BAŞKENT UNIVERSITY

ENGINEERING FACULTY

ELECTRICAL-ELECTRONICS
ENGINEERING DEPARTMENT

EEM 322 - MICROPROCESSORS LAB

EXPERIMENT NO. 02:

BASIC DEBUG AND ASSEMBLY COMMANDS

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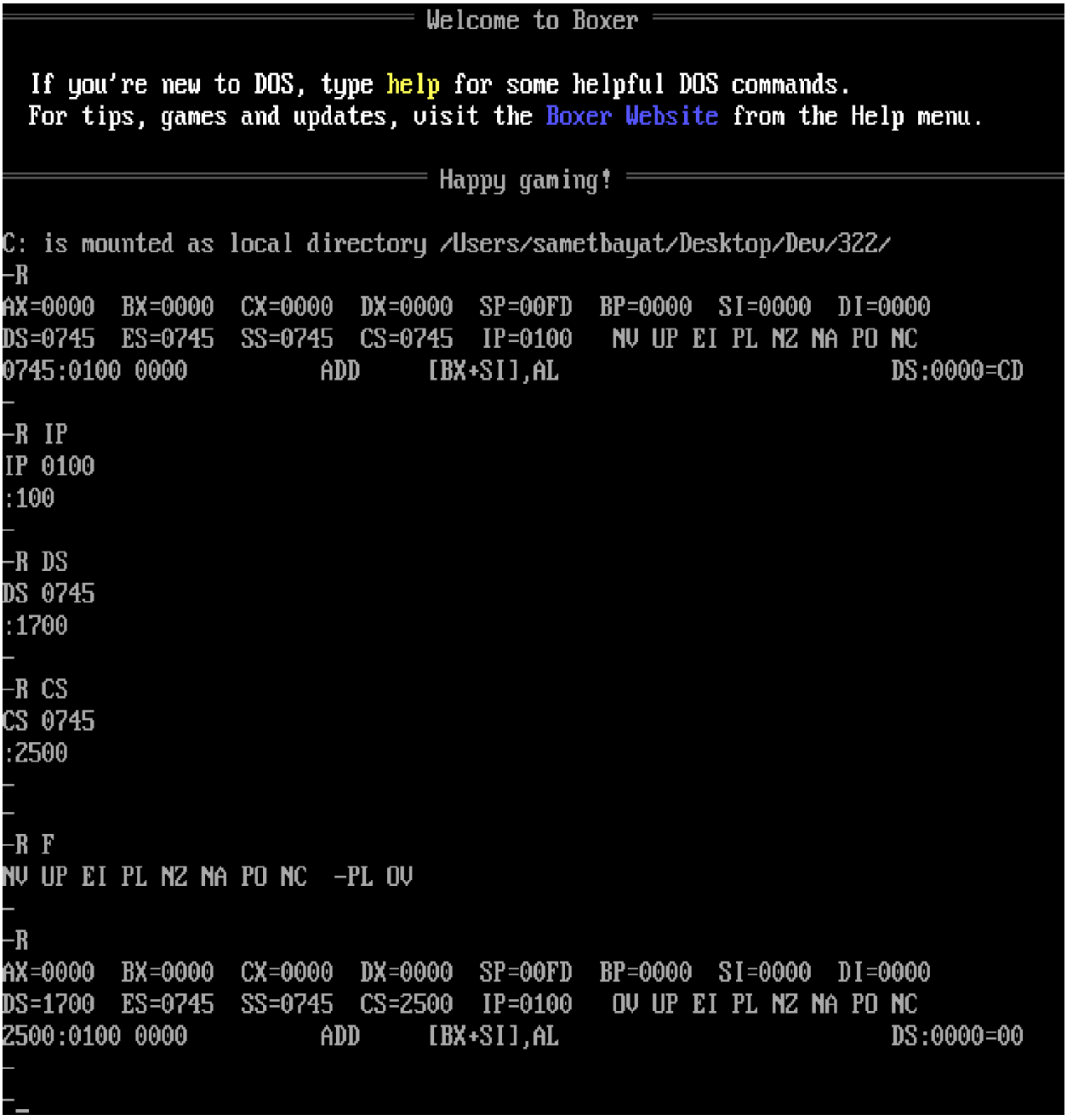
1. Using the REGISTER command,

a) Display the current contents of the registers.
b) Change the value of the IP register to 100_{16}.
c) Change the value of the DS register to 1700_{16}.
d) Change the contents of the CS register to 2500_{16}.
e) Set the sign flag to "positive" and the overflow flag to "overflow occurred".
f) Observe the changes you made using the REGISTER command.



