LNCT GROUP OF COLLEGES
"WORKING TOWARDS BEING THE BEST"

Name of Student: ______________________________

Enrollment No.: ______________________________

Class: ______________________________

Section: ______________________________

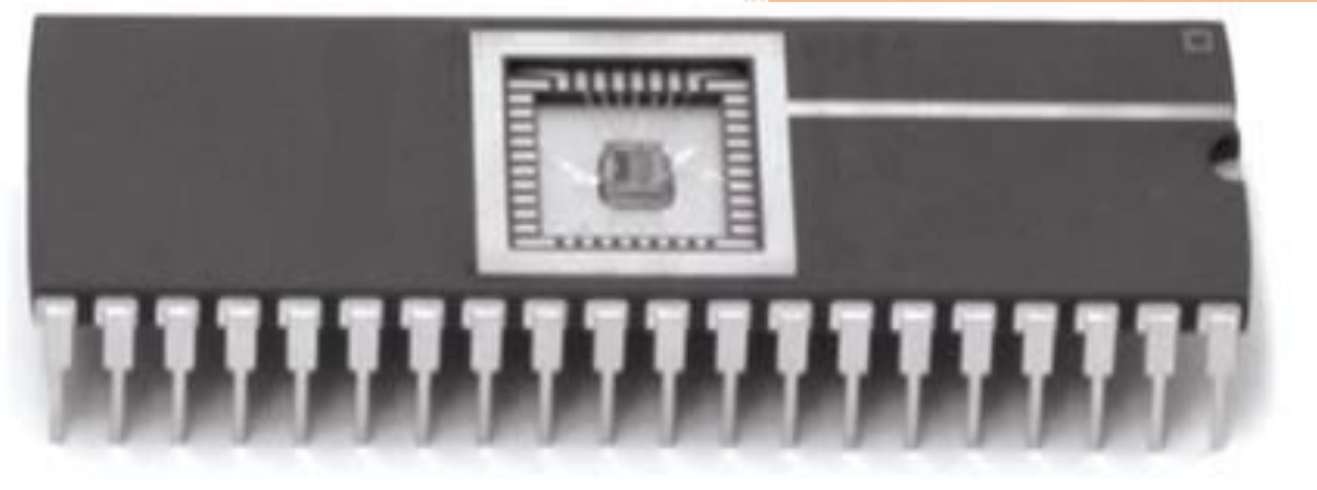
Session: ______________________________

LAKSHMI NARAIN COLLEGE OF TECHNOLOGY & SCIENCE
श्रद्धावान लभते ज्ञानम्

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

Microprocessor & Its Applications [EC-501]

Lab Manual



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LAKSHMI NARAIN COLLEGE OF TECHNOLOGY & SCIENCE

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Vision and Mission of the Department

Vision

To be world-wide recognized for adopting and keeping innovation and entrepreneurship mindset as abreast of learning to produce professionals as valuable, ethical and moral resource for industry and society.

Mission

- To establish an ecosystem where students could grow with innovative practices followed in communication engineering.
- To adopt the global approaches to transform the young aspirant into most acceptable engineering professional catering the modern challenges of the society in the most ethical with full of patriotic zeal.
- To facilitate and felicitate all the learners to have close interactions with the industry experts and researchers for keeping them updated of the current and future needs of the society.
- To develop the mindset of being innovative and entrepreneurial in the future engineering professionals.

ELETRONICS AND COMMUNICATION ENGINEERING

PSO

1. To analyze, design and develop solutions of real time problems and industry needs.
2. Ability of effectively communicating with the professionals and preparation of reports, documents and presentation while working in teams.
3. Knowledge and understanding of latest developments in the field of VLSI, Embedded system, Networking, Matlab and other major tools necessary for keeping pace with the industry.
4. Ability of solving complex engineering problems with ethical and law full approach to prevent the society and environment from adverse impacts.

DEPARTMENT OF ELECTRONIC AND COMMUNICATION ENGINEERING

PEOs

1. The graduate will have the knowledge and skills of analog and digital communication in providing necessary solutions to the real world problems.
2. The graduate will be able to design, develop, analyze and implement the modern tools and systems involving principles of electronics and telecommunication engineering.
3. The graduate will be following the ethical practices of the core industry and supporting software industry in providing most acceptable solution to the society.
4. The graduate will have the innovative mindset of learning and implementing the latest technological advancements and research outcomes in the electronic hardware and software to keep pace with the rapid developments in socio economic world.

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Name of Student:____________________Enrollment No.: ________________

S.No.	Title of the Experiment	Date of Experiment	Date of Experiment	Remark
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Code of Conducts for the Laboratory

- All bags must be left at the indicated place.
- The lab timetable must be strictly followed.
- Be **PUNCTUAL** for your laboratory session.
- Noise must be kept to a minimum.
- Workspace must be kept clean and tidy at all time.
- Handle the experiment kit and interfacing kits with care.
- All students are liable for any damage to the accessories due to their own negligence.
- Students are strictly **PROHIBITED** from taking out any items from the laboratory.
- Students are **NOT** allowed to work alone in the laboratory without the Lab Supervisor
- Report immediately to the Lab Supervisor if any malfunction of the accessories, is there.
- Before leaving the lab Place the stools properly.
- Please check the laboratory notice board regularly for updates.

Experiment -1
Installation and Study of 8086 assemblers/compilers

Aim: Installation and study of 8086 assemblers/compilers.

(a) Debug

(b) Emu86

(c) NASM

Theory:

To understand the architecture of 8086 microprocessor.

Enable to write small assembly language programs using DEBUG utility program.

To understand the design flows of NASM and Emu8086.

Introduction:

Assembly language programs resemble a compiled language programs, like PASCAL. In compiled languages the user first creates a source file, which is a text file of entire program. The compiler changes it into machine language instructions. In the compiled language program the entire program is transformed into machine language at once. Assembly Language is converted into executable machine code by a utility program referred to as an assembler, the conversion process is referred to as assembly, or assembling the code.

Microprocessor:

A silicon chip that contains a CPU. In the world of personal computers, the terms microprocessor and CPU are used interchangeably. A Microprocessor (sometimes abbreviated µP) is a digital electronic component with miniaturized transistors on a single semiconductor integrated circuit (IC).Microprocessors also control the logic of almost all digital devices, from clock radios to fuel-injection systems for automobiles. A **microprocessor** incorporates the functions of a computer's CPU on a single integrated circuit, or at its most a few integrated circuits. All modern CPUs are microprocessors making the micro-prefix redundant.

Central Processing Unit(CPU) on a single silicon chip (called microchip) that can be 'Soft Wired' by using different programming instructions.When coupled with memory and input-output devices, a microprocessor becomes a microcomputer.INTEL 4004,one of the most earliest microprocessors, had a 4-bit data bus and could address 4.5 kilobytes of memory. The first mass produced Microprocessor was Intel 8080 than in 1973 cost about $400.

Three basic characters differentiate microprocessors: -

- → INSTRUCTION SET: - The set of the instructions that microprocessor can execute.
- → BANDWIDTH: - The number of bits processed in a single instruction.
- → CLOCK SPEED: - Given in Megahertz (MHz), the clock speed determines how many instructions per second the processor can execute.

In addition to bandwidth and clock speed, microprocessors are classified as being either RISC (reduced instruction set computer) or CISC (complex instruction set computer).

Two basic characteristics differentiate microprocessors:
Instruction set: The set of instructions that the microprocessor can execute.

Bus width: The number of bits processed in a single instruction.

8086 Architecture:

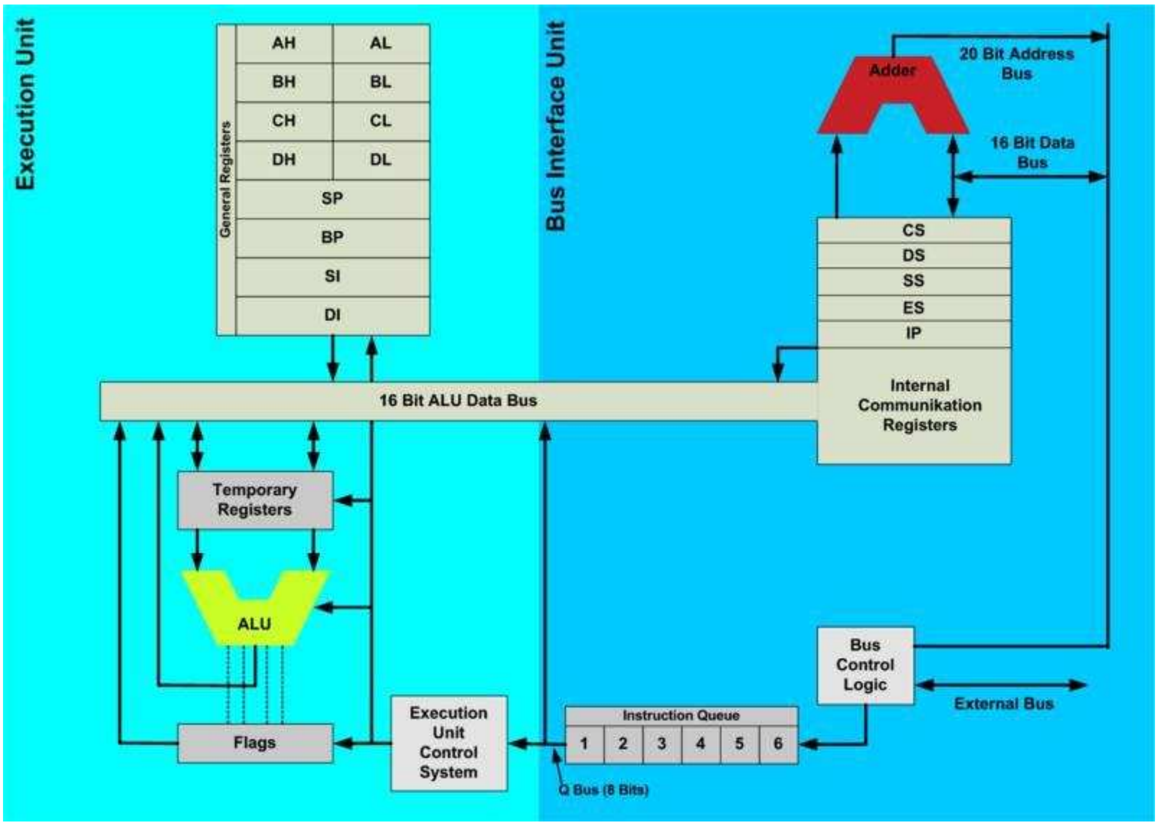


Figure 1. 8086 Architecture

- 8086 is a 16 bit µp.

- 8086 has a 20 bit address bus can access upto 2^{20} memory locations (1 MB) .
- It can support up to 64K I/O ports.
- It provides 14, 16-bit registers.
- It has multiplexed address and data bus AD0-AD15 and A16–A19.
- It requires single phase clock with 33% duty cycle to provide internal timing.
- 8086 is designed to operate in two modes, Minimum and Maximum.
- It can prefetches up to 6 instruction bytes from memory and queues them in order to speed up instruction execution.
- It requires +5V power supply.
- A 40-pin dual in line package.

