SSN College of Engineering Department of Computer Science and Engineering

III year - UCS1512 – Microprocessors Lab

Matrix operations

Exp No: 05

Name: Rahul Ram M

Register Number: 185001121

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a) Matrix addition:

Aim:

Design 8086 program for matrix addition.

Procedure for executing MASM:

1. Run Dosbox and mount your masm folder to a drive in dosbox.
2. Goto the mounted drive.
3. Save the 8086 program with extension .asm in the same folder using command “edit”
4. After creating the file, assemble it using the command “masm filename.asm”
5. Link the file using the command “link filename.obj;”
6. Use debug command with filename.exe to execute and analyse the memory contents, “debug filename.exe”.
7. In debug, command “u” will display the unassembled code.
8. Use command “d segment:offset” to see the content of memory locations starting from segment:offset address.
9. To change the value in memory, use the command “e segment:offset”
10. Verify the memory contents to ensure the updates (using command “d”).
11. . Execute using the command “g” and check the outputs.
12. “q” to exit from debug and “exit” to exit from command prompt and to close the Dosbox.

Algorithm:

1. Move the starting address of data segment to AX register and move the data from AX register to DS register.
2. Move the value of the variable ROW1 to AL register and ROW2 to BL register.
3. Compare AL and BL register. IF they are not equal, jump to EXIT.
4. Move the value of the variable COLUMNN1 to AL register and COLUMN2 to BL register.
5. Compare AL and BL register. IF they are not equal, jump to EXIT.
6. Move the value of the variable ROW1 to AL register.

7. Multiply AL and BL using MUL AL.
8. Move 00H to AL register and copy AX to CX register.
9. Load effective addresses of the variables MAT1, MAT2 and RESULT to SI, Di and BX register respectively.
10. L1: Move 00H to AH register.
11. Move the value at SI and DI register's location to AL and DL register respectively.
12. Now add AL and DL. If there is no carry, jump to HERE else increment AH register.
13. HERE: Move the value of AX register to BX's location.
14. Increment SI and Di register and add 2 to BX register.
15. Loop to L1.
16. EXIT: INT 21H means invoke the interrupt identified by the hexadecimal number 21. In MS-DOS, invoking interrupt 21h while AH = 4Ch causes the current process to terminate and uses the value of register AL as the exit code of the process.

Program:

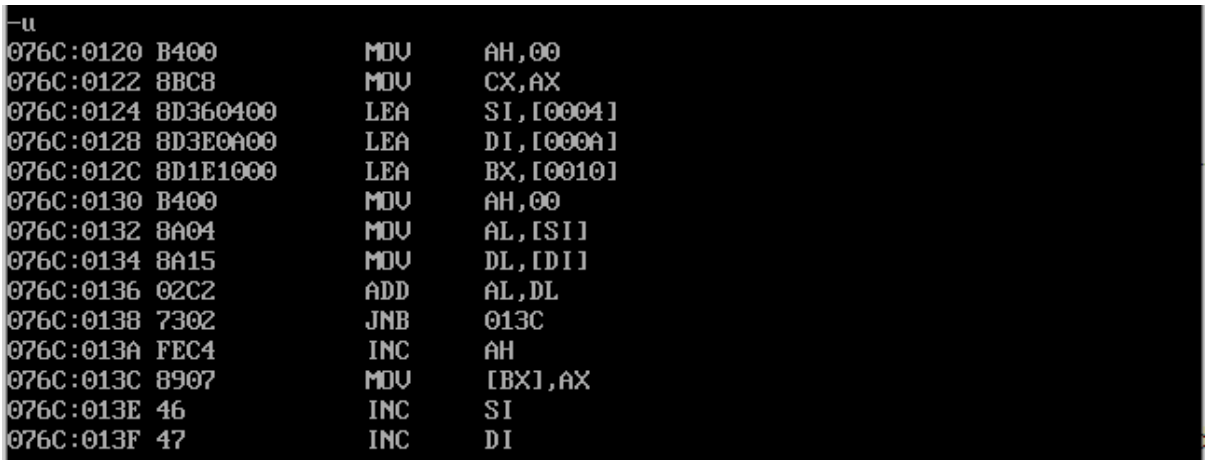
```
;Program for matrix addition

assume cs:code,ds:data
data segment
   row1 db 02h
   row2 db 02h
   column1 db 03h
   column2 db 03h
   mat1 db 0ffh, 02h, 03h
        db 04h, 05h, 06h
   mat2 db 0eeh, 30h, 03h
        db 03h, 03h, 03h
   result dw 00h, 00h, 00h
        dw 00h, 00h, 00h

data ends
code segment
   org 0100h
start:
   mov ax, data
   mov ds, ax

   mov al, row1
   mov bl, row2
   cmp al, bl
   jnz exit
   mov al, column1
   mov bl, column2
   cmp al, bl
   jnz exit

   mov al, row1
   mul al
   mov ah, 00h
   mov cx, ax
   lea si, mat1
```

```
  mov al, row1
  mul al
  mov ah, 00h
  mov cx, ax
  lea si, mat1
  lea di, mat2
  lea bx, result
l1:
  mov ah, 00h
  mov al, [si]
  mov dl, [di]
  add al, dl
  jnc here
  inc ah
here:
  mov [bx], ax
  inc si
  inc di
  add bx, 2
  loop l1
exit:
  mov ah,4ch
  int 21h
code ends
end start
```