2. Using the FILL command, replace the current values of 32 storage locations starting from the address DS:22 with the value 44_{16}.

   $32_{10} = 20_{16}$, from 22nd, we need 22 + 20 - 1 = 41 space to fill.

```
-F DS:22 41 44
```

3. Using the DUMP command, observe the contents of the first 72 bytes of the current data segment starting from address DS:00.

```
-D DS:00 72
1700:0000  00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00   ................
1700:0010  00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00   ................
1700:0020  00 00 44 44 44 44 44 44-44 44 44 44 44 44 44 44   ..DDDDDDDDDDDDDD
1700:0030  44 44 44 44 44 44 44 44-44 44 44 44 44 44 44 44   DDDDDDDDDDDDDDDD
1700:0040  44 44 00 00 00 00 00 00-00 00 00 00 00 00 00 00   DD..............
1700:0050  00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00   ................
1700:0060  00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00   ................
1700:0070  00 00 00                                         ...
```

Hex	Char
40	@
41	A
42	B
43	C
44	D

Also if we inspect the ASCII table, it is seen that the 'D' character and HEX value 44 matches.

... ...

FUN FACT: The default character for 'None-00' is set as '.(dot)' If we DUMP 2E value which is ASCII equivalent of '.(dot)', we cannot observe the change in right hand-side.

2E	.

```
-F DS:80 83 2E
-D DS:70 90
1700:0070  00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00   ................
1700:0080  2E 2E 2E 2E 00 00 00 00-00 00 00 00 00 00 00 00   ................
1700:0090  00                                               .
```

... ...

4. Using the MOVE command, copy 20 storage locations starting from address DS:22 to the storage locations starting from CS:100 and observe the changes for DS and CS using the DUMP command.

$20_{10} = 14_{16}$, 22 + 14 − 1 = 35_{16}.

- USAGE:
D DS:FROM TO
D CS:INITIAL_ADDRESS FINAL_ADDRESS

```
-M DS:22 35 CS:100
-
-D DS:20 72
1700:0020  00 00 44 44 44 44 44 44-44 44 44 44 44 44 44 44   ..DDDDDDDDDDDDDD
1700:0030  44 44 44 44 44 44 44 44-44 44 44 44 44 44 44 44   DDDDDDDDDDDDDDDD
1700:0040  44 44 00 00 00 00 00 00-00 00 00 00 00 00 00 00   DD..............
1700:0050  00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00   ................
1700:0060  00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00   ................
1700:0070  00 00 00                                         ...
-
-D CS:100 130
2500:0100  44 44 44 44 44 44 44 44-44 44 44 44 44 44 44 44   DDDDDDDDDDDDDDDD
2500:0110  44 44 44 44 00 00 00 00-00 00 00 00 00 00 00 00   DDDD............
2500:0120  00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00   ................
2500:0130  00                                               .
-_
```

NOTE: If we do not indicate the end address by default it shows 8 lines.

```
-
-D DS: 20
1700:0020  00 00 44 44 44 44 44 44-44 44 44 44 44 44 44 44   ..DDDDDDDDDDDDDD
1700:0030  44 44 44 44 44 44 44 44-44 44 44 44 44 44 44 44   DDDDDDDDDDDDDDDD
1700:0040  44 44 00 00 00 00 00 00-00 00 00 00 00 00 00 00   DD..............
1700:0050  00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00   ................
1700:0060  00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00   ................
1700:0070  00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00   ................
1700:0080  00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00   ................
1700:0090  00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00   ................
-
-D CS:100
2500:0100  44 44 44 44 44 44 44 44-44 44 44 44 44 44 44 44   DDDDDDDDDDDDDDDD
2500:0110  44 44 44 44 00 00 00 00-00 00 00 00 00 00 00 00   DDDD............
2500:0120  00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00   ................
2500:0130  00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00   ................
2500:0140  00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00   ................
2500:0150  00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00   ................
2500:0160  00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00   ................
2500:0170  00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00   ................
-
```