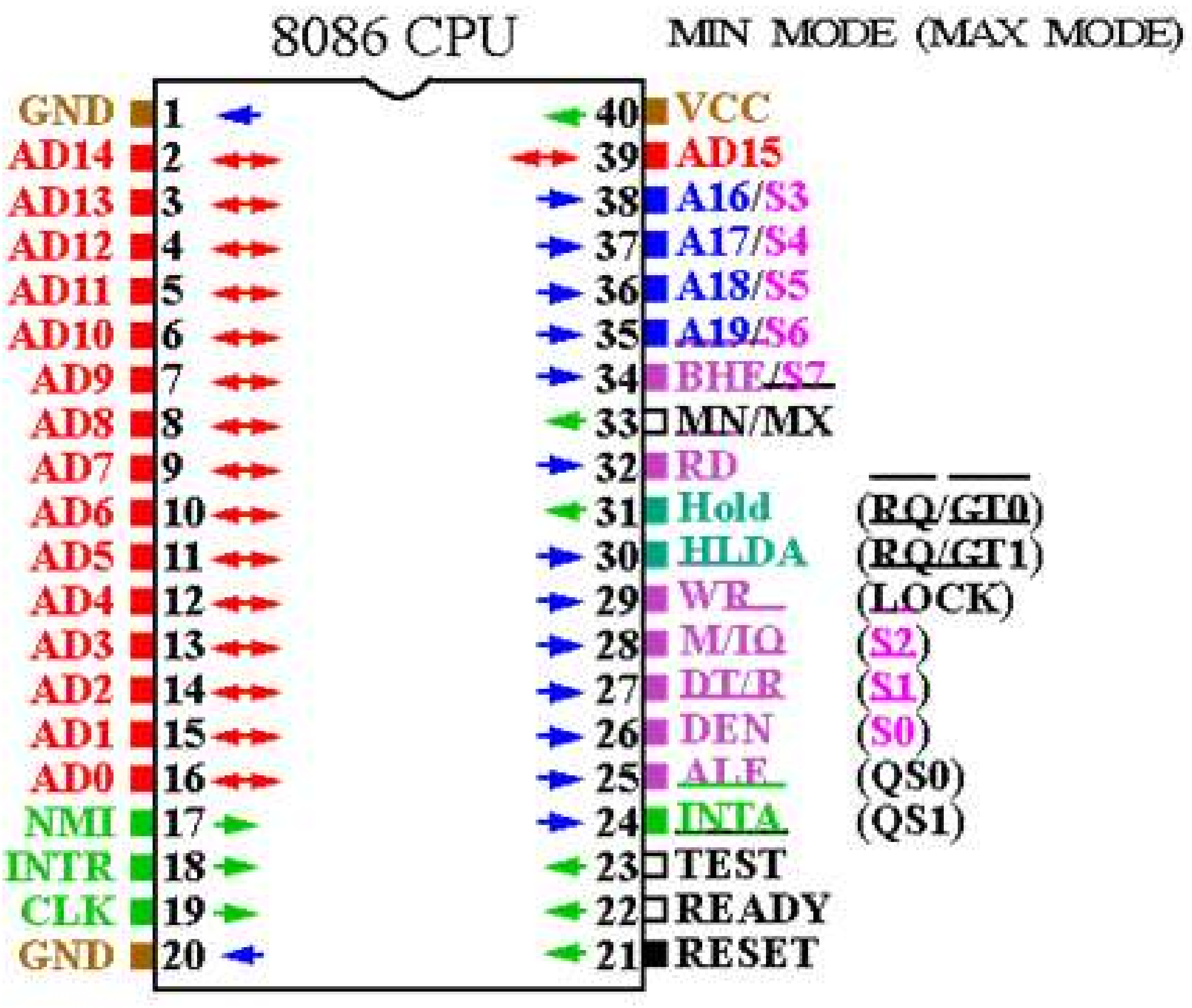


Figure 2. 8086 Pin Diagram

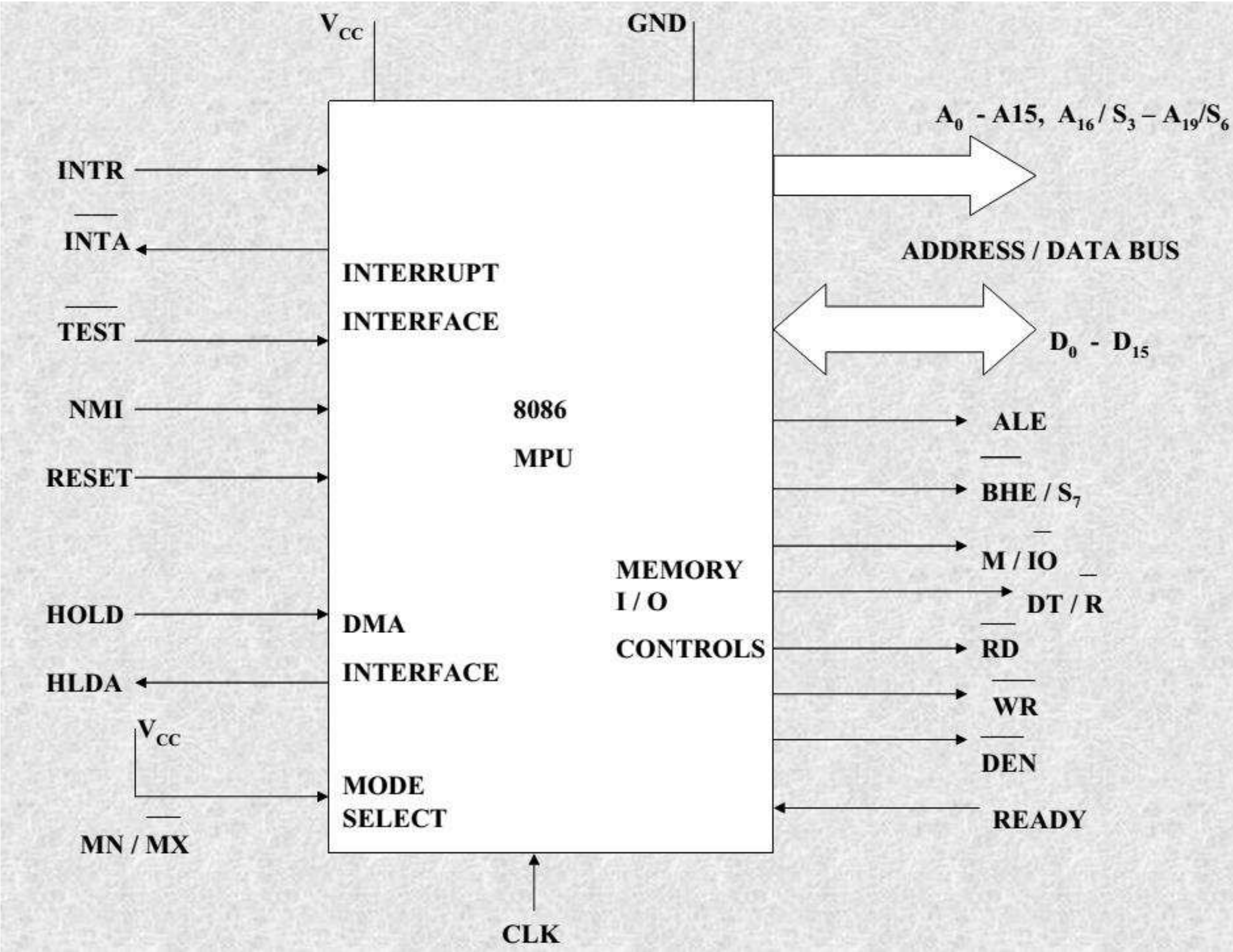


Figure 3. 8086 Signal Diagram

Debug for 8086:

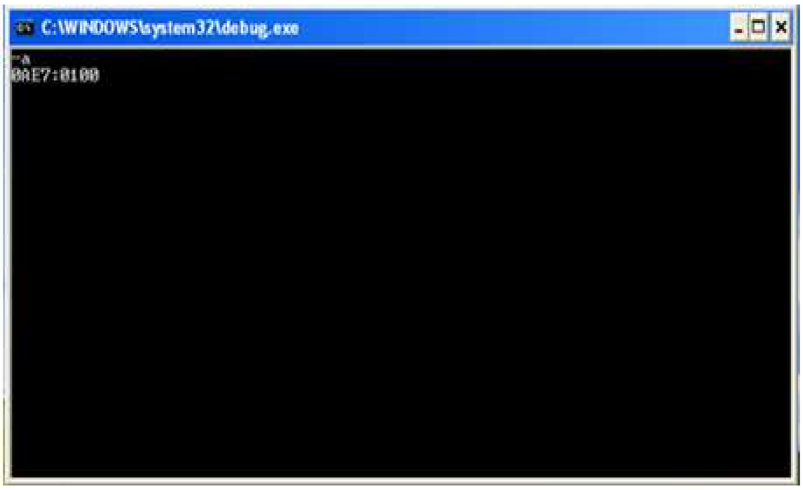


Figure4. Debug- DOS based emulator for Windows

A debugger displays the contents of memory and lets us view the registers and variables as they change. We can step through a program one line at a time called tracing, making it easier to find logic errors.

Debugger Functions

Some of the most rudimentary functions that a debugger canperform are the following:

- Assemble short programs
- View a program's source code, along with its machine code
- View the CPU registers and flags
- Trace or execute a program, watching variables for changes
- Enter new values into memory
- Search for binary or ASCII values in memory
- Move a block of memory from one location to another
- Fill a block of memory
- Load and write disk files

Debugger Commands

- A Assemble a program using instruction mnemonics
- R Display the contents of registers and flags
- T Trace a single instruction
- U Disassemble memory into assembler mnemonics
- D Dump (display) the contents of memory
- E Enter bytes into memory
- Q Quit DEBUG and return to DOS
- L Load data from disk
- W Write data from memory to disk
- N Create a filename for use by the L and W commands

EMU8086:

The integrated 8086 assembler can generate console programs that can be executed on any computer that runs x86 machine code (Intel/AMD architecture)

The architecture of the 8086 Intel microprocessor is called **"Von Neumann architecture"** after the mathematician who conceived of the design.

A CPU can interpret the contents of memory as either instructions or data; there's no difference in the individual bytes of memory, only the way in which they're arranged. Because of this, it's even possible for programs to re-write their own instructions, then execute the instructions they've changed.

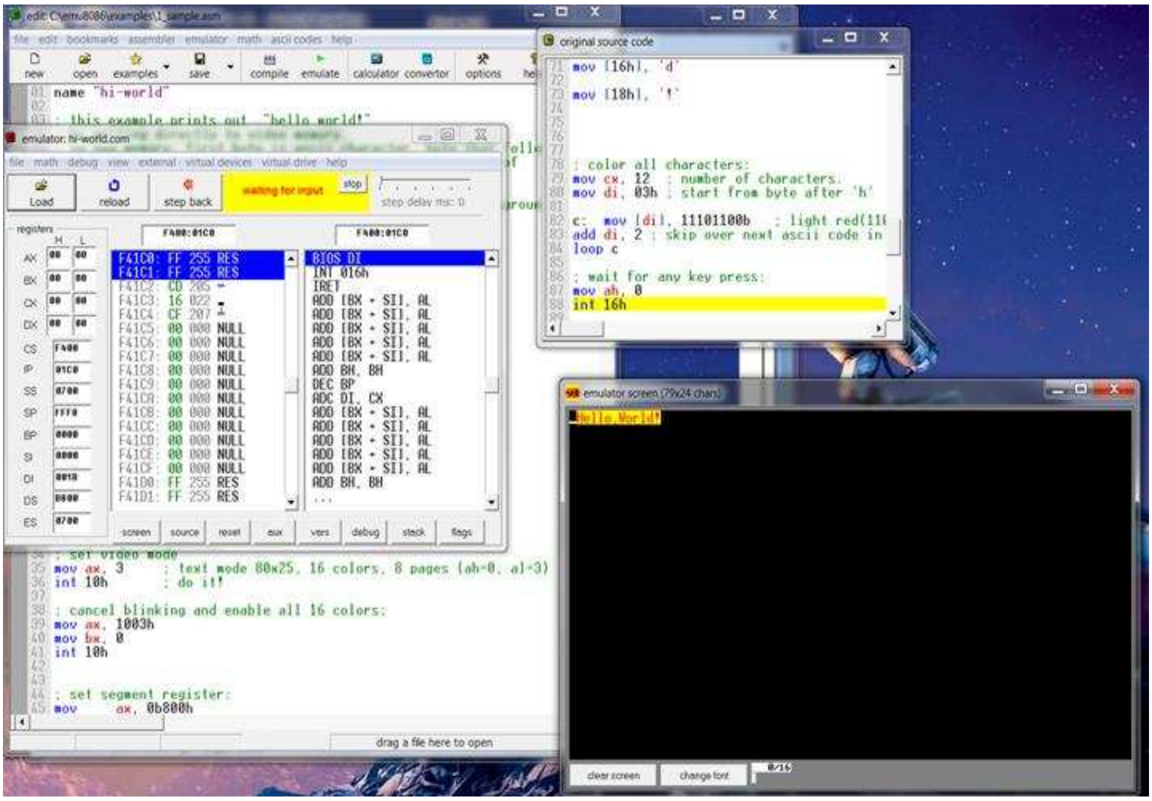


Figure 5.emu 8086 compiled output

NASM: The Netwide Assembler

The Netwide Assembler, NASM, is an 80x86 and x86−64 assembler designed for portability and modularity.It supports a range of object file formats, including Linux and *BSD a.out, ELF, COFF, Mach−O,Microsoft 16−bit OBJ, Win32and Win64. It will also output plain binary files. Its syntax is designed to besimple and easy to understand, similar to Intel's but less complex. It supports all currently known x86architectural extensions, and has strong support for macros.

To assemble a file, you issue a command of the form
nasm −f <format><filename> [−o <output>]
For example,
nasm −f elf myfile.asm
will assemble myfile.asminto an ELFobject file myfile.o. And
nasm −f bin myfile.asm −o myfile.com
will assemble myfile.asminto a raw binary file myfile.com.

To produce a listing file, with the hex codes output from NASM displayed on the left of the original sources,use the –loption to give a listing file name, for example:
nasm −f coff myfile.asm −l myfile.lst

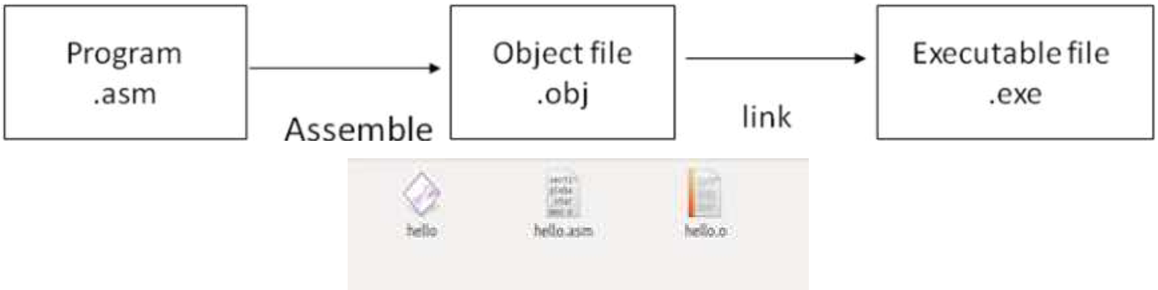


Figure 6. Flow of program development

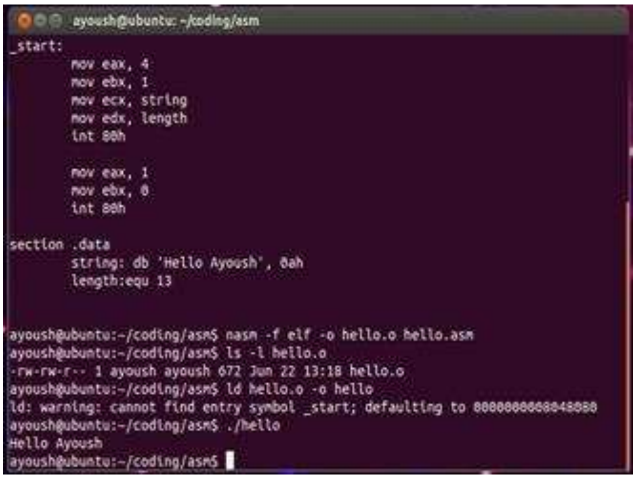


Figure 7. Snapshot of NASM Assembler

Summary:

The native language is machine language (using 0,1 to represent the operation).A single machine instruction can take up one or more bytes of code. Assembly language is used to write the program using alphanumeric symbols (or mnemonic), eg. ADD, MOV, PUSH etc.The program will then be assembled (similar to compiled) and linked into an executable program. The executable program could be .com, .exe, or .bin files.An **assembly language**is a low-level programming language for a computer, or other programmable device, in which there is a very strong (generally one-to-one) correspondence between the language and the architecture's machine code instructions.

