NAME: Meith Navlakha
SAP: 60004190068
POA Practical

EXPERIMENT 8

AIM: Implement 8086 based Assembly programs.

THEORY:

Intel 8086 is built on a single semiconductor chip and packaged in a 40-pin IC package. The type of package is DIP (Dual Inline Package). Intel 8086 uses 20 address lines and 16 data- lines. It can directly address up to 220 = 1 Mbyte of memory. 8086 is designed to operate in two modes, i.e., Minimum and Maximum mode.

Main registers			
	AH	AL	**AX** (primary accumulator)
	BH	BL	**BX** (base, accumulator)
	CH	CL	**CX** (counter, accumulator)
	DH	DL	**DX** (accumulator, extended acc)
Index registers			
0 0 0 0	SI		Source Index
0 0 0 0	DI		Destination Index
0 0 0 0	BP		Base Pointer
0 0 0 0	SP		Stack Pointer
Program counter			
0 0 0 0	IP		Instruction Pointer
Segment registers			
CS		0 0 0 0	Code Segment
DS		0 0 0 0	Data Segment
ES		0 0 0 0	Extra Segment
SS		0 0 0 0	Stack Segment
Status register			
	- - - - O D I T S Z - A - P - C		Flags

It consists of a powerful instruction set, which provides operation like division and multiplication very quickly.

8086 microprocessor supports 8 types of instructions:

- Data Transfer Instructions
- Arithmetic Instructions
- Bit Manipulation Instructions
- String Instructions
- Program Execution Transfer Instructions (Branch & Loop Instructions)
- Processor Control Instructions
- Iteration Control Instructions
- Interrupt Instructions

CODE:

1) Program to add two word length numbers

```
OPR1: DW 0x6969        ; declare first number
OPR2: DW 0x0420        ; declare second number
RESULT: DW 0           ; declare place to store result

; actual entry point of the program
start:
MOV AX, word OPR1       ; move first number to AX
MOV BX, word OPR2       ; move second number to BX
CLC                     ; clear the carry flag
ADD AX, BX              ; add BX to AX
MOV DI, OFFSET RESULT   ; move offset of result to DI
MOV word [DI], AX       ; store result
print reg               ; print result
```

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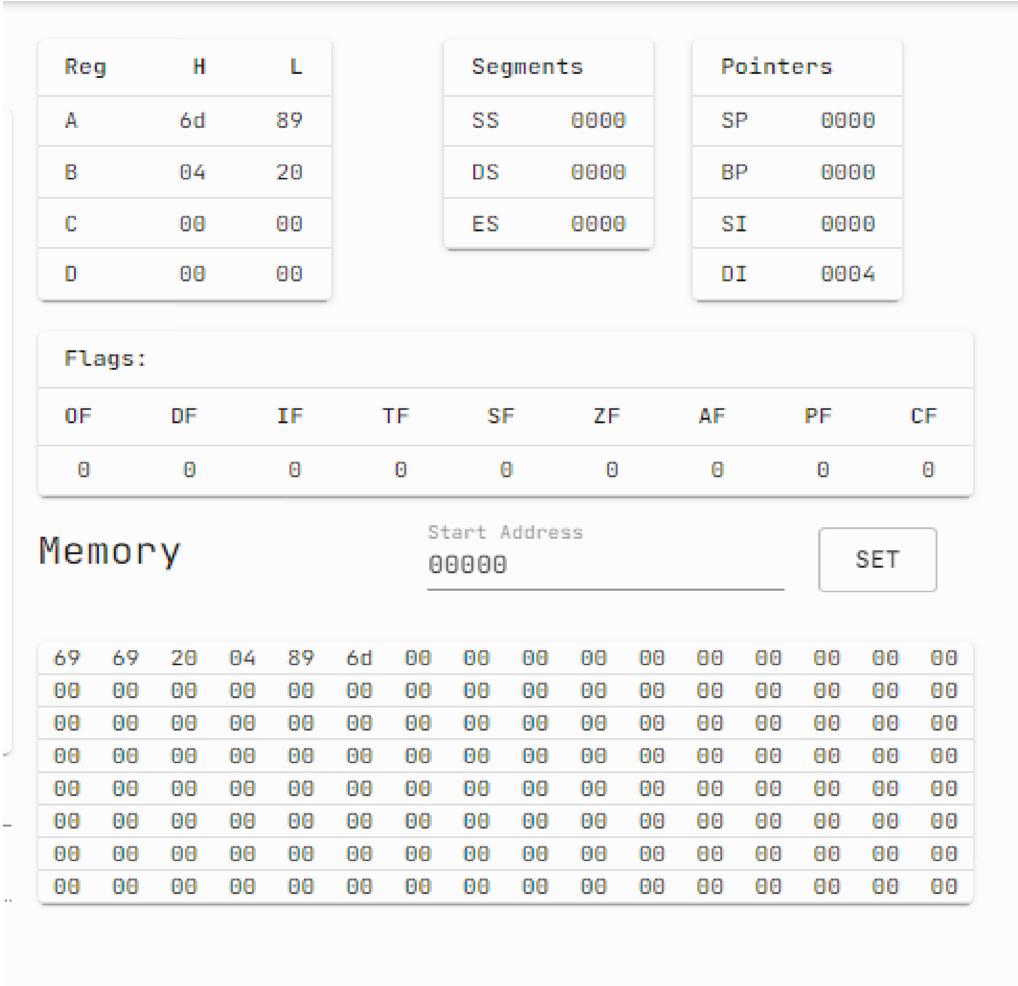
OUTPUT:



Reg	H	L
A	6d	89
B	04	20
C	00	00
D	00	00

Segments	
SS	0000
DS	0000
ES	0000

Pointers	
SP	0000
BP	0000
SI	0000
DI	0004

Flags:

OF	DF	IF	TF	SF	ZF	AF	PF	CF
0	0	0	0	0	0	0	0	0

Memory

Start Address
00000

SET

69	69	20	04	89	6d	00	00	00	00	00	00	00	00	00	00
00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00

2) A Program to move data from one segment to another

```
SET 0                 ; set address for segment 1
src:DB 0x3            ; store data
DB 0x5
DB 0x7

SET 0x1               ; set addresss for segment 2
dest:DB [0,3]         ; store data

; actual entry point of the program
start:
print mem 0:8         ; print initial state of segment 1
print mem 0x10:8      ; print initial state of segment 2

MOV AX, 0             ; move address of seg1
```

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```
MOV DS,AX              ; to ds
MOV AX , 0x1           ; move address of seg2
MOV ES,AX              ; to es
MOV SI, OFFSET src     ; move offset of source data
MOV SI, OFFSET dest    ; move offset of destination data
MOV CX, 0x3            ; move number of data items
print reg              ; print state of registers
_loop:
mov AH, byte DS[SI]    ; move one byte from source to ah
mov byte ES[DI],AH     ; move ah to destination
inc SI
inc DI
dec CX                 ; decrement count
jnz _loop              ; if count is not zero jump back
print mem 0:8          ; print final state of segment 1
print mem 0x10:8       ; print final state of segment 2
```

OUTPUT:

Reg	H	L
A	07	01
B	00	00
C	00	00
D	00	00

Segments	
SS	0000
DS	0000
ES	0001

Pointers	
SP	0000
BP	0000
SI	0003
DI	0003

Flags:

OF	DF	IF	TF	SF	ZF	AF	PF	CF
0	0	0	0	0	1	0	1	0

Memory

Start Address
00000

SET

03	05	07	00	00	00	00	00	00	00	00	00	00	00	00	00
03	05	07	00	00	00	00	00	00	00	00	00	00	00	00	00
00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00

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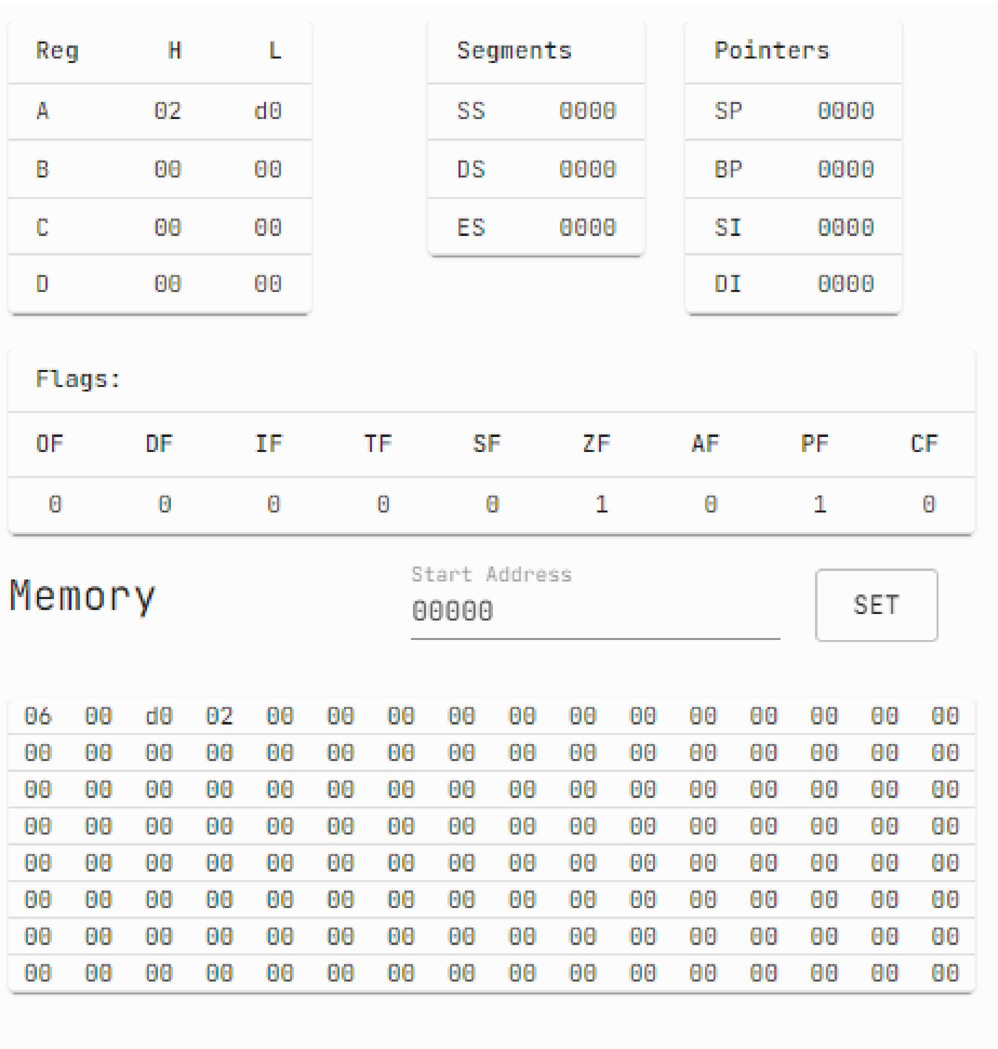
3) Program to calculate factorial using looping

```
NUM: DW 0x6      ; calculate factorial of 6
RESULT: DW 0     ; place to store the reult
; actual entry point of the program
start:
MOV CX,word NUM      ; move number into cx
MOV AX, 0x1          ; initialize accumulator with 1
NOTZEROLOOP:         ; label to jump back to
MUL CX               ; multiple by the number
DEC CX               ; decrement the number
JNZ NOTZEROLOOP      ; if not zero jump back
MOV word RESULT,AX  ; store the result in memory
print reg            ; print registers
```

OUTPUT:



Reg	H	L
A	02	d0
B	00	00
C	00	00
D	00	00

Segments	
SS	0000
DS	0000
ES	0000

Pointers	
SP	0000
BP	0000
SI	0000
DI	0000

Flags:

OF	DF	IF	TF	SF	ZF	AF	PF	CF
0	0	0	0	0	1	0	1	0

Memory

Start Address
00000

SET

06	00	d0	02	00	00	00	00	00	00	00	00	00	00	00	00
00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00

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SAP: 60004190068
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4) Program to show use of interrupts

