conditional Jumps

Boolean Instructions

- **AND**
  Boolean AND operation between a source operand and destination operand.

  Syntax:
  AND reg, reg
  AND reg, mem
  AND reg, imm
  AND mem, reg
  AND mem, imm

- **OR**
  Boolean OR operation between a source operand and destination operand.

  Syntax:
  OR reg, reg
  OR reg, mem
  OR reg, imm
  OR mem, reg
  OR mem, imm

- **XOR**
  Boolean XOR operation between a source operand and destination operand.

  Syntax:
  XOR reg, reg
  XOR reg, mem
  XOR reg, imm
  XOR mem, reg
  XOR mem, imm

- **NOT**
  Boolean NOT operation on a destination operand.

  Syntax:
  NOT reg
  NOT mem

- **TEST**
  Similar to AND operation, except that instead of affecting any operands it sets the FLAGS appropriately.

Syntax: *TEST reg, reg*
TEST reg, mem
TEST reg, imm
TEST mem, reg
TEST mem, imm

Example 01:

```
Include Irvine32.inc
.code
main proc
      mov    al, 10101110b        ; Clear only bit 3
      and    al, 11110110b        ; AL = 10100110

      mov    al,  11100011b       ; set bit 2
      or     al, 00000100b        ; AL = 11100111

      mov    al,  10110101b       ;  5 bits means odd parity
      xor    al, 0                ; PF = 0 (PO)

      mov    al,  10100101b       ;  4 bits means even parity
      xor    al, 0                 ; PF = 1 (PE)

      mov    al,  11110000b
      not    al                               ; AL = 00001111b

      mov    al, 00100101b
      test   al, 00001001b        ; ZF = 0

      mov    al, 00100101b
      test   al, 00001000b        ; ZF = 1
       call   DumpRegs
 exit
main ENDP
END main
```

Set Operations (using Boolean instructions)

- **Set Complement**

The complement of a set can be achieved through NOT instruction.

- **Set Intersection**

The intersection of two sets can be achieved through AND instruction.

- **Set Union**

The union of two sets can be achieved through OR instruction.

Example 02:

```
Include Irvine32.inc
 .data
       A DWORD 10000000000000000000000000000111b
       B DWORD 10000001010100000000011101100011b
       msg1 BYTE "A intersection B is: ", 0
       msg2 BYTE "A union B is: ", 0
       msg3 BYTE "Complement of A is: ", 0
.code
main proc
       mov     eax,A
       and     eax, B           ;  A intersection B
       mov     edx, OFFSET msg1
       call    WriteString
       mov     ebx, TYPE DWORD
       call    WriteBinB
       call    Crlf
       mov     eax, A
       or      eax, B           ;  A union B
       mov     edx, OFFSET msg2
       call    WriteString
       mov     ebx, TYPE DWORD
       call    WriteBinB
       call    Crlf
       mov     eax, A
       not     eax                          ; A complement
       mov     edx, OFFSET msg3
       call    WriteString
       mov     ebx, TYPE DWORD
       call    WriteBinB
call    DumpRegs
 exit
main ENDP
END main
```

CMP instruction

CMP (compare) instruction performs an implied subtraction of a source operand from a destination operand for comparison.
For unsigned operands:

• Destination < source	ZF = 0	CF = 1
• Destination > source	ZF = 0	CF = 0
• Destination = source	ZF = 1	CF = 0

For signed operands:

• Destination < source	SF ! = OF
• Destination > source	SF = OF
• Destination = source	ZF = 1

<u>Example 03:</u>

```
Include Irvine32.inc
.code
main proc
        mov     ax, 5
        cmp     ax, 10          ;  ZF = 0       and     CF = 1
        mov     ax, 1000
        cmp     ax,  1000       ; ZF = 1        and     CF =0
        mov     si, 106
        cmp     si, 0           ; ZF = 0        and     CF = 0
call     DumpRegs
 exit
main ENDP
END main
```