Result: We have studied the installation & assembling of 8086 compilers.

Signature of Faculty

Experiment -2
Perform addition and subtraction of 8-bit numbers.

Aim: Write a program in 8086 to perform addition and subtraction of 8-bit numbers.

Software Used: EMU8086

Programs:

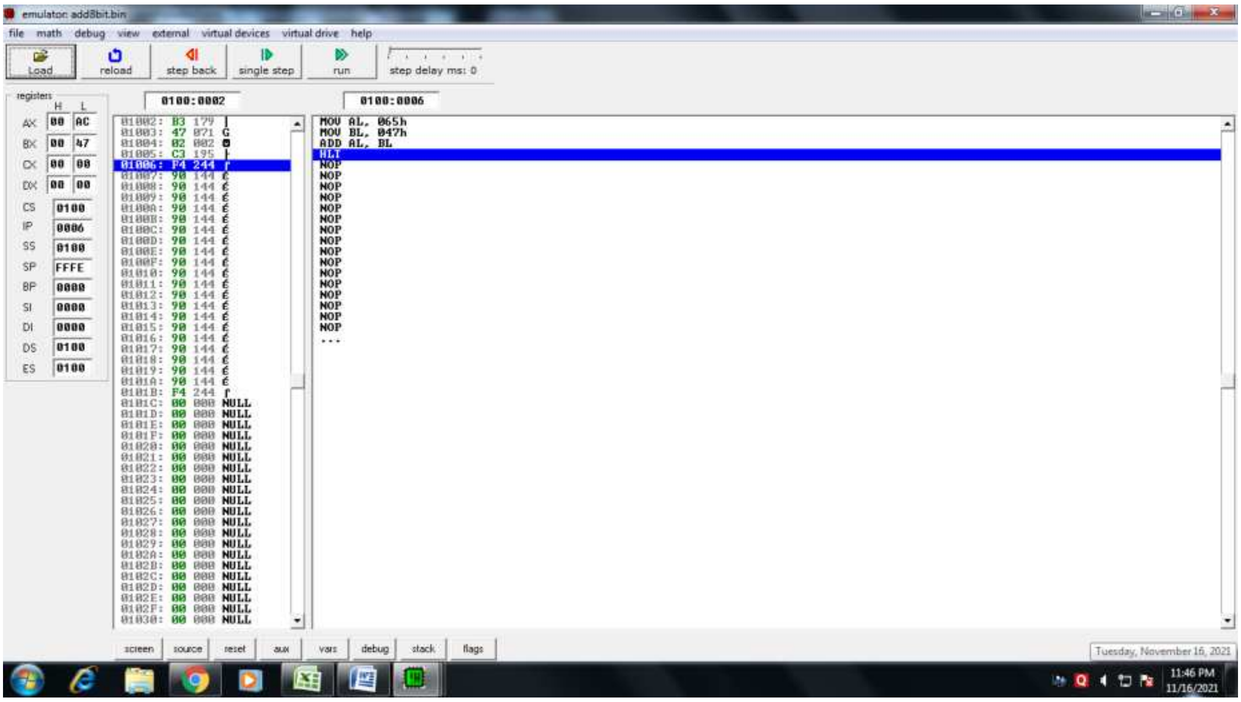
a) **Addition**:

MOV Al, 65H;

MOV Bl, 47H;

ADD Al, Bl;

HLT;



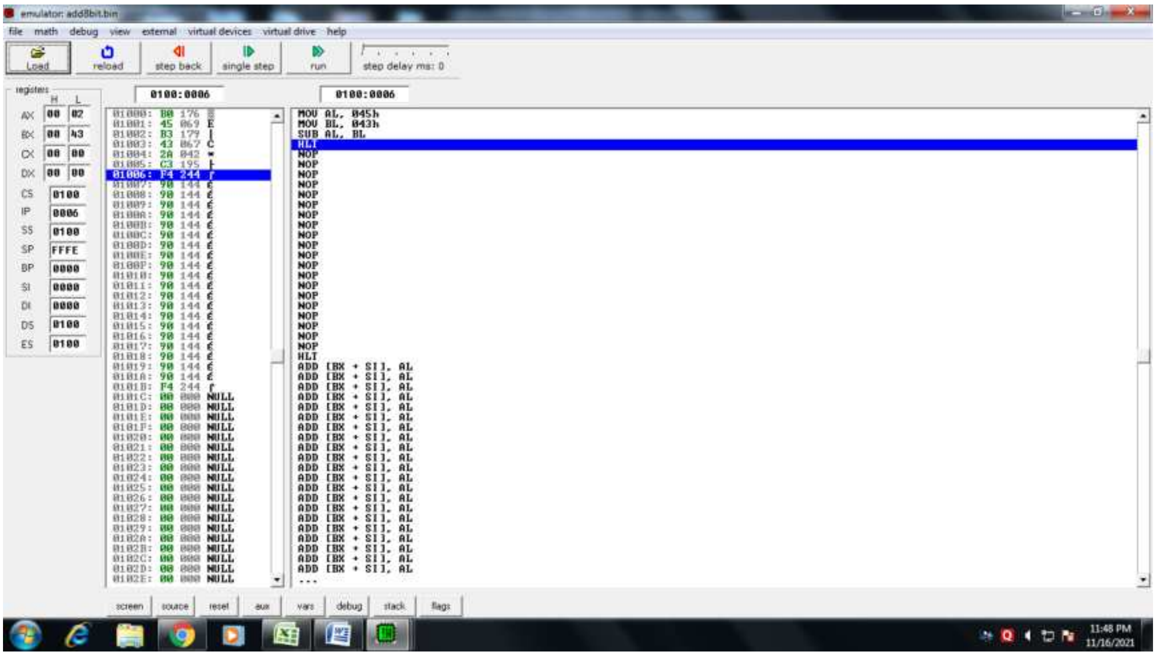
b) **Subtraction**:

MOV Al, 45H;

MOV Bl, 43H;

SUB Al, Bl;

HLT;



Result: We have performed addition and subtraction of 8-bit numbers.

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Signature of Faculty

Experiment - 3
Perform addition, subtraction, multiplication and division of 16-bit numbers.

Aim: Write a program in 8086 to perform:

a) addition of two 16-bit numbers

b) subtraction of two 16-bit numbers

c) multiplication of two 16-bit numbers

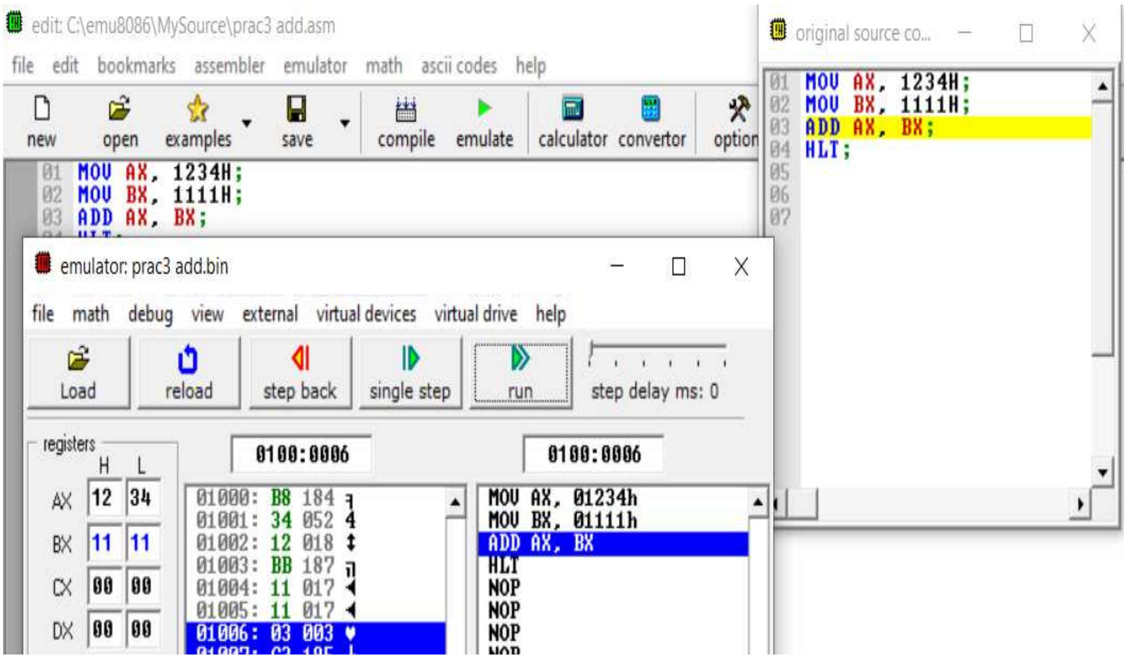
d) division of two 16-bit numbers

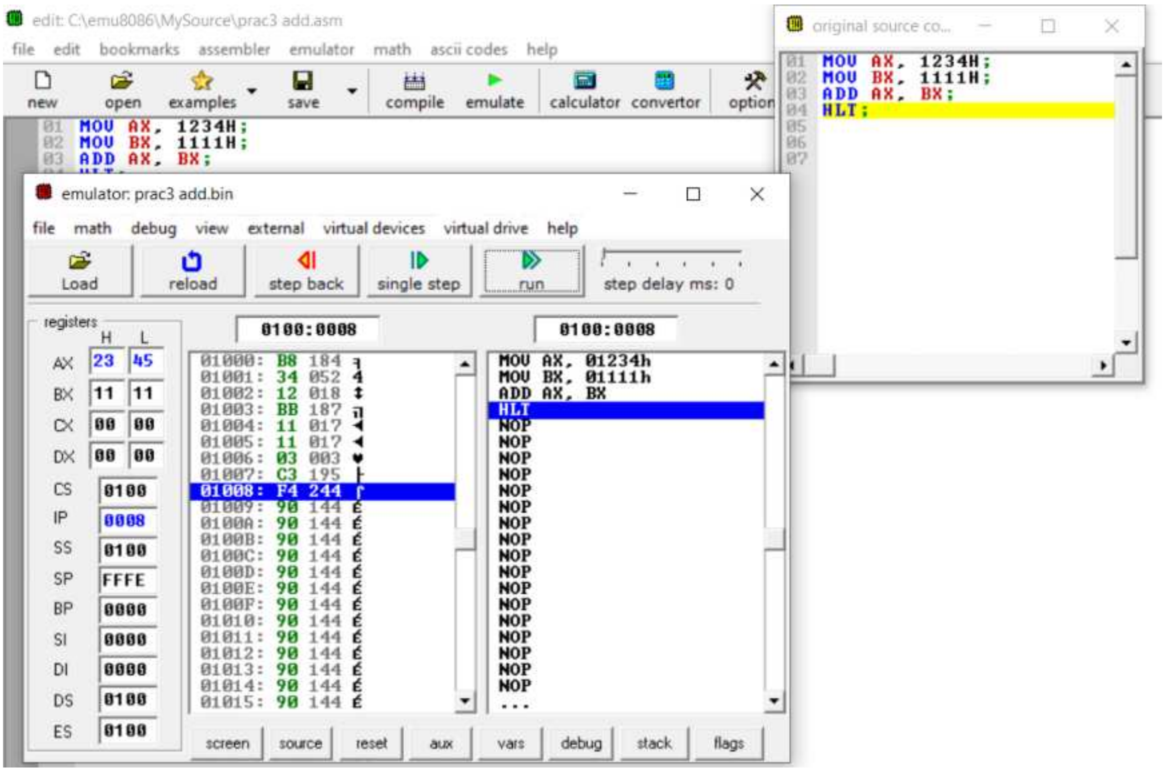
Software Used: Emu8086

Programs:

a) **Addition:**

```
MOV AX, 1234H;
MOV BX, 1111H;
ADD AX, BX;
HLT;
```





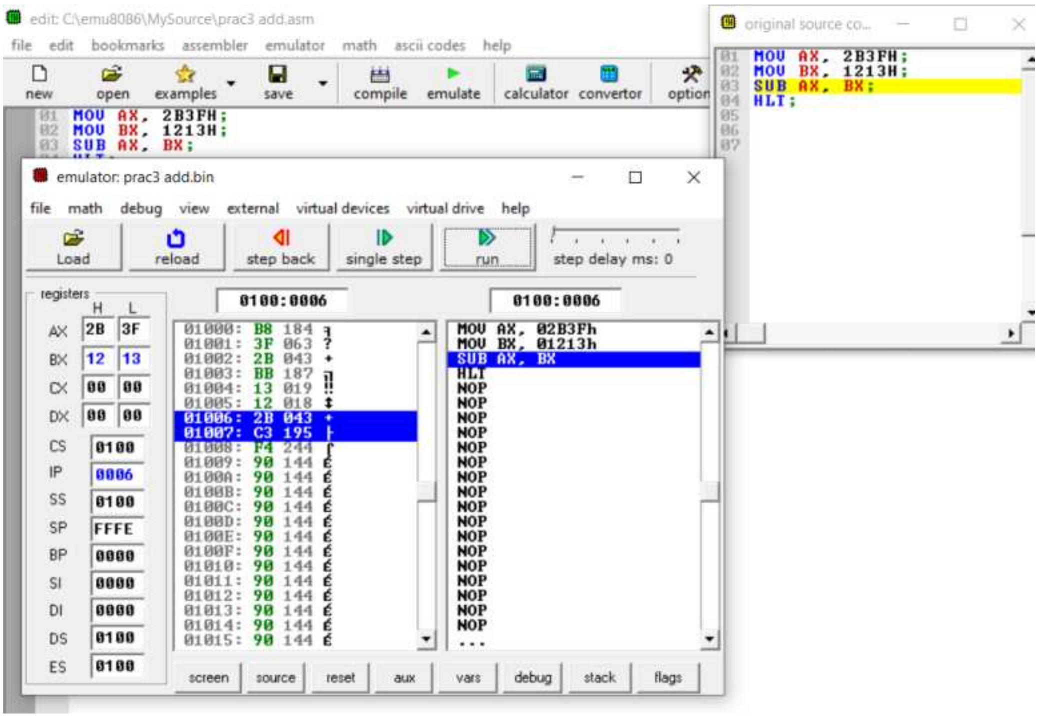
b) **Subtraction**:

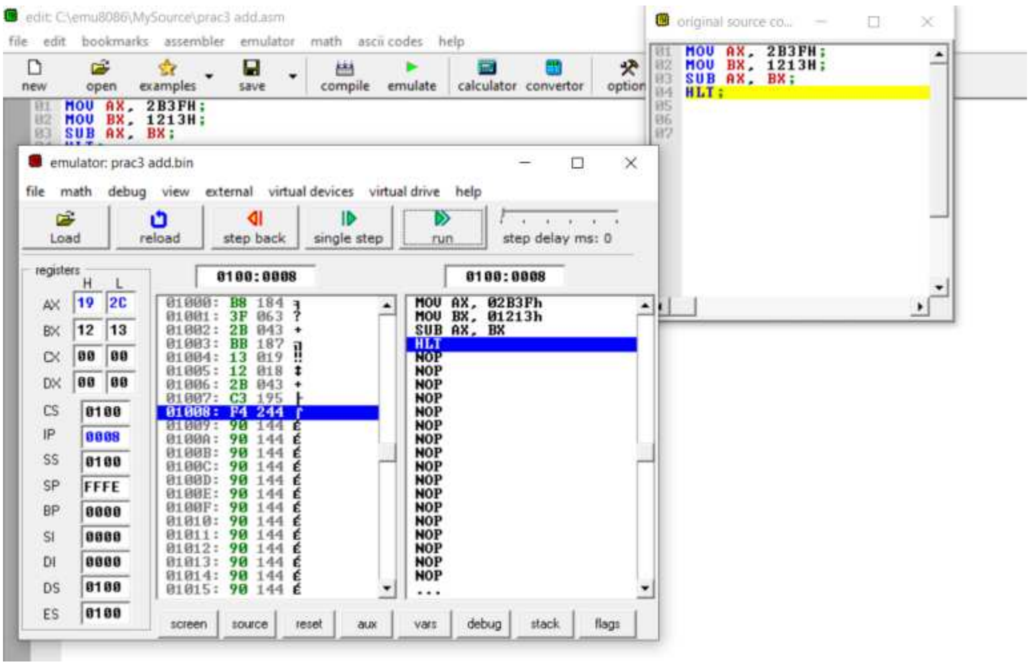
MOV AX, 2B3FH;

MOV BX, 1213H;

SUB AX, BX;

HLT;





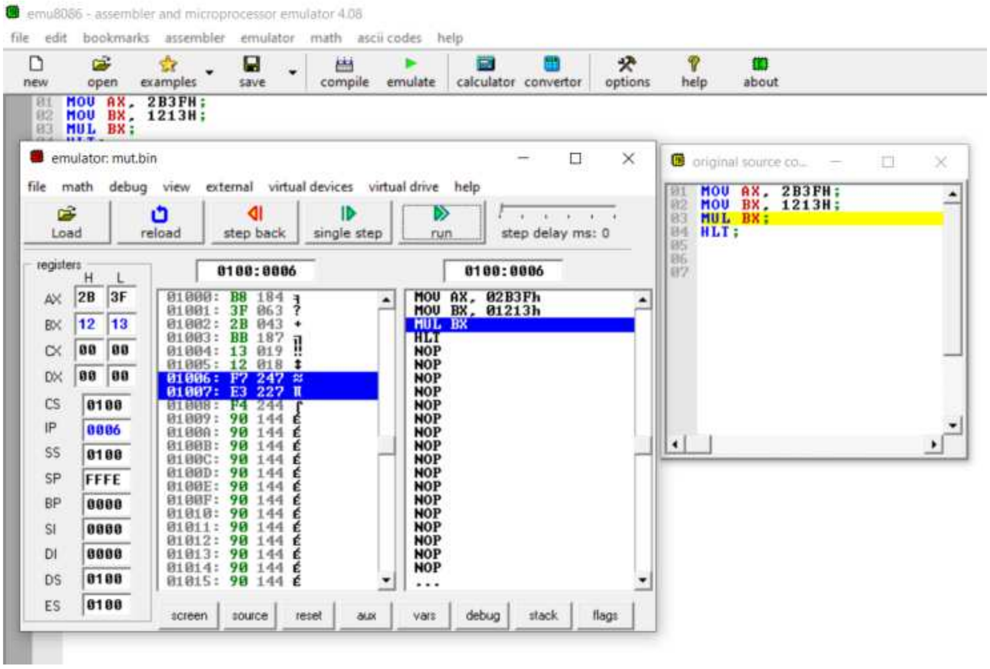
c) **Multiplication**:

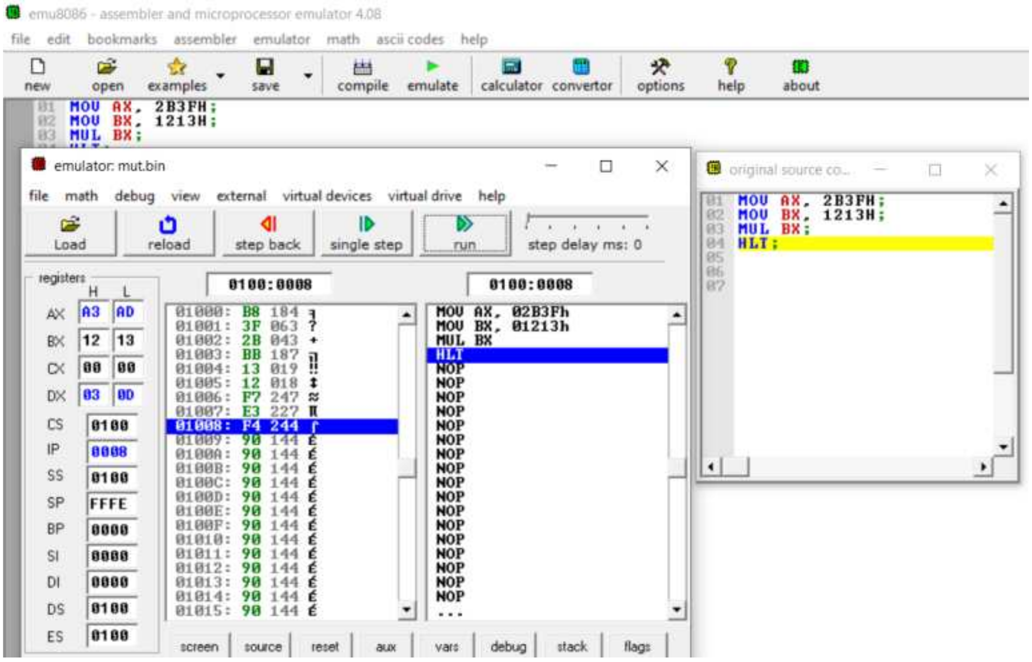
MOV AX, 2B3FH;

MOV BX, 1213H;

MUL BX;

HLT;





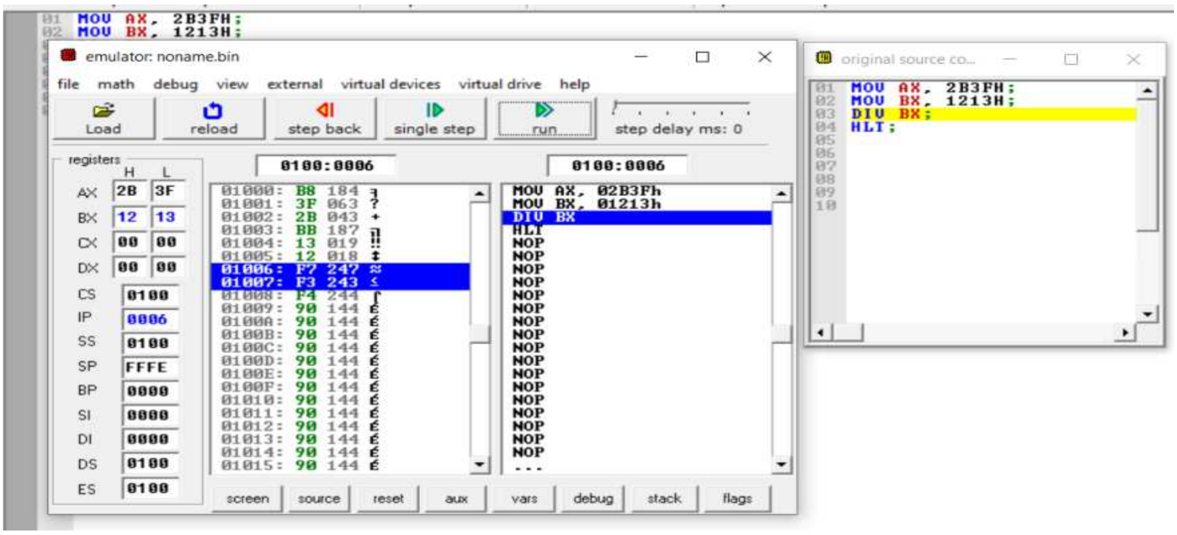
d) Division:

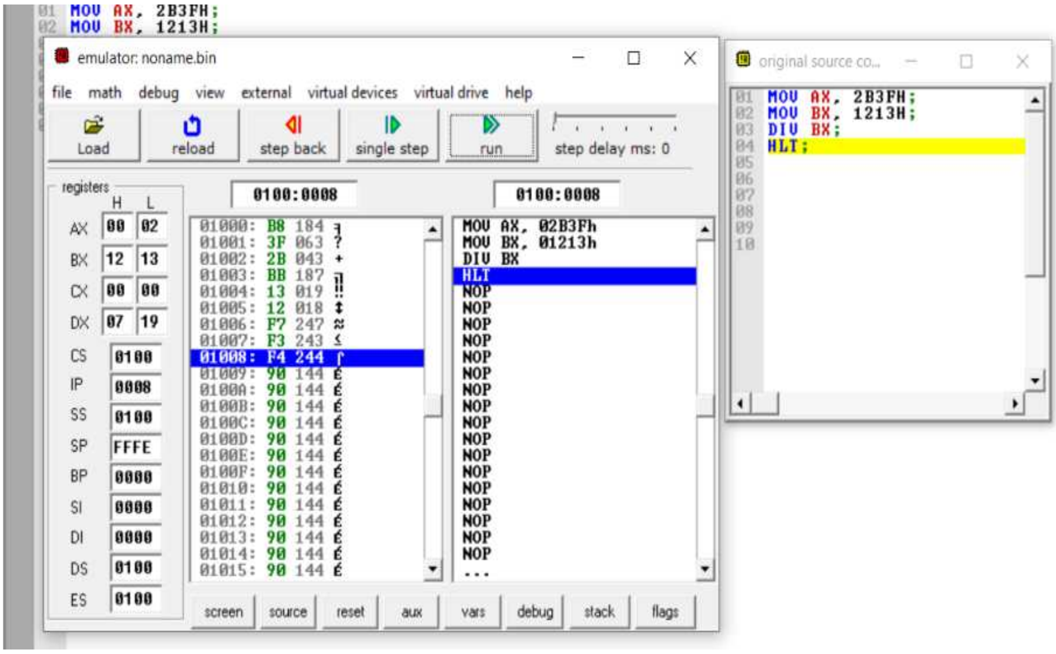
MOV AX, 2B3FH;

MOV BX, 1213H;

DIV BX;

HLT;





<u>Result:</u> We have performed addition, subtraction, multiplication and division of 16-bit numbers

Signature of Faculty

Experiment - 4
Perform Logical Operation using 8086

Aim: Write a program in 8086 to perform various logical operation.