```
hello: DB "Hello World" ; store string

; actual entry point of the program, must be present
start:
MOV AH, 0x13          ; move BIOS interrupt number in AH
MOV CX, 11            ; move length of string in cx
MOV BX, 0             ; mov 0 to bx, so we can move it to es
MOV ES, BX            ; move segment start of string to es, 0
MOV BP, OFFSET hello  ; move start offset of string in bp
MOV DL, 0             ; start writing from col 0
int 0x10              ; BIOS interrupt
```

OUTPUT:

Input

Output

Hello World

Reg	H	L
A	13	00
B	00	00
C	00	0b
D	00	00

Segments	
SS	0000
DS	0000
ES	0000

Pointers	
SP	0000
BP	0000
SI	0000
DI	0000

Flags:

OF	DF	IF	TF	SF	ZF	AF	PF	CF
0	0	0	0	0	0	0	0	0

Memory

Start Address
00000

SET

48	65	6c	6c	6f	20	57	6f	72	6c	64	00	00	00	00	00
00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00

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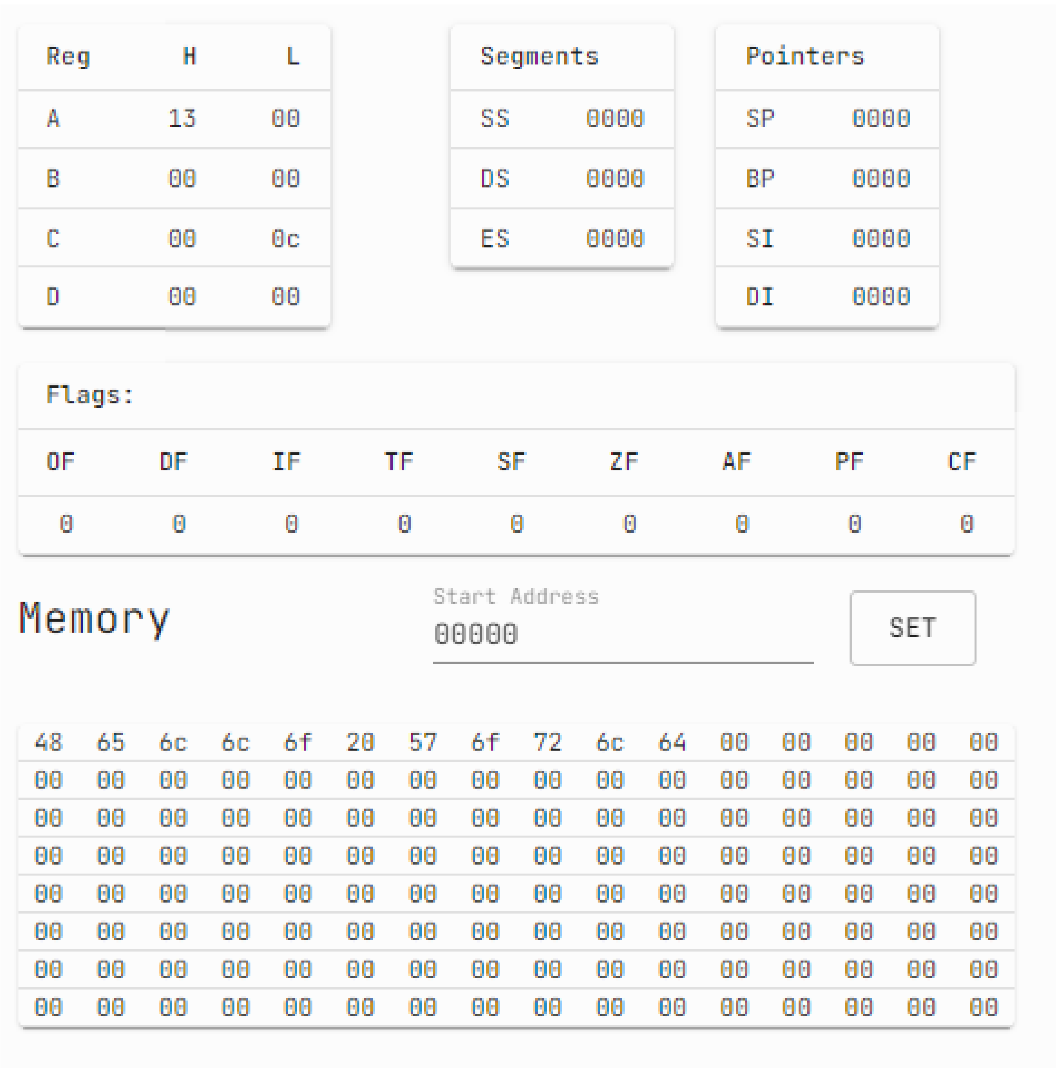
5) Program to show use of interrupts