Conditional Jumps

• Jumps based on Flag values

Mnemonic	Description	Flags / Registers
JZ	Jump if zero	ZF = 1
JNZ	Jump if not zero	ZF = 0
JC	Jump if carry	CF = 1
JNC	Jump if not carry	CF = 0
JO	Jump if overflow	OF = 1
JNO	Jump if not overflow	OF = 0
JS	Jump if signed	SF = 1
JNS	Jump if not signed	SF = 0
JP	Jump if parity (even)	PF = 1
JNP	Jump if not parity (odd)	PF = 0

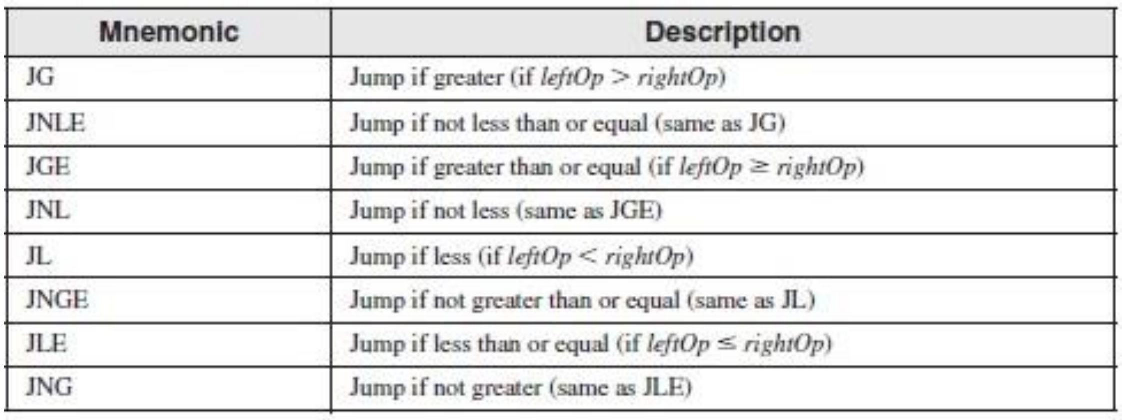
• Jumps based on Equality

Mnemonic	Description
JE	Jump if equal (*leftOp* = *rightOp*)
JNE	Jump if not equal (*leftOp* ≠ *rightOp*)
JCXZ	Jump if CX = 0
JECXZ	Jump if ECX = 0

• Jumps based on unsigned comparisons

Mnemonic	Description
JA	Jump if above (if *leftOp* > *rightOp*)
JNBE	Jump if not below or equal (same as JA)
JAE	Jump if above or equal (if *leftOp* ≥ *rightOp*)
JNB	Jump if not below (same as JAE)
JB	Jump if below (if *leftOp* < *rightOp*)
JNAE	Jump if not above or equal (same as JB)
JBE	Jump if below or equal (if *leftOp* ≤ *rightOp*)
JNA	Jump if not above (same as JBE)

- **Jumps based on signed comparisons**



Mnemonic	Description
JG	Jump if greater (if *leftOp* > *rightOp*)
JNLE	Jump if not less than or equal (same as JG)
JGE	Jump if greater than or equal (if *leftOp* ≥ *rightOp*)
JNL	Jump if not less (same as JGE)
JL	Jump if less (if *leftOp* < *rightOp*)
JNGE	Jump if not greater than or equal (same as JL)
JLE	Jump if less than or equal (if *leftOp* ≤ *rightOp*)
JNG	Jump if not greater (same as JLE)

Example 04:

```
Include Irvine32.inc
 .data
      var1 DWORD 250
      var2 DWORD 125
      larger DWORD ?
.code
main proc
      mov     eax, var1
      mov     larger, eax
      mov     ebx, var2
      cmp     eax, ebx
      jae     L1
      mov     larger, ebx
L1: call      DumpRegs
exit
main ENDP
END main
```