Software Used: EMU8086

Theory:

a) **Not Operation**

1. Start debug utility program on windows xp or Linux.
2. Take operand-1 into register AX.
3. Use logical operation instruction NOT for Not operation.
4. Store the result into register AX.
5. Program halted

b) **AND Operation**

1. Start debug utility program on windows xp or Linux.
2. Take operand-1 into register AX.
3. Take operand-2 into register BX.
4. Use logical operation instruction AND for AND operation.
5. Store the result into register AX.
6. Program halted

c) **OR Operation**

1. Start debug utility program on windows xp or Linux.
2. Take operand-1 into register AX.
3. Take operand-2 into register BX.
4. Use logical operation instruction OR for OR operation.
5. Store the result into register AX.
6. Program halted\

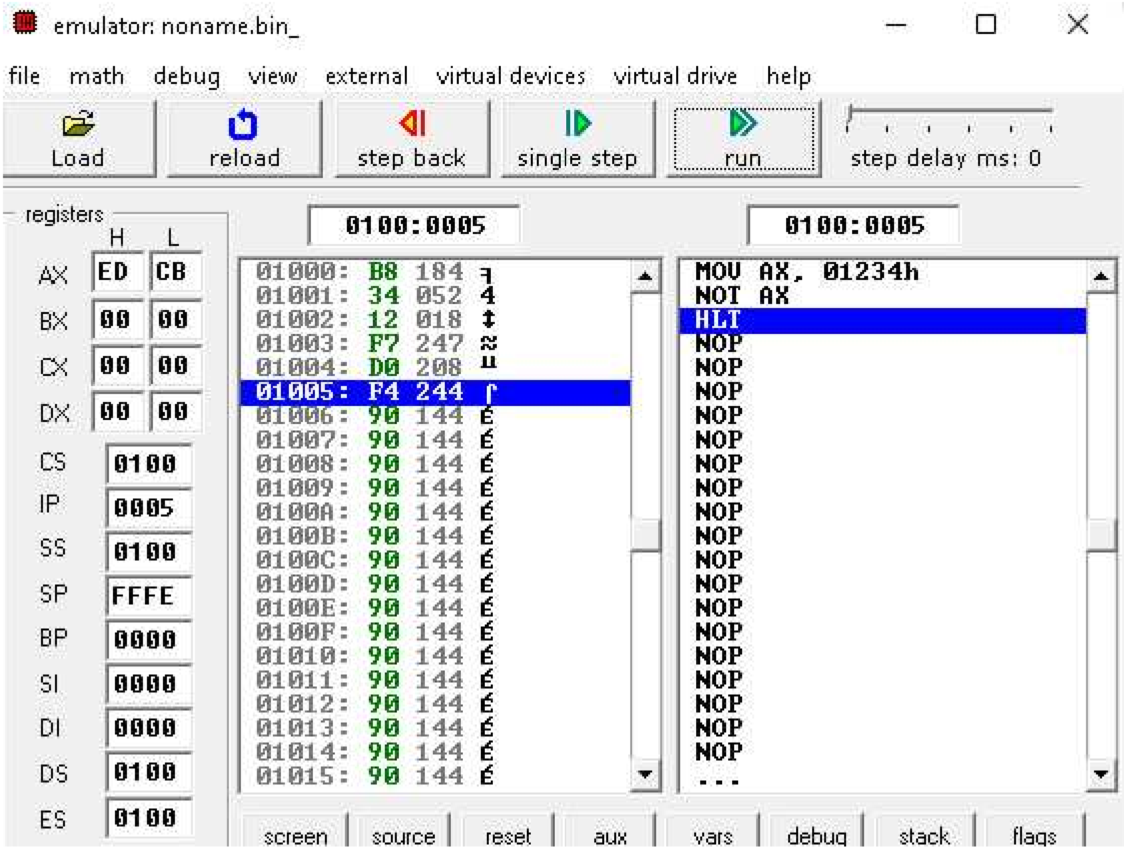
d) **XOR Operation**

1. Start debug utility program on windows xp or Linux.
2. Take operand-1 into register AX.
3. Take operand-2 into register BX.
4. Use logical operation instruction XOR for XOR operation.
5. Store the result into register AX.
6. Program halted

Programs:

i) **NOT operation:**

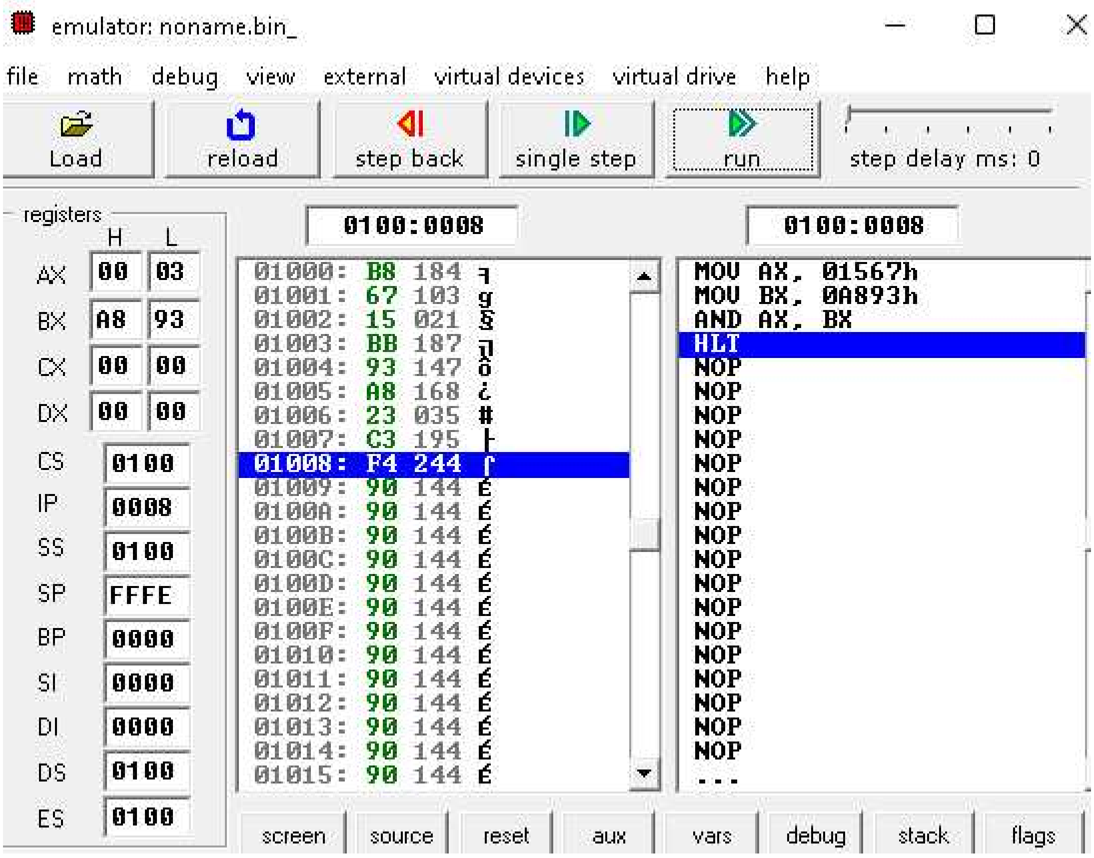
MOV AX, 1234H;
NOT AX;
HLT;



ii) **AND operation:**

MOV AX, 1567H;

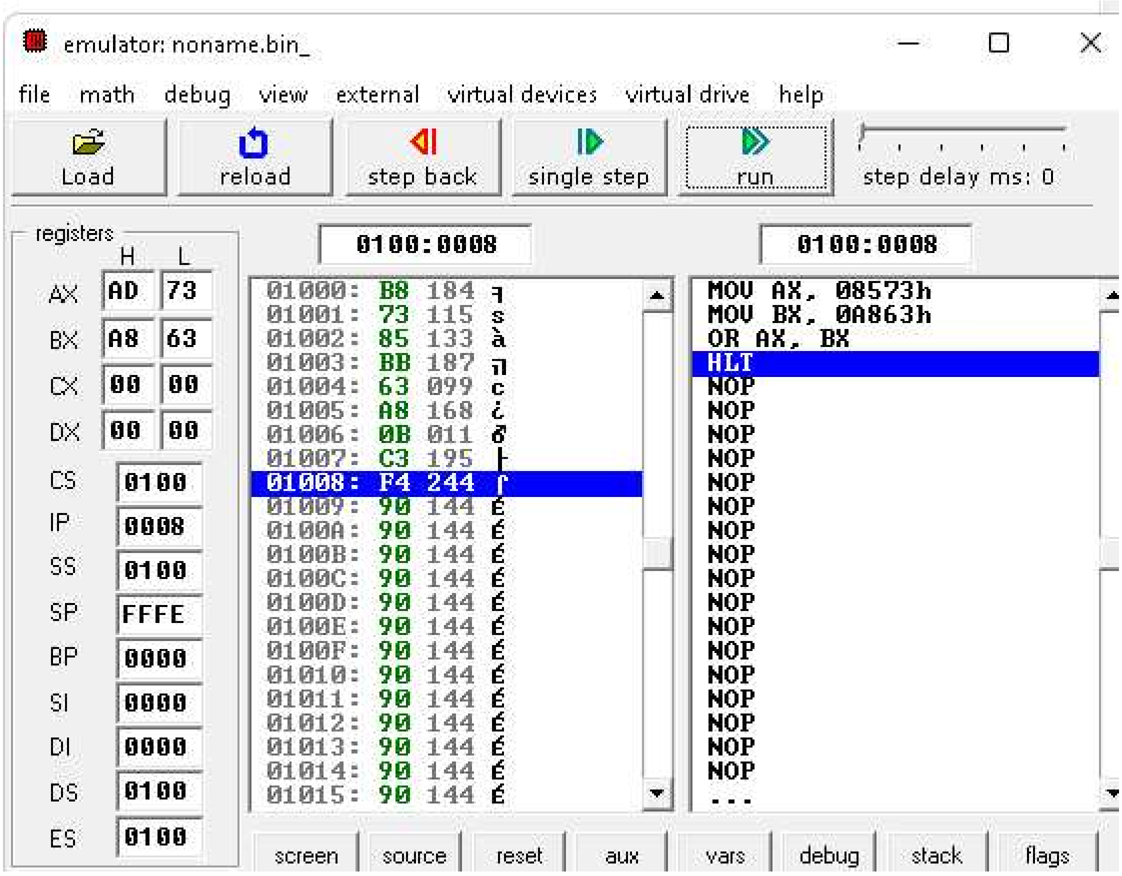
MOV BX, 0A893H;
AND AX, BX;
HLT;



iii) OR operation:

MOV AX, 1567H;

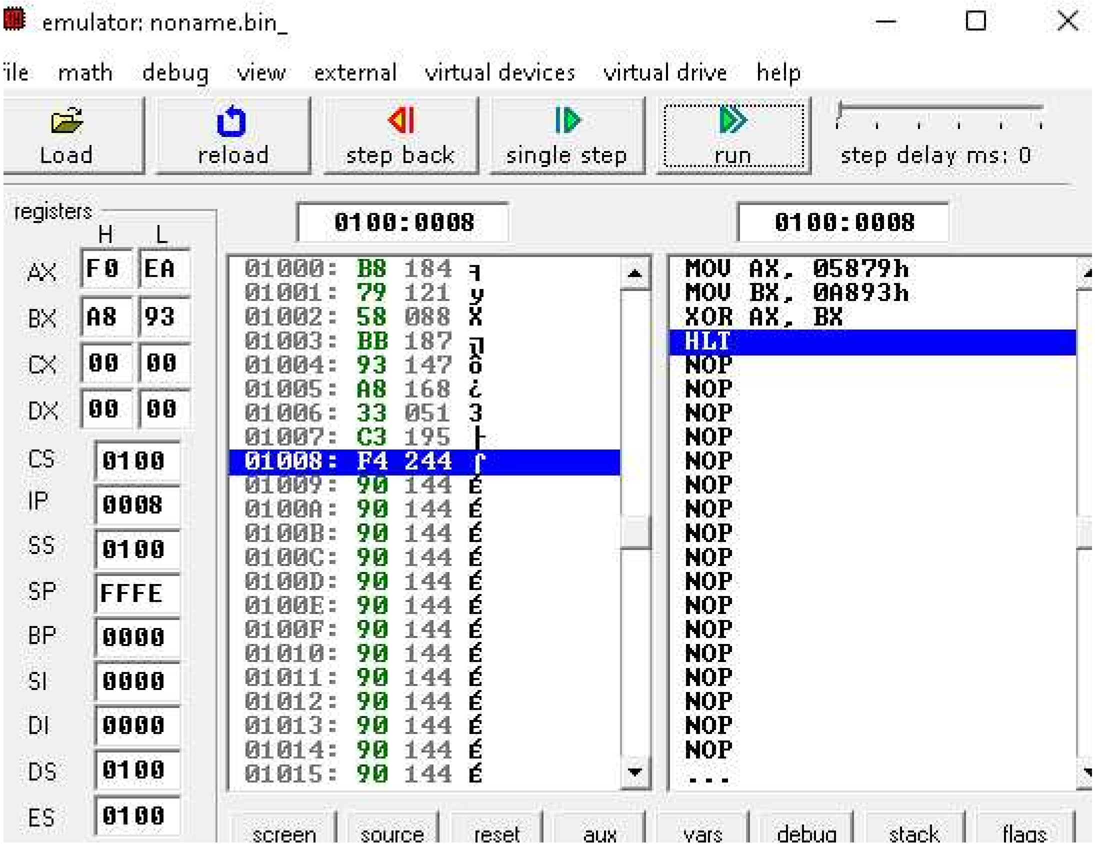
MOV BX, 0A893H;
OR AX, BX;
HLT;



iv) EX-OR operation:

MOV AX, 1567H;

MOV BX, 0A893H;
EXOR AX, BX;
HLT;



Result: We have performed various logical operations in 8086.