	Program	**Comments**
START:	ORG 0100H	Memory instruction starts from 0010H.
	MOV AX, DATA MOV DS, AX	Transferring the data from DATA to AX register and from AX register to DS register.
	MOV AL, ROW1	AL <- ROW1
	MOV BL, ROW2	BL <- ROW2
	CMP AL, BL	Compare AL and BL register.
	JNZ EXIT	Jump to EXIT if not equal.
	MOV AL, COLUMN1	AL <- COLUMN1
	MOV BL, COLUMN2	BL <- COLUMN2
	CMP AL, BL	Compare AL and BL register.
	JNZ EXIT	Jump to EXIT if not equal.
	MOV AL, ROW1	AL <- ROW1
	MUL AL	AX <- AL x BL
	MOV AH, 00H	AH <- 00H
	MOV CX, AX	CX <- AX
	LEA SI, MAT1	Load effective address of MAT1 to SI.
	LEA DI, MAT2	Load effective address of MAT2 to DI.
	LEA BX. RESULT	Load effective address of RESULT to BX.
L1:	MOV AH, 00H	AH <- 00H
	MOV AL, [SI]	AL <- [SI]
	MOV DL, [DI]	DL <- [DI]

	ADD AL, DL	AL <- AL + DL
	JNC HERE	Jump to HERE if there is a carry.
	INC AH	Increment AH.
HERE:	MOV [BX], AX	[BX] <- AX
	INC SI	Increment SI.
	INC DI	Increment DI.
	ADD BX, 2	BX <- BX + 2
	LOOP L1	Loop to L1.
EXIT:	MOV AH, 4CH INT 21H	Terminates the program.

Snapshot of sample input and output:



Adding matrices of same dimensions:

MAT1 [[FF, 02, 03], [04, 05, 06]]

MAT2 [[EE, 30, 03], [03, 03, 03]]

RESULT [[01 ED, 00 32, 00 06], [00 07, 00 08, 00 09]]

```
-d 076a:0000
076A:0000  02 02 03 03 FF 02 03 04-05 06 EE 30 03 03 03 03   ...........0....
076A:0010  00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00   ................
076A:0020  00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00   ................
076A:0030  00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00   ................
076A:0040  00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00   ................
076A:0050  00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00   ................
076A:0060  00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00   ................
076A:0070  00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00   ................
-g

Program terminated normally
-d 076a:0000
076A:0000  02 02 03 03 FF 02 03 04-05 06 EE 30 03 03 03 03   ...........0....
076A:0010  ED 01 32 00 06 00 07 00-08 00 09 00 00 00 00 00   ..2.............
076A:0020  00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00   ................
076A:0030  00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00   ................
076A:0040  00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00   ................
076A:0050  00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00   ................
076A:0060  00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00   ................
076A:0070  00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00   ................
```

Adding matrices of different dimensions.