Example 05:

```
Include Irvine32.inc
 .data
      var1    DWORD 50
      var2    DWORD 25
      var3    DWORD 103
      msg     BYTE "The smallest integer is: ", 0
.code
main proc
moveax, var1
      cmp     eax, var2
      jbe     L1
```

```
        mov     eax, var2
        L1:
        cmp     eax, var3
        jbe     L2
        mov     eax, var3
        L2:
        mov     edx, OFFSET msg
        call    WriteString
        call    WriteDec
call    DumpRegs
 exit
main ENDP
END main
```

Example 06:

```
Include Irvine32.inc
 .data
char BYTE ?
.code
main proc
L1:
        mov     eax, 10                  ; create 10ms delay
        call    Delay
        call    ReadKey                  ; reads a key input
        jz      L1                       ; repeat if no key is pressed
        mov     char, al         ; saves the character
call    DumpRegs
 exit
main ENDP
END main
```

Lab Task(s):

1. Translate the following pseudo-code to Assembly Language:

```
var = 5
if ( var<ecx ) AND        (ecx>=edx)
        then
        x = 0
else
        x = 1
```

2. Use cmp and jumps to find the first non-zero value in the given array:

```
        intArr    SWORD    0, 0, 0, 0, 1, 20, 35, -12, 66, 4, 0
```

3. Write a program that takes four input integers from the user. Then compare and display a message whether these integers are equal or not.

4. Write a program for sequential search. Take an input from the user and find if it occurs in the following array:

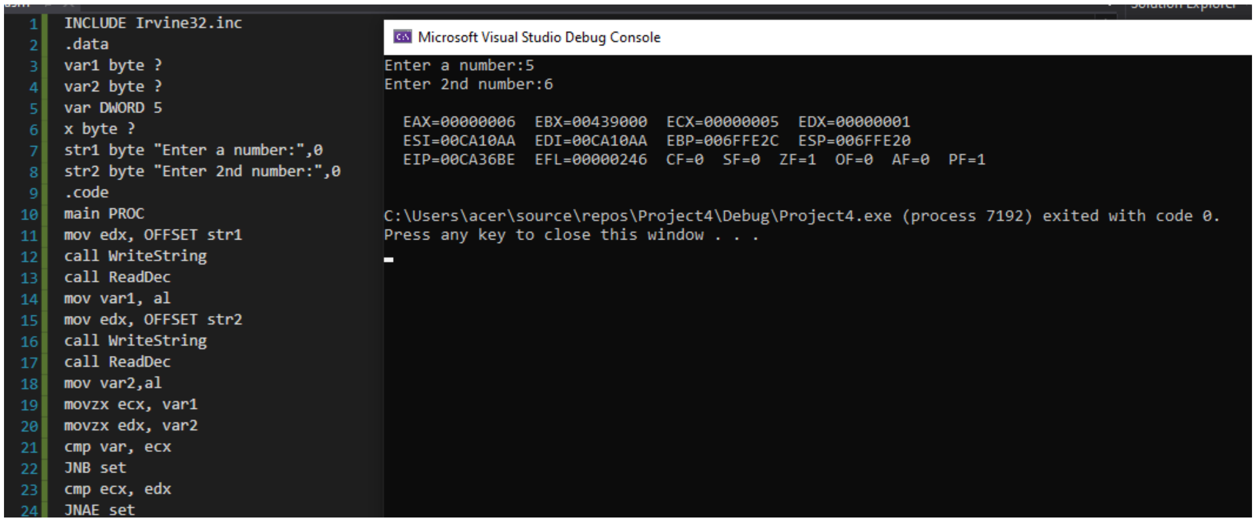
```
    arr    WORD      10, 4, 7, 14, 299, 156, 3, 19, 29, 300, 20
```

5. Translatethe followingpseudo-codeto Assembly Language:

```
Swap_Count = 0
for all elements of list
        if list[i] > list[i+1]
                swap(list[i], list[i+1])
                Swap_Count = Swap_Count + 1
        end if
end for
Print Swap_Count
```