Using the COMPARE command, perform the following operations: a) Compare the new contents of 20 storage locations starting from the address DS:22 with the contents starting from the address CS:100.
b) Repeat step (a) for 40 storage locations.

$20_{10} = 14_{16}$, $22_{16} + 14_{16} - 1_{16} = 35_{16}$
$40_{10} = 28_{16}$, $22_{16} + 28_{16} - 1_{16} = 49_{16}$

```
-C DS:22 35 CS:100
-
-C DS:22 49 CS:100
1700:0036  44  00  2500:0114
1700:0037  44  00  2500:0115
1700:0038  44  00  2500:0116
1700:0039  44  00  2500:0117
1700:003A  44  00  2500:0118
1700:003B  44  00  2500:0119
1700:003C  44  00  2500:011A
1700:003D  44  00  2500:011B
1700:003E  44  00  2500:011C
1700:003F  44  00  2500:011D
1700:0040  44  00  2500:011E
1700:0041  44  00  2500:011F
```

PART a: No change b/w 22 to 35 so program does not print anything.
PART b: From Code Segment 114 to 11F change detected. We see the comparison because of that.

5. Using the SEARCH command, determine the locations where the values 44_{16} and FA_{16} occur between addresses DS:00 and DS:30.

```
-S DS:00 30 FA
-
-S DS:00 30 44
1700:0022
1700:0023
1700:0024
1700:0025
1700:0026
1700:0027
1700:0028
1700:0029
1700:002A
1700:002B
1700:002C
1700:002D
1700:002E
1700:002F
1700:0030
```

1st : Program could not find value **FA.**
2nd : Program found value **44** and showed the addresses.

6. Using the ASSEMBLE command, enter the following instructions and obtain their machine language equivalents using the UNASSEMBLE command. (Set the IP value to 100_{16}.)

*** "- A" FOR ASSEMBLE, "- U" FOR UNASSEMBLE.**

```
-A 100
2500:0100 MOV AX, 55
2500:0103 MOV BX, AX
2500:0105 MOV CX, 20
2500:0108 MOV DX, 0110
2500:010B OR  CX, AX
2500:010D OR  AX, CX
2500:010F ADD BX, AX
2500:0111 SUB BX, AX
2500:0113 ROL DX, 1
2500:0115 ROR DX, 1
2500:0117 ROR DX, 1
2500:0119 NOT DX
2500:011B
-
```

```
MOV AX,55
MOV BX,AX
MOV CX,20
MOV DX,0110
OR CX,AX
OR AX,CX
ADD BX,AX
SUB AX,BX
ROL DX,1
ROR DX,1
ROR DX,1
NOT DX
```

```
-U 100
2500:0100 B85500        MOV     AX,0055
2500:0103 89C3          MOV     BX,AX
2500:0105 B92000        MOV     CX,0020
2500:0108 BA1001        MOV     DX,0110
2500:010B 09C1          OR      CX,AX
2500:010D 09C8          OR      AX,CX
2500:010F 01C3          ADD     BX,AX
2500:0111 29C3          SUB     BX,AX
2500:0113 D1C2          ROL     DX,1
2500:0115 D1CA          ROR     DX,1
2500:0117 D1CA          ROR     DX,1
2500:0119 F7D2          NOT     DX
2500:011B 0000          ADD     [BX+SI],AL
2500:011D 0000          ADD     [BX+SI],AL
2500:011F 0000          ADD     [BX+SI],AL
-_
```

We wrote Assembly code from IP=100 "**-A 100**".
Then unassemble with "**-U 100**"command. Second column from left expresses the machine code equivalent of the "Assembly" codes.