MAT1 [[FF, 02, 03]]

MAT2 [[EE, 30, 03], [03, 03, 03]]

```
-d 076a:0000
076A:0000  01 02 03 03 FF 02 03 EE-30 03 03 03 03 00 00 00   ........0.......
076A:0010  00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00   ................
076A:0020  00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00   ................
076A:0030  00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00   ................
076A:0040  00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00   ................
076A:0050  00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00   ................
076A:0060  00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00   ................
076A:0070  00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00   ................
-g

Program terminated normally
-d 076a:0000
076A:0000  01 02 03 03 FF 02 03 EE-30 03 03 03 03 00 00 00   ........0.......
076A:0010  00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00   ................
076A:0020  00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00   ................
076A:0030  00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00   ................
076A:0040  00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00   ................
076A:0050  00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00   ................
076A:0060  00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00   ................
076A:0070  00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00   ................
```

Result:

Thus the 8086 program for matrix addition is executed successfully in DOS-BOX.

b) Matrix subtraction:

Aim:

Design 8086 program for Matrix subtraction.

Algorithm:

1. Move the starting address of data segment to AX register and move the data from AX register to DS register.
2. Move the value of the variable ROW1 to AL register and ROW2 to BL register.
3. Compare AL and BL register. IF they are not equal, jump to EXIT.
4. Move the value of the variable COLUMNN1 to AL register and COLUMN2 to BL register.
5. Compare AL and BL register. IF they are not equal, jump to EXIT.
6. Move the value of the variable ROW1 to AL register.
7. Multiply AL and BL using MUL AL.
8. Move 00H to AL register and copy AX to CX register.
9. Load effective addresses of the variables MAT1, MAT2 and RESULT to SI, Di and BX register respectively.
10. L1: Move 00H to AH register.
11. Move the value at SI and DI register's location to AL and DL register respectively.
12. Now sub AL and DL. If there is no carry, jump to HERE else negate AL and increment AH register.
13. HERE: Move the value of AX register to BX's location.
14. Increment SI and Di register and add 2 to BX register.
15. Loop to L1.
16. EXIT: INT 21H means invoke the interrupt identified by the hexadecimal number 21. In MS-DOS, invoking interrupt 21h while AH = 4Ch causes the current process to terminate and uses the value of register AL as the exit code of the process.

Program:

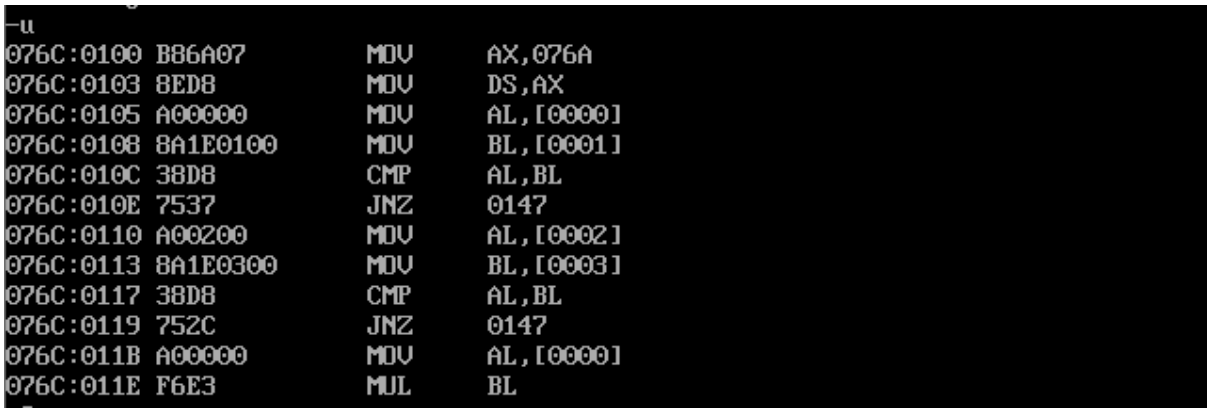
```
;Program for matrix subtraction

assume cs:code,ds:data
data segment
   row1 db 02h
   row2 db 02h
   column1 db 03h
   column2 db 03h
   mat1 db 0ffh, 02h, 03h
        db 04h, 05h, 06h
   mat2 db 0eeh, 30h, 03h
        db 03h, 03h, 03h
   result dw 00h, 00h, 00h
        dw 00h, 00h, 00h

data ends
code segment
   org 0100h
start:
   mov ax, data
   mov ds, ax

; checking if number of rows and columns of both matrix are equal.
   mov al, row1
   mov bl, row2
   cmp al, bl
   jnz exit
   mov al, column1
   mov bl, column2
   cmp al, bl
   jnz exit

   mov al, row1
   mul bl
   mov ah, 00h
```

```
  mov al, row1
  mul bl
  mov ah, 00h
  mov cx, ax
  lea si, mat1
  lea di, mat2
  lea bx, result
l1:
  mov ah, 00h
  mov al, [si]
  mov dl, [di]
  sub al, dl
  jnc here
  neg al
  inc ah
here:
  mov [bx], ax
  inc si
  inc di
  add bx, 2
  loop l1
exit:
  mov ah, 4ch
  int 21h
code ends
end start
```