LAB 7

Q1 Code + Output



```
INCLUDE Irvine32.inc
.data
var1 byte ?
var2 byte ?
var DWORD 5
x byte ?
str1 byte "Enter a number:",0
str2 byte "Enter 2nd number:",0
.code
main PROC
mov edx, OFFSET str1
call WriteString
call ReadDec
mov var1, al
mov edx, OFFSET str2
call WriteString
call ReadDec
mov var2,al
movzx ecx, var1
movzx edx, var2
cmp var, ecx
JNB set
cmp ecx, edx
JNAE set
```

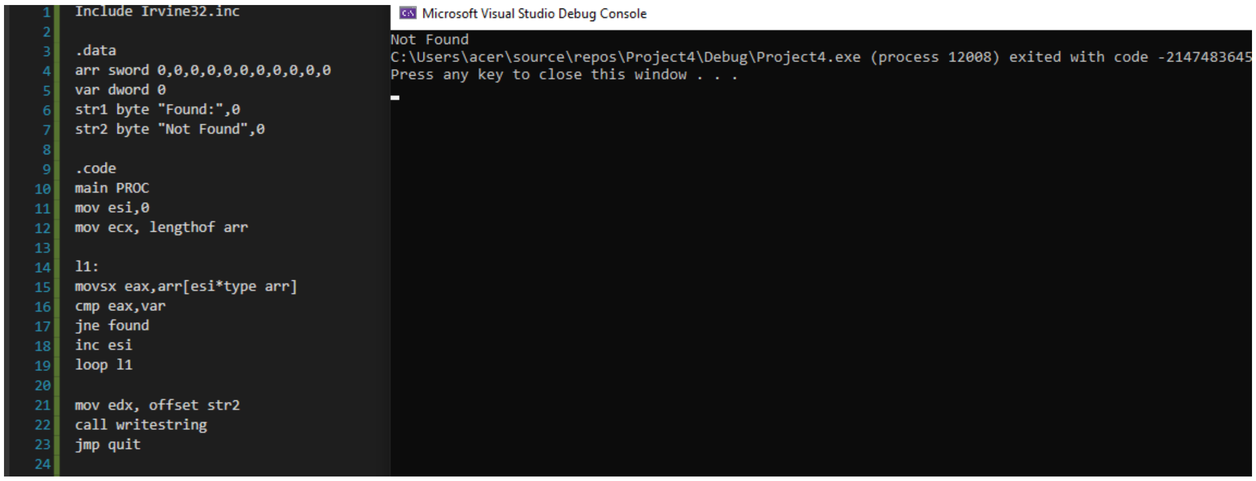
Microsoft Visual Studio Debug Console

```
Enter a number:5
Enter 2nd number:6

  EAX=00000006  EBX=00439000  ECX=00000005  EDX=00000001
  ESI=00CA10AA  EDI=00CA10AA  EBP=006FFE2C  ESP=006FFE20
  EIP=00CA36BE  EFL=00000246  CF=0  SF=0  ZF=1  OF=0  AF=0  PF=1


C:\Users\acer\source\repos\Project4\Debug\Project4.exe (process 7192) exited with code 0.
Press any key to close this window . . .
```

Q2 Code + Output



```
Include Irvine32.inc

.data
arr sword 0,0,0,0,0,0,0,0,0,0,0,0
var dword 0
str1 byte "Found:",0
str2 byte "Not Found",0

.code
main PROC
mov esi,0
mov ecx, lengthof arr

l1:
movsx eax,arr[esi*type arr]
cmp eax,var
jne found
inc esi
loop l1

mov edx, offset str2
call writestring
jmp quit

```

Microsoft Visual Studio Debug Console

```
Not Found
C:\Users\acer\source\repos\Project4\Debug\Project4.exe (process 12008) exited with code -2147483645
Press any key to close this window . . .
```