Signature of Faculty

Experiment - 5

Perform Universal Gate Operation using 8086

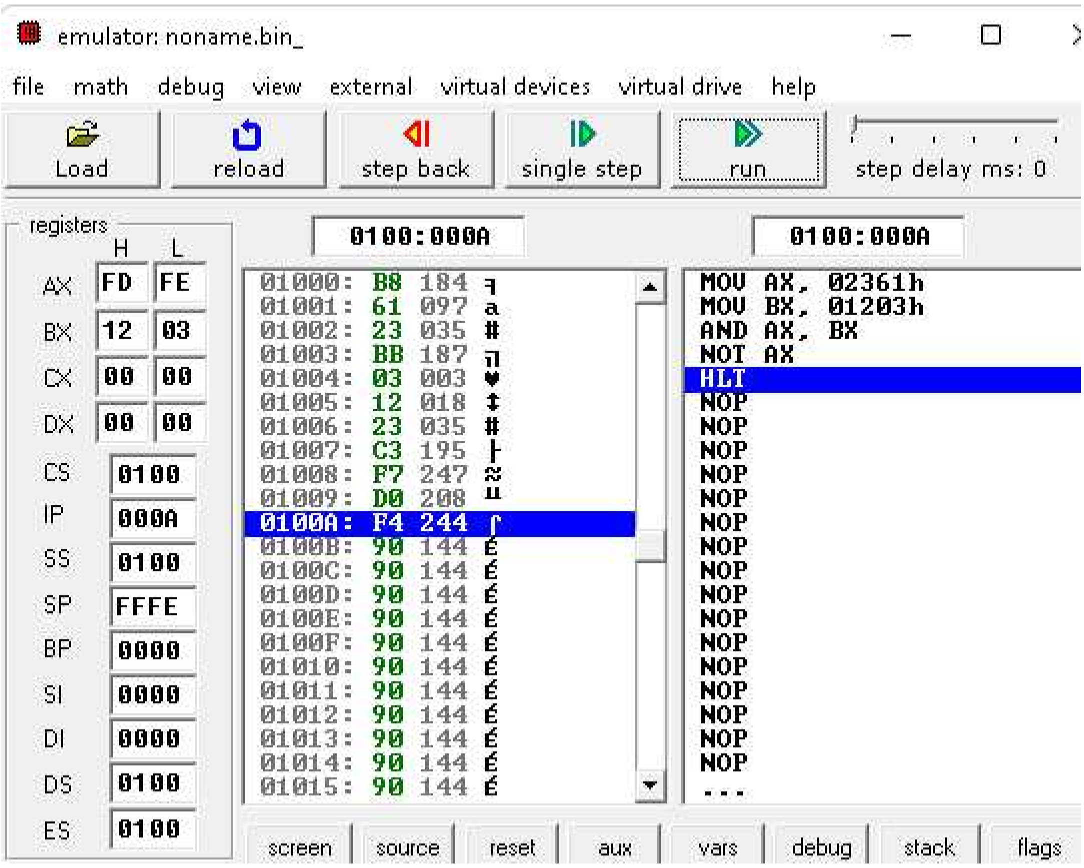
Aim: Write a program in 8086 to perform universal gate operation.

Software Used: EMU8086

Programs:

i) **NAND operation:**

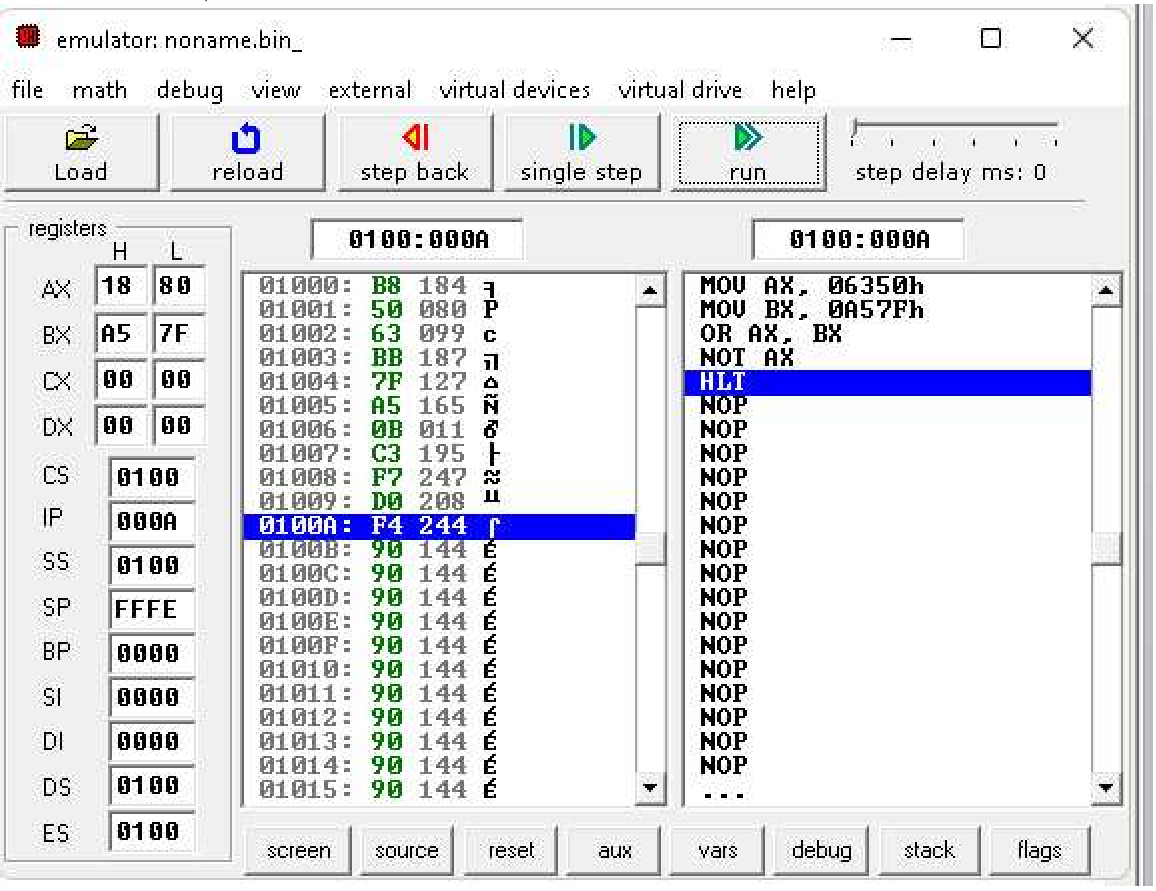
```
MOV AX, 1567H;
MOV BX, 0A893H;
AND AX, BX;
NOT AX;
HLT;
```



ii) **NOR operation:**

```
MOV AX, 1567H;
MOV BX, 0A893H;
```

OR AX, BX;
NOT AX;
HLT;



Result: Universal Gates has been performed in 8086.

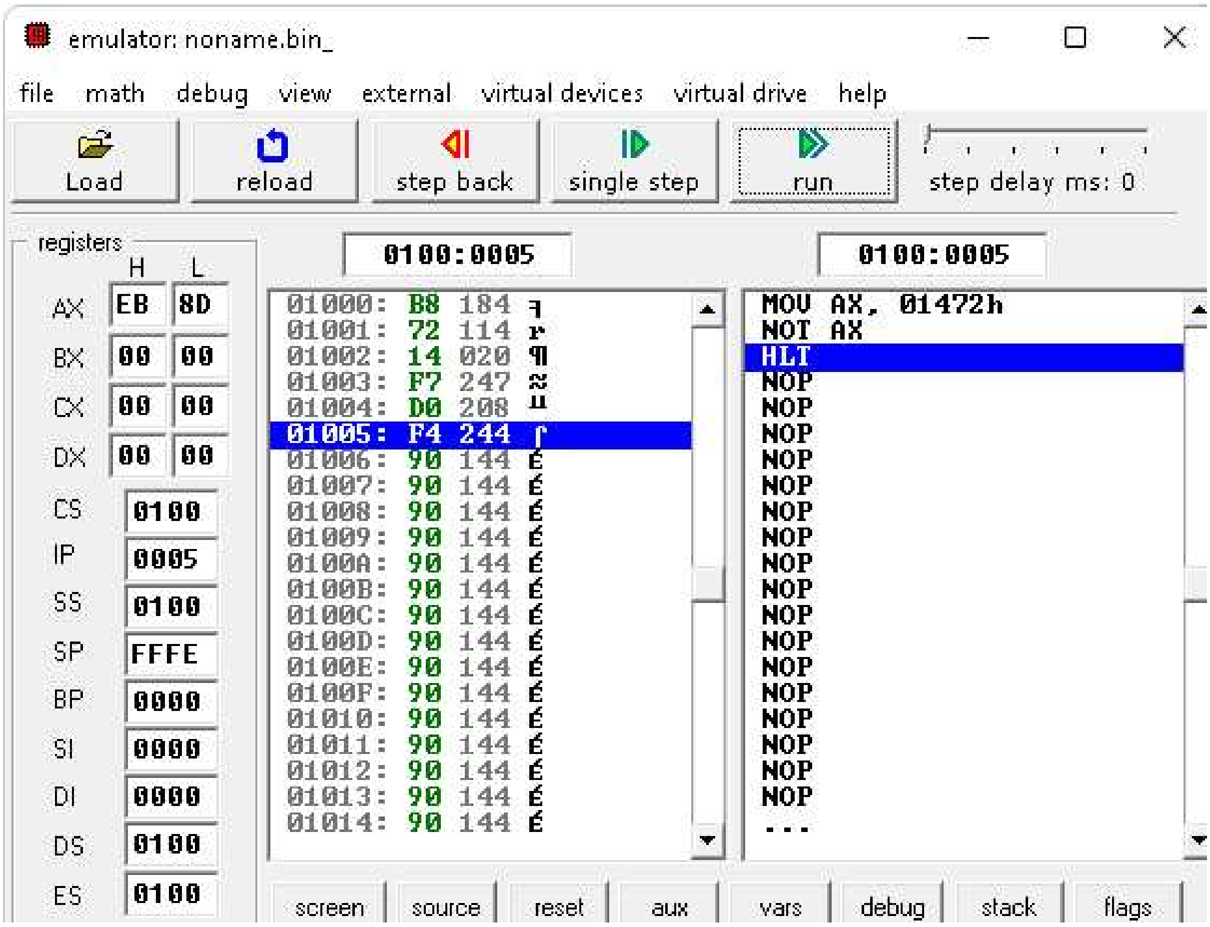
Signature of Faculty

Experiment - 6
Find 1's and 2's complements

Aim: Write a program to find one's and two's complement of a number in 8086.

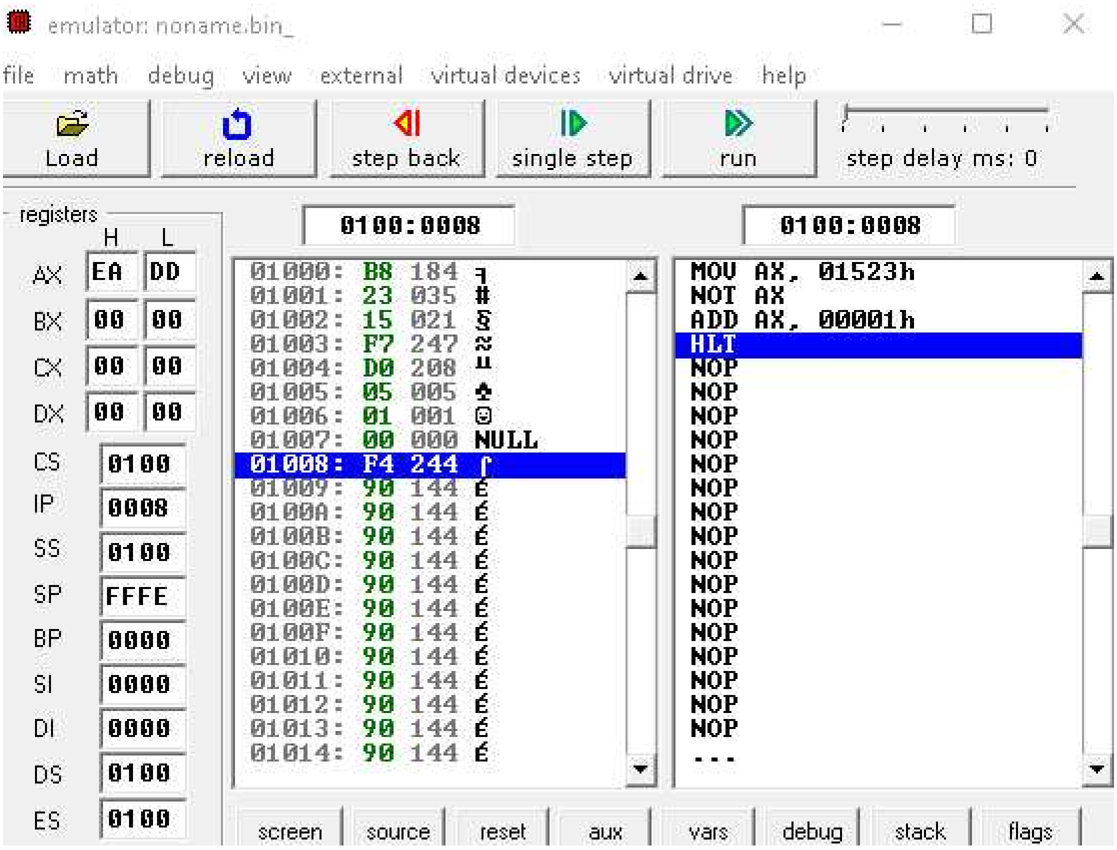
Program: -

1. **One's complement:**
   MOV AX, 1472H;
   NOT AX;
   HLT;