	Program	**Comments**
START:	ORG 0100H	Memory instruction starts from 0010H.
	MOV AX, DATA MOV DS, AX	Transferring the data from DATA to AX register and from AX register to DS register.
	MOV AL, ROW1	AL <- ROW1
	MOV BL, ROW2	BL <- ROW2
	CMP AL, BL	Compare AL and BL register.
	JNZ EXIT	Jump to EXIT if not equal.
	MOV AL, COLUMN1	AL <- COLUMN1
	MOV BL, COLUMN2	BL <- COLUMN2
	CMP AL, BL	Compare AL and BL register.
	JNZ EXIT	Jump to EXIT if not equal.
	MOV AL, ROW1	AL <- ROW1
	MUL AL	AX <- AL x BL
	MOV AH, 00H	AH <- 00H
	MOV CX, AX	CX <- AX
	LEA SI, MAT1	Load effective address of MAT1 to SI.
	LEA DI, MAT2	Load effective address of MAT2 to DI.
	LEA BX. RESULT	Load effective address of RESULT to BX.
L1:	MOV AH, 00H	AH <- 00H
	MOV AL, [SI]	AL <- [SI]

	MOV DL, [DI]	DL <- [DI]
	SUB AL, DL	AL <- AL - DL
	JNC HERE	Jump to HERE if there is a carry.
	NEG AL	Negate the value in the AL register (takes 2's compliment).
	INC AH	Increment AH.
HERE:	MOV [BX], AX	[BX] <- AX
	INC SI	Increment SI.
	INC DI	Increment DI.
	ADD BX, 2	BX <- BX + 2
	LOOP L1	Loop to L1.
EXIT:	MOV AH, 4CH INT 21H	Terminates the program.

Snapshot of sample input and output:



Subtracting matrices of same dimensions:

MAT1 [[FF, 02, 03], [04, 05, 06]]

MAT2 [[EE, 30, 03], [03, 03, 03]]

RESULT [[00 11, 01 2E, 00 00], [00 01, 00 02, 00 03]]

```
-d 076a:0000
076A:0000  02 02 03 03 FF 02 03 04-05 06 EE 30 03 03 03 03   ...........0....
076A:0010  00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00   ................
076A:0020  00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00   ................
076A:0030  00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00   ................
076A:0040  00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00   ................
076A:0050  00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00   ................
076A:0060  00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00   ................
076A:0070  00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00   ................
-g

Program terminated normally
-d 076a:0000
076A:0000  02 02 03 03 FF 02 03 04-05 06 EE 30 03 03 03 03   ...........0....
076A:0010  11 00 2E 01 00 00 01 00-02 00 03 00 00 00 00 00   ................
076A:0020  00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00   ................
076A:0030  00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00   ................
076A:0040  00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00   ................
076A:0050  00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00   ................
076A:0060  00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00   ................
076A:0070  00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00   ................
```

Subtracting matrices of different dimensions:

MAT1 [[FF, 02, 03]]

MAT2 [[EE, 30, 03], [03, 03, 03]

```
-d 076a:0000
076A:0000  01 02 03 03 FF 02 03 EE-30 03 03 03 03 00 00 00   ........0.......
076A:0010  00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00   ................
076A:0020  00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00   ................
076A:0030  00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00   ................
076A:0040  00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00   ................
076A:0050  00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00   ................
076A:0060  00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00   ................
076A:0070  00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00   ................
-g

Program terminated normally
-d 076a:0000
076A:0000  01 02 03 03 FF 02 03 EE-30 03 03 03 03 00 00 00   ........0.......
076A:0010  00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00   ................
076A:0020  00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00   ................
076A:0030  00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00   ................
076A:0040  00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00   ................
076A:0050  00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00   ................
076A:0060  00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00   ................
076A:0070  00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00   ................
```

Result:

Thus the 8086 program for matrix subtraction is executed successfully in DOS-BOX.