7. Using the TRACE command, execute the above program and observe the changes in register values step by step.

```
-R
AX=0000  BX=0000  CX=0000  DX=0000  SP=00FD  BP=0000  SI=0000  DI=0000
DS=1700  ES=0745  SS=0745  CS=2500  IP=0100   OV UP EI PL NZ NA PO NC
2500:0100 B85500        MOV     AX,0055
-
-T

AX=0055  BX=0000  CX=0000  DX=0000  SP=00FD  BP=0000  SI=0000  DI=0000
DS=1700  ES=0745  SS=0745  CS=2500  IP=0103   OV UP EI PL NZ NA PO NC
2500:0103 89C3          MOV     BX,AX
-
-T

AX=0055  BX=0055  CX=0000  DX=0000  SP=00FD  BP=0000  SI=0000  DI=0000
DS=1700  ES=0745  SS=0745  CS=2500  IP=0105   OV UP EI PL NZ NA PO NC
2500:0105 B92000        MOV     CX,0020
-
-T

AX=0055  BX=0055  CX=0020  DX=0000  SP=00FD  BP=0000  SI=0000  DI=0000
DS=1700  ES=0745  SS=0745  CS=2500  IP=0108   OV UP EI PL NZ NA PO NC
2500:0108 BA1001        MOV     DX,0110
-
-T

AX=0055  BX=0055  CX=0020  DX=0110  SP=00FD  BP=0000  SI=0000  DI=0000
DS=1700  ES=0745  SS=0745  CS=2500  IP=010B   OV UP EI PL NZ NA PO NC
2500:010B 09C1          OR      CX,AX
-
-T

AX=0055  BX=0055  CX=0075  DX=0110  SP=00FD  BP=0000  SI=0000  DI=0000
DS=1700  ES=0745  SS=0745  CS=2500  IP=010D   NV UP EI PL NZ NA PO NC
2500:010D 09C8          OR      AX,CX
-
-T

AX=0075  BX=0055  CX=0075  DX=0110  SP=00FD  BP=0000  SI=0000  DI=0000
DS=1700  ES=0745  SS=0745  CS=2500  IP=010F   NV UP EI PL NZ NA PO NC
2500:010F 01C3          ADD     BX,AX
```

```
-T

AX=0075  BX=00CA  CX=0075  DX=0110  SP=00FD  BP=0000  SI=0000  DI=0000
DS=1700  ES=0745  SS=0745  CS=2500  IP=0111   NV UP EI PL NZ NA PE NC
2500:0111 29C3          SUB     BX,AX
-
-T

AX=0075  BX=0055  CX=0075  DX=0110  SP=00FD  BP=0000  SI=0000  DI=0000
DS=1700  ES=0745  SS=0745  CS=2500  IP=0113   NV UP EI PL NZ NA PE NC
2500:0113 D1C2          ROL     DX,1
-
-T

AX=0075  BX=0055  CX=0075  DX=0220  SP=00FD  BP=0000  SI=0000  DI=0000
DS=1700  ES=0745  SS=0745  CS=2500  IP=0115   NV UP EI PL NZ NA PE NC
2500:0115 D1CA          ROR     DX,1
-T

AX=0075  BX=0055  CX=0075  DX=0110  SP=00FD  BP=0000  SI=0000  DI=0000
DS=1700  ES=0745  SS=0745  CS=2500  IP=0117   NV UP EI PL NZ NA PE NC
2500:0117 D1CA          ROR     DX,1
-
-T

AX=0075  BX=0055  CX=0075  DX=0088  SP=00FD  BP=0000  SI=0000  DI=0000
DS=1700  ES=0745  SS=0745  CS=2500  IP=0119   NV UP EI PL NZ NA PE NC
2500:0119 F7D2          NOT     DX
-
-T

AX=0075  BX=0055  CX=0075  DX=FF77  SP=00FD  BP=0000  SI=0000  DI=0000
DS=1700  ES=0745  SS=0745  CS=2500  IP=011B   NV UP EI PL NZ NA PE NC
2500:011B 0000          ADD     [BX+SI],AL                      DS:0055=00
-_
```