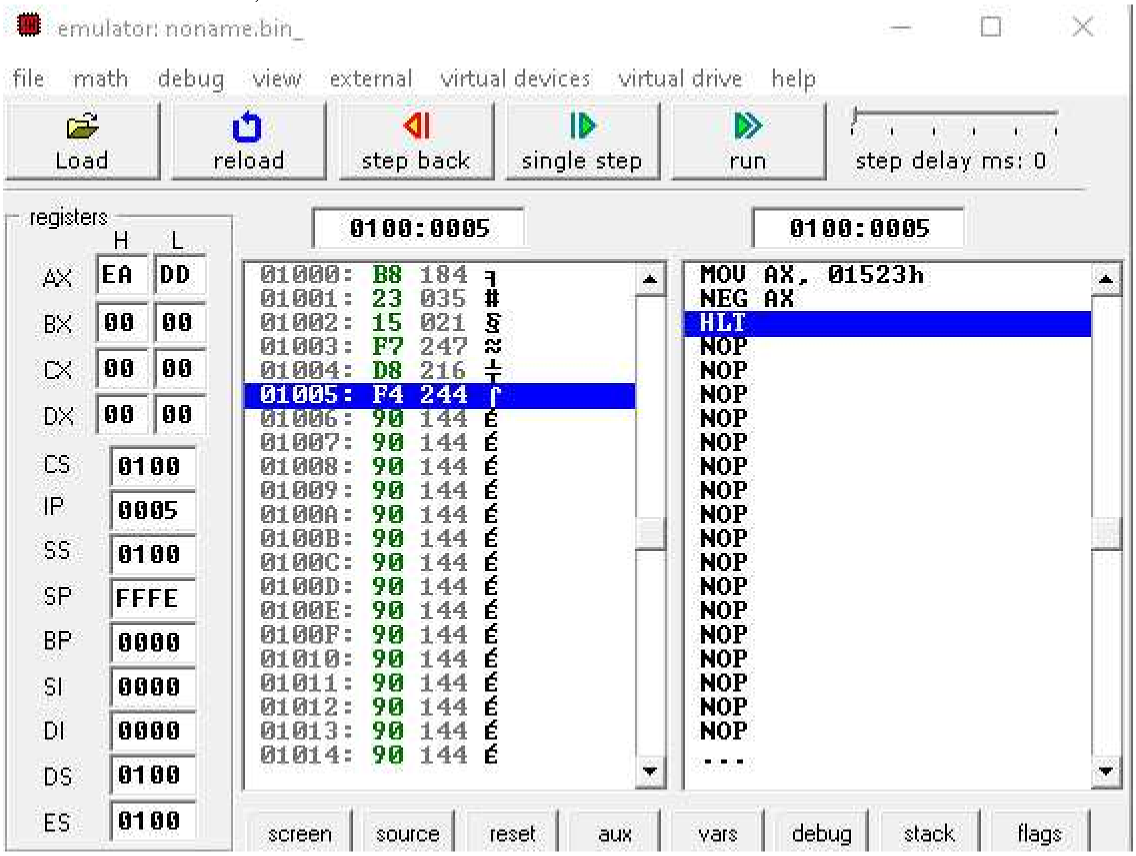
2. **Two's complement:**
   a) MOV AX,1523H;
      NOT AX;

ADD AX,0001H;
HLT;



b) MOV AX,1523H;
NEG AX;

HLT;



Result: one's and two's complement of a number in 8086 has been evaluated.

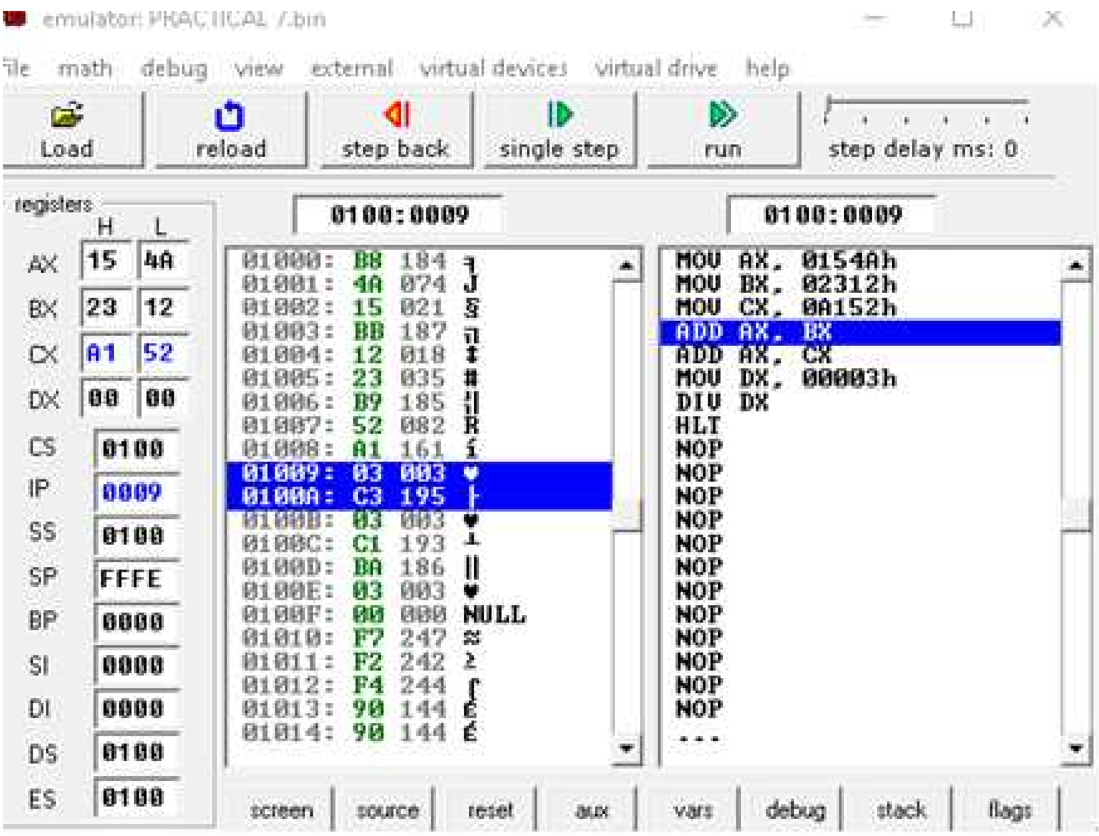
Signature of Faculty

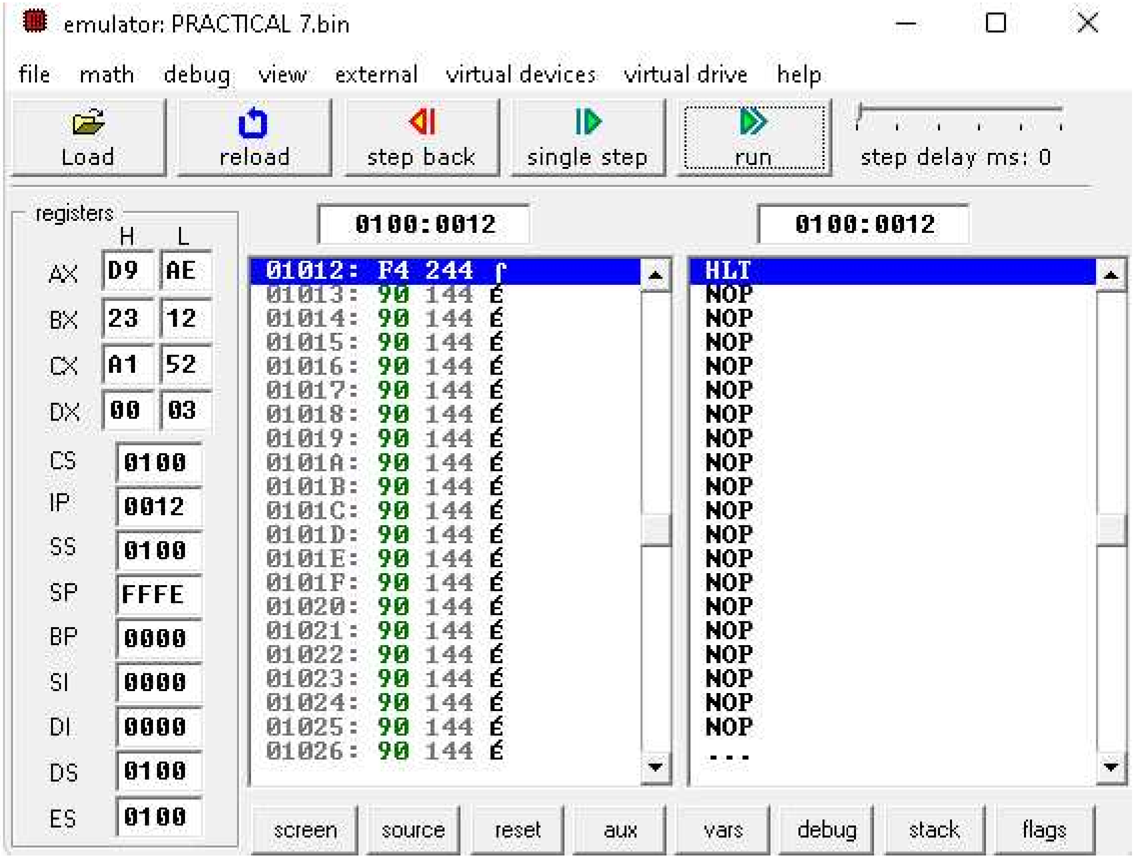
Find the average of numbers

Aim: Write a program to find average of 3 numbers in 8086.

Program: -

```
MOV AX, 154AH;
MOV BX, 2312H;
MOV CX, 0A152H;
ADD AX, BX;
ADD AX, CX;
MOV DX, 0003H;
DIV DX;
HLT;
```





Result: Average of three numbers has been evaluated.