Q3 Code + Output

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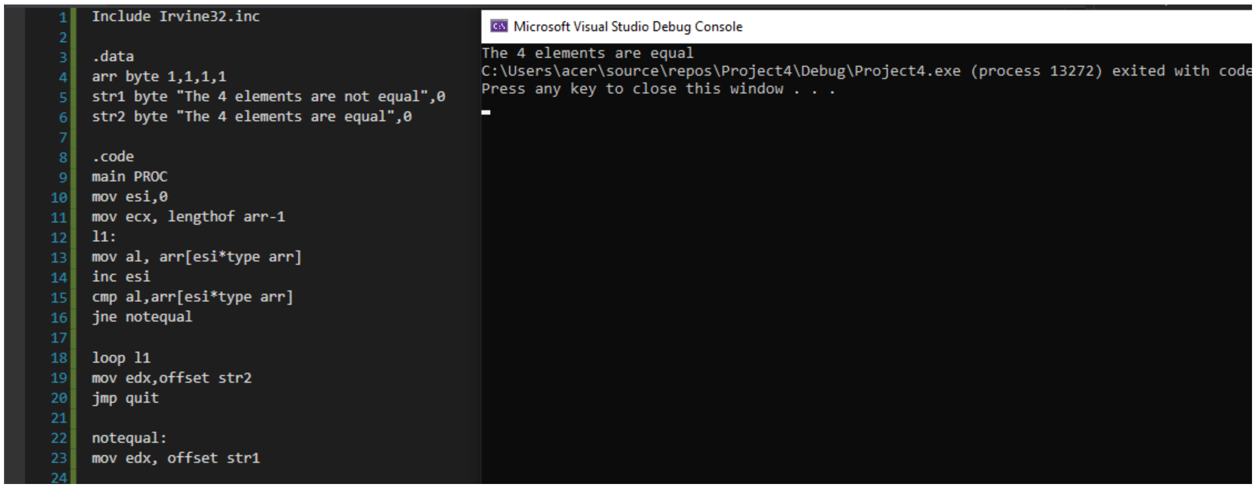
LAB 7

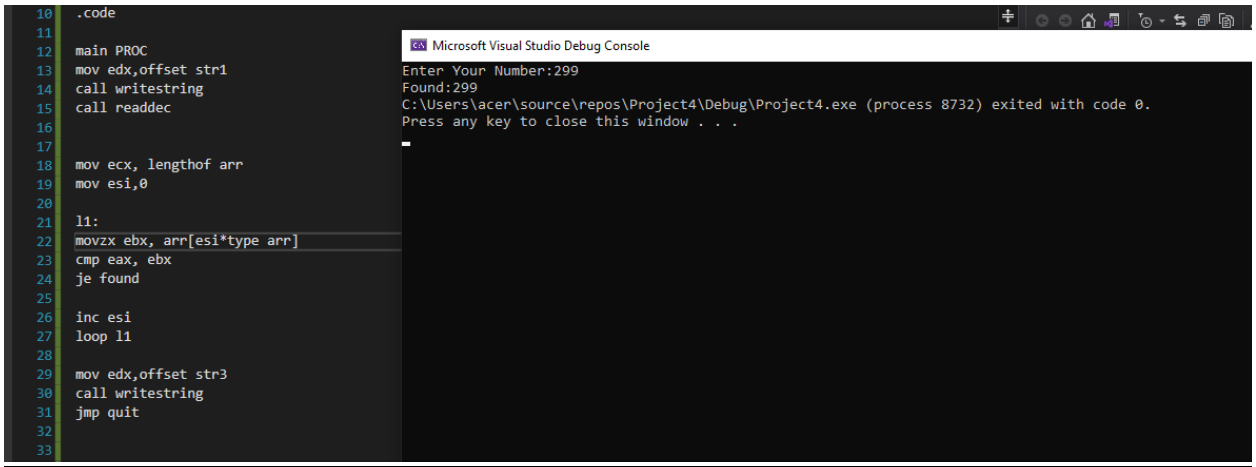


```
Include Irvine32.inc

.data
arr byte 1,1,1,1
str1 byte "The 4 elements are not equal",0
str2 byte "The 4 elements are equal",0

.code
main PROC
mov esi,0
mov ecx, lengthof arr-1
l1:
mov al, arr[esi*type arr]
inc esi
cmp al,arr[esi*type arr]
jne notequal

loop l1
mov edx,offset str2
jmp quit

notequal:
mov edx, offset str1
```

