

Computer Organization and Assembly Language Programming

Lab Manual 1 – Setup and Running your first program

Activity 1: Setup

Follow this link to get started: <https://github.com/ASD0x41/Assembly-Programming-Package>

If above link doesn't work for you then follow this:

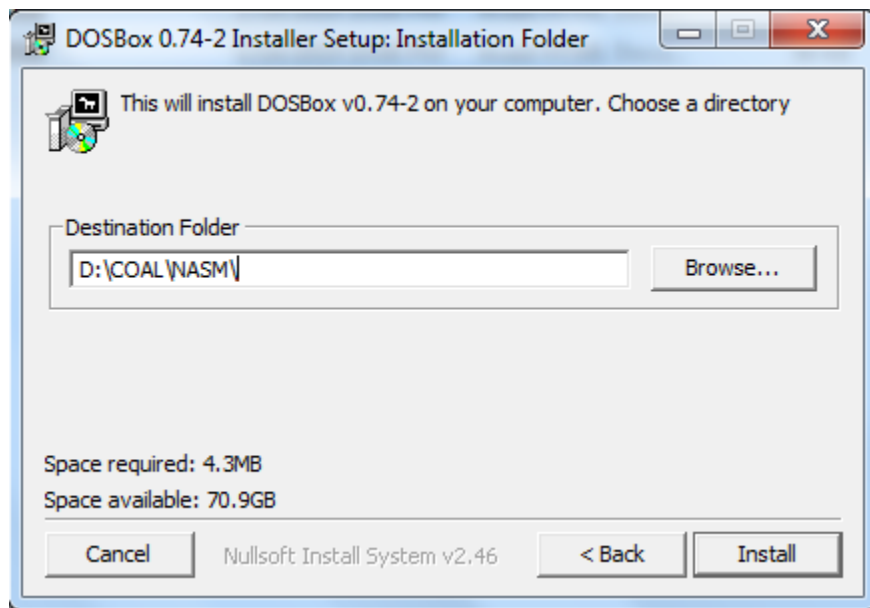
Suggested version of NASM (you will need to install this in coming instructions):

<https://www.nasm.us/pub/nasm/releasebuilds/2.15.05/>

Option 3:

Make a separate folder COAL and NASM in your machine for example "D:\COAL\NASM". Visit the link given below. Download and install NASM, AFD and DOSBOX, according to the instructions, in your NASM folder.

<http://wetolearn.blogspot.com/2013/09/setting-up-afd-nasm-and-dosbox-for-8086.html>



After installations double click "DOSBox 0.74-2 Options.bat" file and at the end of the file paste following lines:

```
MOUNT C D://COAL//NASM  
C:
```

(We are mounting C drive to our folder where we have saved AFD and we will save our .asm file in this directory)

You may follow links given below for **Video Tutorial of Setup:**

Tutorial part

1: https://drive.google.com/file/d/1N3lWL8hsN0ZbhF3tINwCWWwj_eHQqk6/view?usp=sharing

Tutorial part 2: <https://drive.google.com/file/d/10p8qyaOVOWF5lDighrMKE-uNYQX-c3bL/view?usp=sharing>

AFD: https://drive.google.com/file/d/1eXnD3JEwBelFiJT6ilk7gluudV2Fu_iX/view?usp=sharing

NASM: https://drive.google.com/file/d/1ZoeE2MxjNaK7DdJKCacYfAJyn006MI_F/view?usp=sharing

Dosbox: <https://drive.google.com/file/d/1DnaDlk4RoGBFDP1y4Dr3q89xwM3gx1d1/view?usp=sharing>

Activity 2: Running your First Program

Follow these step in order to run your first program:

- 1- Copy/paste following code in notepad

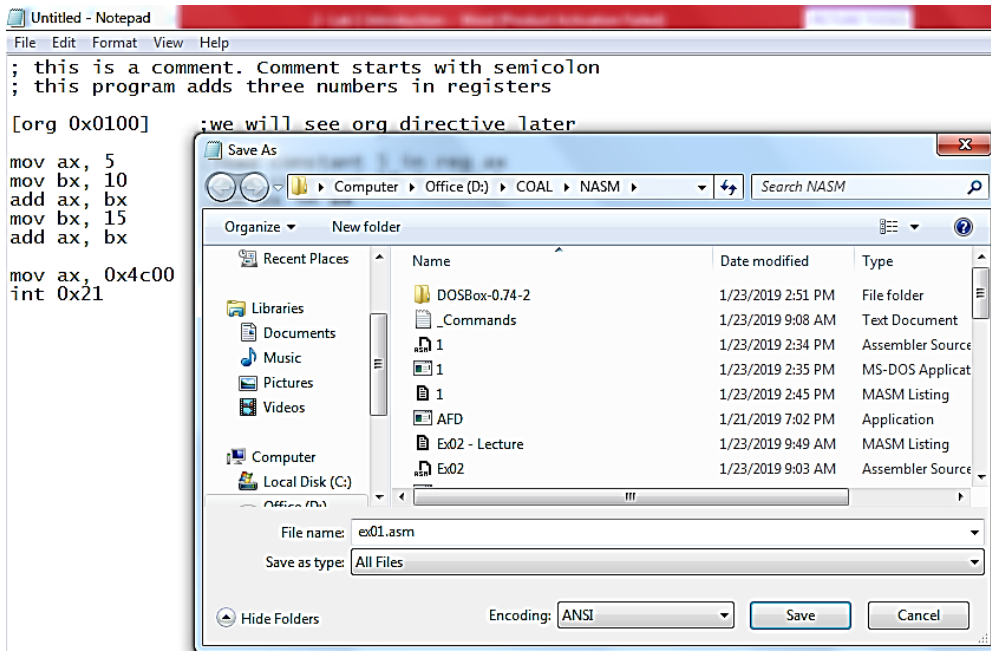
```
; this is a comment. Comment starts with semicolon
; this program adds three numbers in registers

[org 0x0100] ;we will see org directive later

mov ax, 5      ; AX = 5
mov bx, 10     ; BX = 10
add ax, bx     ; AX = AX + BX
mov bx, 15     ; BX = 15
add ax, bx     ; AX = AX + BX

mov ax, 0x4c00 ;terminate the program
int 0x21
```

- 2- Save this file as “ex01.asm” in your NASM folder e.g. “D:\COAL\NASM”:



- Go to NASM installation directory (e.g. "D:\COAL\NASM"). Double click **nasmpath.bat** (batch file) and type following command there. (Your .asm file and nasm should be in one folder)

nasm ex01.asm -o ex01.com -l ex01.lst

- Above command will assemble your code and create ex01.com and ex01.lst files. Open ex01.lst file in notepad.
 - What is opcode of instruction "mov ax, someConstant"
 - Verify the above opcode everywhere the instruction has been used.
 - What does "B80500" mean?
 - Verify the opcode of instruction "mov bx, someConstant" throughout the machine code.
 - What is the offset of first instruction?
 - Why are offsets of second and third instructions 3 and 6?
 - What should be the size of ex01.com file?
 - Right click ex01.com and verify its size.

- Open DOSBox (by double clicking dosbox.exe), following window will appear:

```

DOSBox 0.74-2, Cpu speed: 3000 cycles, Frameskip 0, Program: DOSBOX

Welcome to DOSBox v0.74-2

For a short introduction for new users type: INTRO
For supported shell commands type: HELP

To adjust the emulated CPU speed, use ctrl-F11 and ctrl-F12.
To activate the keymapper ctrl-F1.
For more information read the README file in the DOSBox directory.

HAVE FUN!
The DOSBox Team http://www.dosbox.com

Z:\>SET BLASTER=A220 I7 D1 H5 T6

Z:\>MOUNT C D://COAL//NASM
Drive C is mounted as local directory D://COAL//NASM\

Z:\>C:

C:\>

```

6- Write following command and press enter.

