Fast**National University of Computer & Emerging Sciences, Karachi**

**EL-213: Computer Organization & Assembly Language Lab**

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| **Lab 4:** *Data Related Operators & Directives* | **Session:** Fall 2018 |
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**Direct-offset Operands**

You can add a displacement to the name of a variable, creating a direct-offset operand.

***Example:***

*.data*

*arrayB BYTE 10h,20h,30h,40h,50h*

*.code*

*mov al, arrayB ; AL = 10h*

*mov al, [arrayB+1] ; AL = 20h*

*mov al, [arrayB+2] ; AL = 30h*

**OFFSET Operator**

The OFFSET operator returns the offset of a data label.

***Syntax:***

MOV reg32, OFFSET mem ; our 32-bit register now points to mem

***Example:***

*.data*

*bVal BYTE ?*

*wVal WORD ?*

*dVal DWORD ?*

*dVal2 DWORD ?*

*If bVal is located at offset 00404000h, we would get:*

*mov esi, OFFSET bval ; ESI = 00404000*

*mov esi, OFFSET wVal ; ESI = 00404001*

*mov esi, OFFSET dVal ; ESI = 00404003*

*mov esi, OFFSET dVal2 ; ESI = 00404007*

**PTR Operator**

You can use the PTR operator to override the declared size of an operand.

***Example:***

*.data*

*val32 DWORD 12345678h*

*.code*

*mov ax, word PTR val32 ;AX=5678h*

*mov dx, word PTR val32+2 ;DX=1234h*

**ALIGN Directive**

The ALIGN directive aligns a variable on a byte, word, double-word, or paragraph boundary.

***Syntax:***

ALIGN bound (where bound is either 1, 2 or 4)

***Example:***

*bVal BYTE ? ; 00404000*

*ALIGN 2*

*wVal WORD ? ; 00404002*

*bVal BYTE ? ; 00404004*

*ALIGN 4*

*dVal DWORD ? ; 00404008*

*dVal2 DWORD ? ; 0040400C*

For further reading: http://web.cs.iastate.edu/~prabhu/Tutorial/PIPELINE/addressAlign.html

**TYPE Operator**

The TYPE operator returns the size, in bytes, of a single element of a variable.

***Syntax:***

MOV reg16, TYPE mem

***Example:***

*.data*

*var1 BYTE ? ; TYPE var1 = 1*

*var2 WORD ? ; TYPE var2 = 2*

*var3 DWORD ? ;TYPE var3 = 4*

*var4 QWORD ? ;TYPE var4 = 8*

***Example:***

*.data*

*var1 BYTE 20h*

*var2 WORD 1000h*

*var3 DWORD ?*

*var4 BYTE 10, 20, 30, 40, 50*

*msg BYTE ‘File not found’, 0*

*.code*

*mov ax, TYPE var1 ; AX = 0001*

*mov ax, TYPE var2 ; AX = 0002*

*mov ax, TYPE var3 ; AX = 0004*

*mov ax, TYPE var4 ; AX = 0001*

*mov ax, TYPE msg ; AX = 0001*

**LENGTHOF Operator**

The LENGTHOF operator counts the number of individual elements in a variable that has been defined using DUP.

***Syntax:***

MOV reg16 , LENGTHOF mem

***Example:***

*.data*

*val1 WORD 1000h*

*val2 SWORD 10, 20, 30*

*array WORD 32 DUP(0)*

*array2 WORD 5 DUP(3 DUP(0))*

*message BYTE ‘File not found’, 0*

*.code*

*mov ax, LENGTHOF val1 ; AX = 1*

*mov ax, LENGTHOF val2 ; AX = 1*

*mov ax, LENGTHOF array ; AX = 32*

*mov ax, LENGTHOF array2 ; AX = 5*

*mov ax, LENGTHOF message ; AX = 1*

**SIZEOF Operator**

The SIZEOF operator returns the number of bytes an array takes up. It is similar in effect to multiplying LENGTHOF with TYPE.

***Syntax:***

MOV reg16/32 , SIZEOF mem

***Example:***

*intArray WORD 32 DUP(0) ; SIZEOF = 64*

**Exercises**

1. Initialize a double word array consisting of elements 61,43,11,52, 25. Sort the given array in ascending order directly with the help of registers (you do not need to use a loop here). Use direct-offset addressing to access the array elements.

2. Use following array declarations:

*arrayB BYTE 5, 6, 2*

*arrayW WORD 15, 5, 10*

*arrayD DWORD 60, 12, 18*

Now initialize three double word variables PROD1, PROD2, PROD3 and perform following operations (expressed in pseudo-code here):

PROD1 = arrayB[0] \* arrayW[0] \* arrayD[0]

PROD2 = arrayB[1] \* arrayW[1] \* arrayD[1]

PROD3 = arrayB[2] \* arrayW[2] \* arrayD[2]

**Note:** You can use PTR or any other directives/operators, if required.

3. Write instructions to evaluate the following expressions. Variables x , y , w, u and v must store consecutive uninitialized storage in memory between range -127 to +128.

*z = x + y + w – v +u*

4. Initialize two arrays:

*array1 BYTE 10, 20, 30, 40*

*array2 WORD DUP(?)*

Copy elements of array1 into array2 in reverse order.