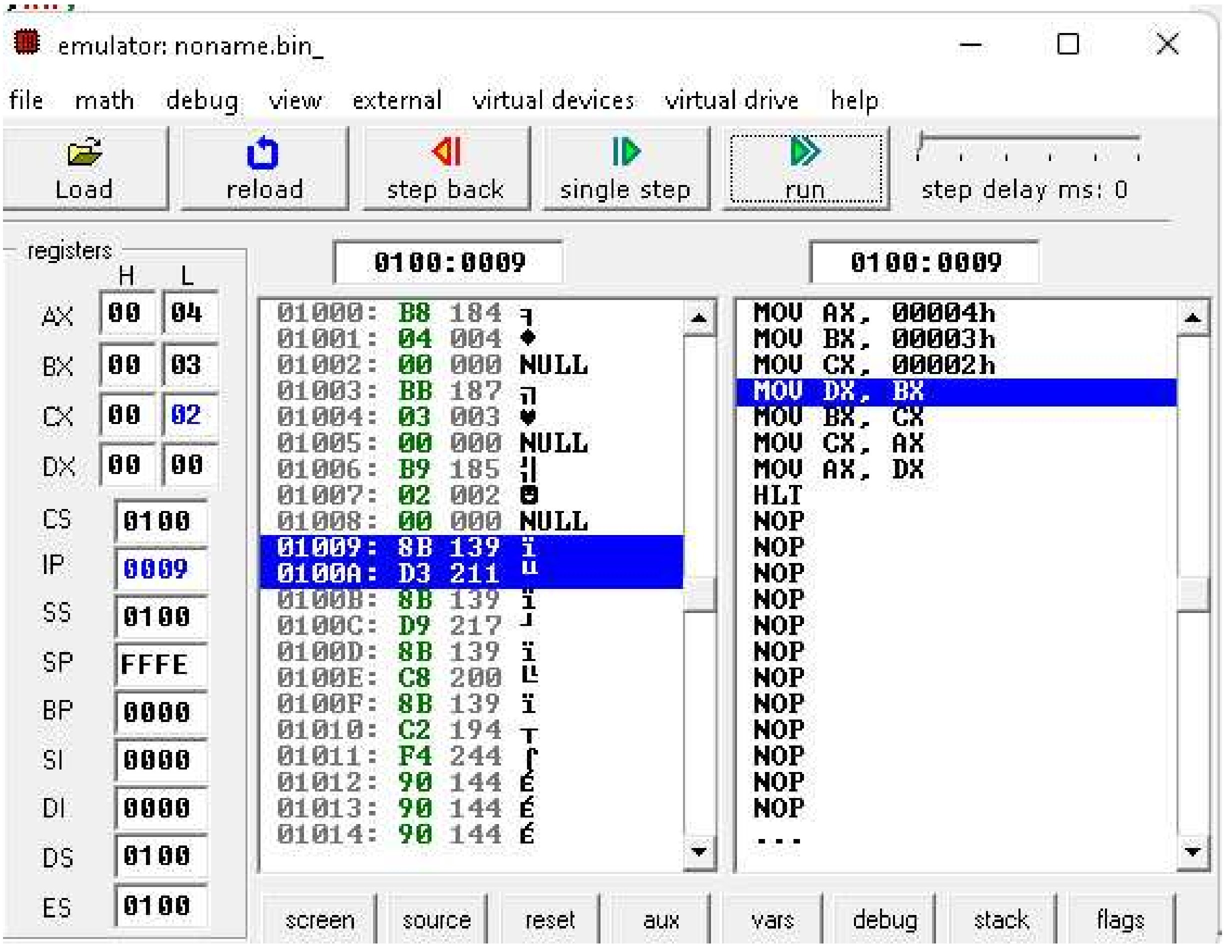
Signature of Faculty

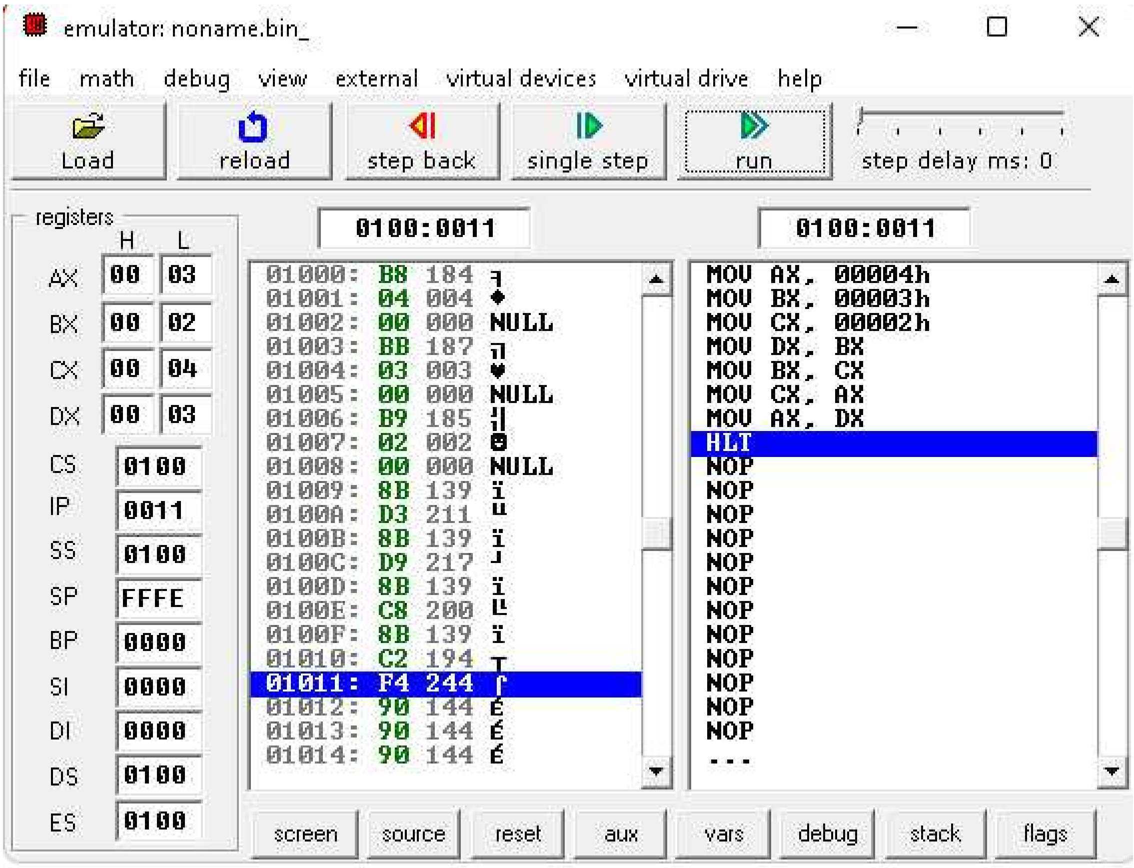
Experiment – 8
Exchanging the data of registers

Aim: Write a program in 8086 to exchange the data of the registers.

Program: -

```
MOV AX, 0004H;
MOV BX, 0003H;
MOV DX, BX;
MOV BX, CX;
MOV CX, AX;
MOV AX, DX;
HLT;
```





Result: Ex-changing the data of the registers has been performed.

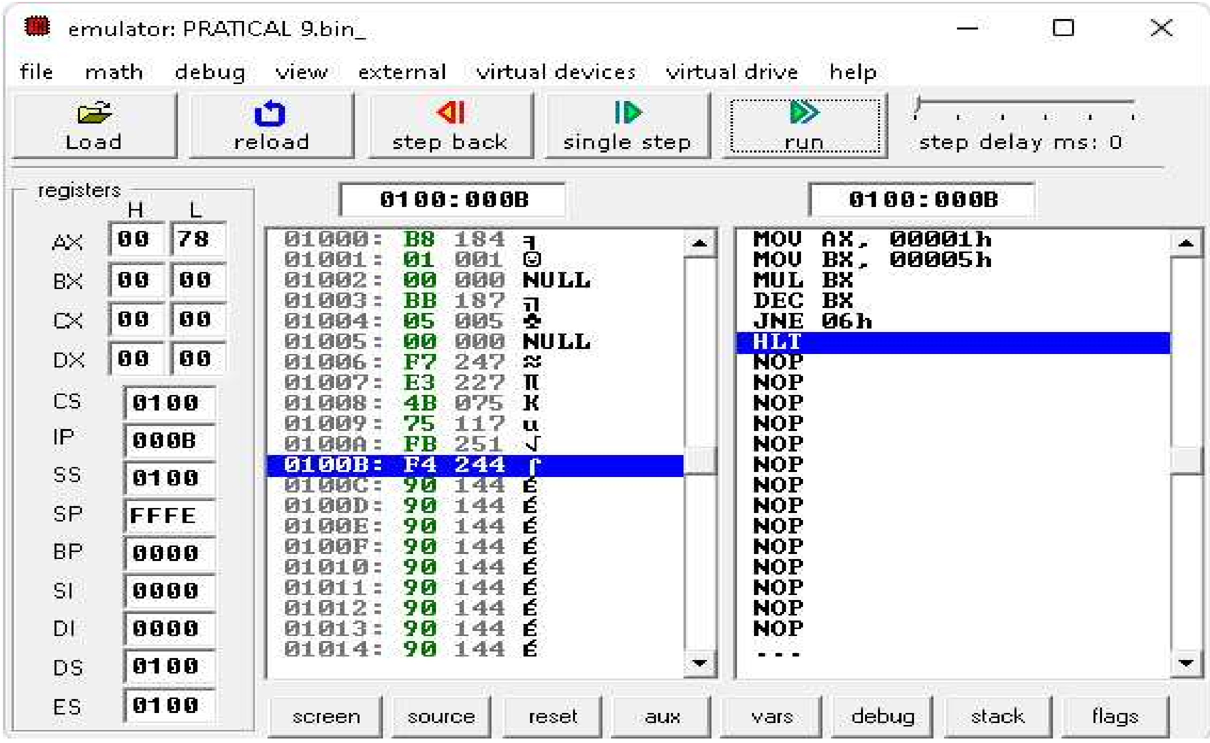
Signature of Faculty

Experiment – 9
Finding factorial of a number

Aim: Write a program to find factorial of a number in 8086.

Program: -

```
MOV AX,0001H;
MOV BX,0005H;
MUL BX;
DEC BX:
JNZ L1;
HLT;
```



Result: Factorial of a number in 8086 has been evaluated.

Signature of Faculty

Experiment – 10
Stepper Motor Rotation

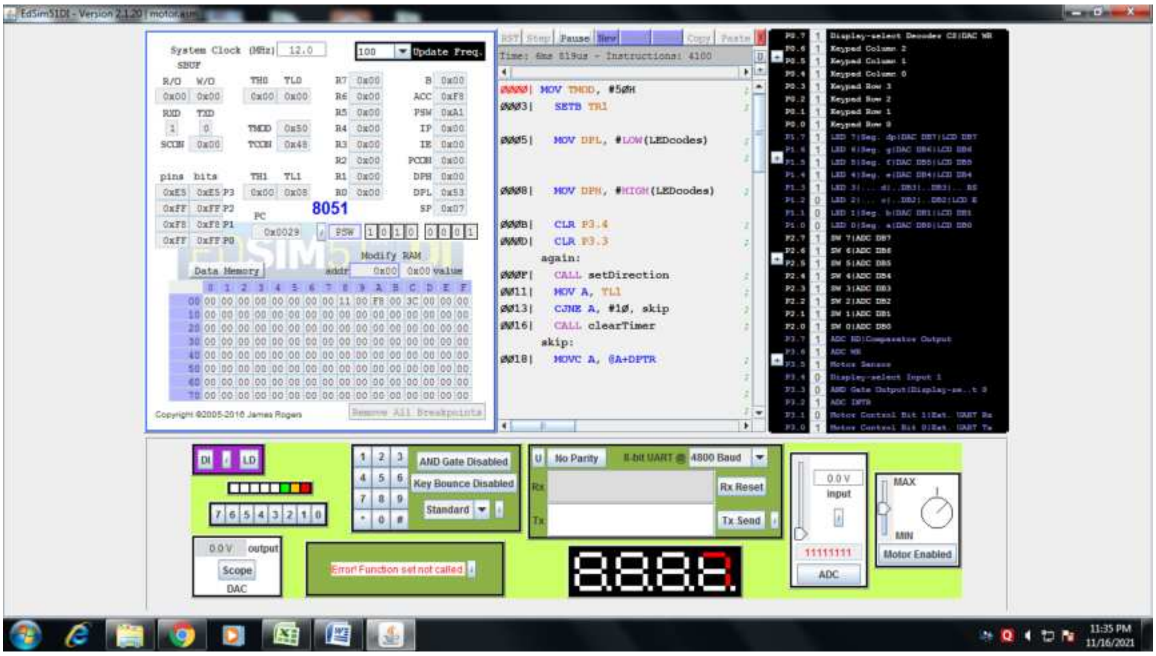
Aim: Write a program to rotate stepper motor using 8051

Program: -

```
0000| MOV TMOD, #50H                    ; put timer 1 in event
counting mode
0003|     SETB TR1                      ; start timer 1

0005|     MOV DPL, #LOW(LEDcodes)       ; | put the low byte of the
start address of the
                                             ; | 7-segment code table
into DPL

0008|     MOV DPH, #HIGH(LEDcodes)      ; put the high byte into DPH

000B|     CLR P3.4                      ; |
000D|     CLR P3.3                      ; | enable Display 0
      again:
000F|     CALL setDirection             ; set the motor's direction
0011|     MOV A, TL1                         ; move timer 1 low byte
to A
0013|     CJNE A, #10, skip             ; if the number of
revolutions is not 10 skip next instruction
0016|     CALL clearTimer                    ; if the number of
revolutions is 10, reset timer 1
      skip:
0018|     MOVC A, @A+DPTR                    ; | get 7-segment code
from code table - the index into the table is
                                             ; | decided by the value
in A
                                             ; | (example: the data
pointer points to the start of the
                                             ; | table - if there are
two revolutions, then A will contain two,
                                             ; | therefore the second
code in the table will be copied to A)

0019|     MOV C, F0                     ; move motor direction value
to the carry
```

```
001B|     MOV ACC.7, C                  ; | and from there to ACC.7
(this will ensure Display 0's decimal point
                                             ; | will indicate the
motor's direction)

001D|     MOV P1, A                     ; | move (7-seg code for)
number of revolutions and motor direction
                                             ; | indicator to Display
0

001F|     JMP again                     ; do it all again

      setDirection:
0021|     PUSH ACC                      ; save value of A on stack

0023|     PUSH 20H                      ; | save value of location
20H (first bit-addressable
                                             ; |  location in RAM) on
stack

0025|     CLR A                              ; clear A
0026|     MOV 20H, #0                        ; clear location 20H
0029|     MOV C, P2.0                        ; put SW0 value in carry
002B|     MOV ACC.0, C                  ; then move to ACC.0
002D|     MOV C, F0                     ; move current motor
direction in carry
002F|     MOV 0, C                      ; and move to LSB of location
20H (which has bit address 0)

0031|     CJNE A, 20H, changeDir        ; | compare SW0 (LSB of A)
with F0 (LSB of 20H)
                                             ; | - if they are not the
same, the motor's direction needs to be reversed

0034|     JMP finish                         ; if they are the same,
motor's direction does not need to be changed
      changeDir:
0036|     CLR P3.0                      ; |
0038|     CLR P3.1                      ; | stop motor

003A|     CALL clearTimer                    ; reset timer 1
(revolution count restarts when motor direction changes)
003C|     MOV C, P2.0                        ; move SW0 value to carry
```

```
003E|     MOV F0, C                     ; and then to F0 - this is
the new motor direction
0040|     MOV P3.0, C                        ; move SW0 value (in
carry) to motor control bit 1
0042|     CPL C                              ; invert the carry

0043|     MOV P3.1, C                        ; | and move it to motor
control bit 0 (it will therefore have the opposite
                                             ; | value to control bit
1 and the motor will start
                                             ; | again in the new
direction)
      finish:
0045|     POP 20H                            ; get original value for
location 20H from the stack
0047|     POP ACC                            ; get original value for
A from the stack
0049|     RET                                ; return from subroutine

      clearTimer:
004A|     CLR A                              ; reset revolution count
in A to zero
004B|     CLR TR1                            ; stop timer 1
004D|     MOV TL1, #0                        ; reset timer 1 low byte
to zero
0050|     SETB TR1                      ; start timer 1
0052|     RET                                ; return from subroutine

      LEDcodes:        ; | this label points to the start address
of the 7-segment code table which is
                       ; | stored in program memory using the DB
command below
                       DB 11000000B, 11111001B, 10100100B,
10110000B, 10011001B, 10010010B, 10000010B, 11111000B, 10000000B,
10010000B
```



Result: Stepper motor rotation has been performed using 8051 programming.

Signature of Faculty