```
hello: DB "Hello World"   ; store string

; actual entry point of the program
start:
MOV AH, 0x13          ; move BIOS interrupt number in AH
MOV CX, 12            ; move length of string in cx
MOV BX, 0             ; mov 0 to bx, so we can move it to es
MOV ES, BX            ; move segment start of string to es, 0
MOV BP, OFFSET hello  ; move start offset of string in bp
MOV DL, 0             ; start writing from col 0
int 0x10              ; BIOS interrupt
```

OUTPUT:



Reg	H	L
A	13	00
B	00	00
C	00	0c
D	00	00

Segments	
SS	0000
DS	0000
ES	0000

Pointers	
SP	0000
BP	0000
SI	0000
DI	0000

Flags:

OF	DF	IF	TF	SF	ZF	AF	PF	CF
0	0	0	0	0	0	0	0	0

Memory

Start Address
00000

SET

48	65	6c	6c	6f	20	57	6f	72	6c	64	00	00	00	00	00
00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00

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6) Program to calculate LCM and GCD of two numbers

```
no1: dw 0x6     ; number 1
no2: dw 0x5     ; number 2
gcd: dw 0       ; place to store gcd
lcm: dw 0       ; place to store lcm

; actual entry point of the program
start:
mov ax, word no1    ; move number 1 in accumulatore
mov bx, word no2    ; move number 2 in register BX
loop0: mov dx, 0x0  ; place to loop back
                    ; cannot use 'loop' as label, as loop is an opcode which will give error when used
with jumps
div bx              ; divide accumulator by bx
mov ax, bx
mov bx, dx
cmp bx, 0x0         ; check if bx is 0
jnz loop0           ; if not loop back
mov word gcd, ax    ; store gcd
mov cx, ax          ; move ax in cx
mov ax, word no1    ; move number 1 in accumulatore
mov bx, word no2    ; move number 2 in register BX
mul bx              ; multiply accumulator by BX
div cx              ; divide accumulator by CX
mov word lcm, ax    ; store lcm
print mem :16       ; print memory
```

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OUTPUT:

Reg	H	L
A	00	1e
B	00	05
C	00	01
D	00	00

Segments	
SS	0000
DS	0000
ES	0000

Pointers	
SP	0000
BP	0000
SI	0000
DI	0000

Flags:

OF	DF	IF	TF	SF	ZF	AF	PF	CF
0	0	0	0	0	1	0	1	0

Memory

Start Address
00000

SET

06	00	05	00	01	00	1e	00	00	00	00	00	00	00	00	00
00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00

CONCLUSION: In this experiment, I implemented 8086 microprocessor's assembly language based programs. The codes were run on an online 8086 emulator. The programs were to add two word length numbers, to calculate LCM and GCD of two numbers, to transfer the data, to calculate the factorial using loop in 8086 assembly instruction set and programs to implement interrupts.