Microsoft Visual Studio Debug Console

```
The 4 elements are equal
C:\Users\acer\source\repos\Project4\Debug\Project4.exe (process 13272) exited with code
Press any key to close this window . . .
```

Q4 Code + Output

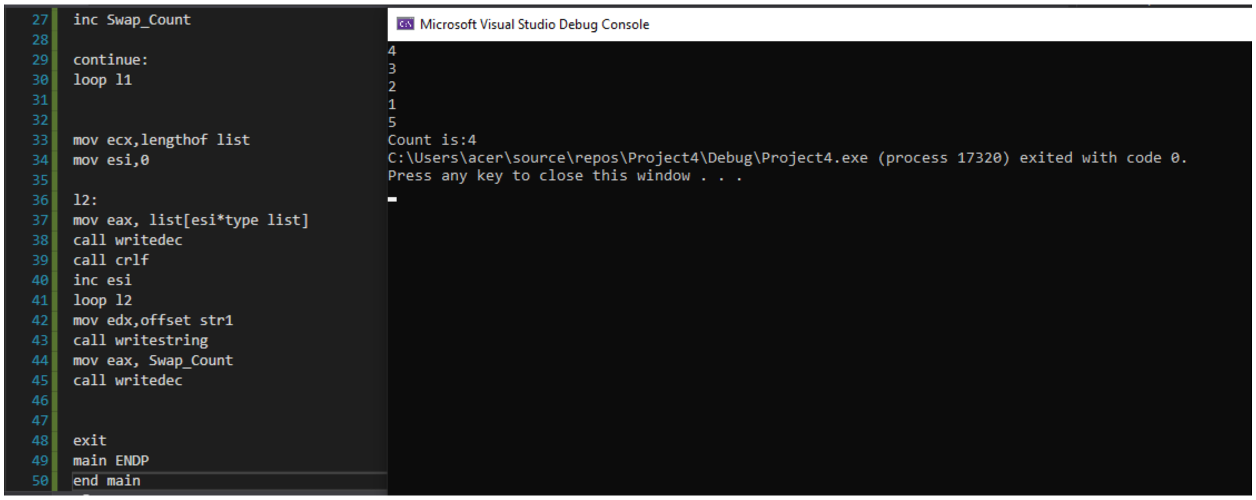


```
.code

main PROC
mov edx,offset str1
call writestring
call readdec


mov ecx, lengthof arr
mov esi,0

l1:
movzx ebx, arr[esi*type arr]
cmp eax, ebx
je found

inc esi
loop l1

mov edx,offset str3
call writestring
jmp quit
```

Microsoft Visual Studio Debug Console

```
Enter Your Number:299
Found:299
C:\Users\acer\source\repos\Project4\Debug\Project4.exe (process 8732) exited with code 0.
Press any key to close this window . . .
```

Q5 Code + Output



```
inc Swap_Count

continue:
loop l1


mov ecx,lengthof list
mov esi,0

l2:
mov eax, list[esi*type list]
call writedec
call crlf
inc esi
loop l2
mov edx,offset str1
call writestring
mov eax, Swap_Count
call writedec


exit
main ENDP
end main
```

Microsoft Visual Studio Debug Console

```
4
3
2
1
5
Count is:4
C:\Users\acer\source\repos\Project4\Debug\Project4.exe (process 17320) exited with code 0.
Press any key to close this window . . .
```

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