Afd ex01.com

(Your AFD.exe should be in same directory where we have installed everything)

```

DOSBox 0.74-2, Cpu speed: 3000 cycles, Frameskip 0, Program: AFD

AX 0000 SI 0000 CS 19F5 IP 0100 Stack +0 0000 Flags 7202
BX 0000 DI 0000 DS 19F5      +2 20CD
CX 0012 BP 0000 ES 19F5 HS 19F5  +4 9FFF OF DF IF SF ZF AF PF CF
DX 0000 SP FFFE SS 19F5 FS 19F5  +6 EA00 0 0 1 0 0 0 0 0

CMD >

0100 B80500 MOV AX,0005
0103 BB0A00 MOV BX,000A
0106 01D8 ADD AX,BX
0108 BB0F00 MOV BX,000F
010B 01D8 ADD AX,BX
010D B804C MOV AX,4C00
0110 CD21 INT 21
0112 0000 ADD [BX+SI],AL

1 0 1 2 3 4 5 6 7
DS:0000 CD 20 FF 9F 00 EA F0 FE AD DE 1B 05 C5 06 00 00
DS:0008 18 01 10 01 18 01 92 01 01 01 01 00 02 FF FF FF
DS:0010 01 01 01 00 02 FF FF FF FF FF FF FF FF EB 19 C0 11
DS:0018 01 01 01 00 02 FF FF FF FF FF FF FF FF EB 19 C0 11
DS:0020 FF FF FF FF FF FF FF FF FF FF FF FF FF EB 19 C0 11
DS:0028 FF FF FF FF EB 19 C0 11
DS:0030 A2 01 14 00 18 00 F5 19 FF FF FF FF 00 00 00 00
DS:0038 FF FF FF FF 00 00 00 00
DS:0040 05 00 00 00 00 00 00 00 00 00 00 00 00 00 00
DS:0048 00 00 00 00 00 00 00 00

2 0 1 2 3 4 5 6 7 8 9 A B C D E F
DS:0000 CD 20 FF 9F 00 EA F0 FE AD DE 1B 05 C5 06 00 00 = f.Ω≡ i |..†...
DS:0010 18 01 10 01 18 01 92 01 01 01 01 00 02 FF FF FF .....#. ....
DS:0020 FF FF FF FF FF FF FF FF FF FF FF FF FF EB 19 C0 11 δ.L.
DS:0030 A2 01 14 00 18 00 F5 19 FF FF FF FF 00 00 00 00 ó.....J. ....
DS:0040 05 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....

1 Step 2ProcStep 3Retrieve 4Help ON 5BRK Menu 6 7 up 8 dn 9 le 10 ri

```

7- Above command will open the debugger and load your ex01.com file in it.

a. What is the value of IP register? And what will be its effect?

- b. Note the initial values of data registers
- c. Press F1 and watch the values of data registers

Activity 3: Explore different functions available in debugger (after completing activity 4 and 5).

Activity 4: Modify this program to generate the sum of first five entries of table of 3, using registers, and watch its execution in the debugger.

Activity 5: Write a program in assembly language that calculates the square of six by adding six to the accumulator six times.

Activity 6: Do exercise 4 and 5 with Byte size operations (for example, AL, AH etc.)

Practice Problems

- 1- Listing files of two programs are given below. What will be the size of their com files?
 (_____)₁₆ and (_____)₁₀

Listing File 1:

```

1          ; a program to add ten numbers
2
3          [org 0x0100]
4
5 00000000 BB[1D00]      mov bx, num1
6 00000003 B90A00        mov cx, 10
7 00000006 B80000        mov ax, 0
8
9 00000009 0307          l1:    add ax, [bx]
10 0000000B 81C30200      add bx, 2
11 0000000F 81E90100      sub cx, 1
12 00000013 75F4          jnz l1
13
14
15
16 00000015 A3[3100]      mov [num1], ax
17
18 00000018 B8004C        mov ax, 0x4c00          ;terminate the program
19 0000001B CD21          int 0x21
20
21 0000001D 010002000300040005- num1:      dw 1, 2, 3, 4, 5, 1, 2, 3, 4, 5
22 00000026 000100020003000400-
23 0000002F 0500

```

Listing File 2:

```

1          ; Multiplication
2
3          [org 0x0100]

```

```

4
5 00000000 E90600                jmp start
6
7 00000003 4E9D          a:      DW 0x9D4E
8 00000005 C3A54E9D      b:      DD 0x9D4EA5C3
9
10 00000009 B8A9FC      start:  mov ax, 0xFcA9
11 0000000C C1E004                shl ax,4
12 0000000F C1C004                rol ax,4
13
14                ;mov [a],0x9D4E      ; Error op size not specified
15 00000012 C706[0300]4E9D      mov word[a],0x9D4E
16
17 00000018 C026[0300]04      shl [a],4; by default this will operate on 1 byte
18 0000001D C006[0300]04      rol [a],4
19
20 00000022 C706[0300]4E9D      mov word[a],0x9D4E
21 00000028 C126[0300]04      shl word[a],4
22 0000002D C106[0300]04      rol word[a],4
23
24 00000032 B8004C      mov ax, 0x4c00                ;terminate the program
25 00000035 CD21      int 0x21

```