RAMANUJAN COLLEGE DELHI UNIVERSITY

MICROPROCESSOR PRACTICALS

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SEMESTER: 5th sem

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INDEX

1) Write a program for 32-bit binary division and multiplication

A) BINARY DIVISIONSS

```
.MODEL SMALL
.DATA
 prompt1 DB 'Enter the 64-bit dividend: $'
 prompt2 DB 13, 10, 'Enter the 32-bit divisor: $'
 message1 DB 13, 10, 'Quotient: $'
 message2 DB 13, 10, 'Remainder: $'
 operandms DD ?
 operandls DD ?
 resultq DD ?
 resultr DD ?
.CODE
.STARTUP
 ; prompt user for the 64-bit dividend
 MOV DX, OFFSET prompt1
 MOV AH, 09H
 INT 21H
 ; clear EBX for holding input
 XOR BX, BX
 ; initialise counter for loop
 MOV CX, 04H
input1:
 ; shift content of EBX for next byte
 SHL BX, 8
 ; accept first digit
 MOV AH, 01H
 INT 21H
 ; check if it is a valid digit
 CMP AL, 39H
 JBE letter1
 ; adjust letters to hex
 SUB AL, 37H
letter1:
; adjust hex characters to hex from ascii
 AND AL, 0FH ; mask contents in AL
 SHL AL, 4 ; shift contents in AL
 MOV BL, AL
 ; accept second digit
 MOV AH, 01H
 INT 21H
 ; check if it is a valid digit
 CMP AL, 39H
 JBE letter2
 ; adjust letters to hex
 SUB AL, 37H
letter2:
 ; adjust hex characters to hex from ascii
 AND AL, 0FH ; mask contents in AL
 ADD BL, AL ; adjust second digit in chunk
```

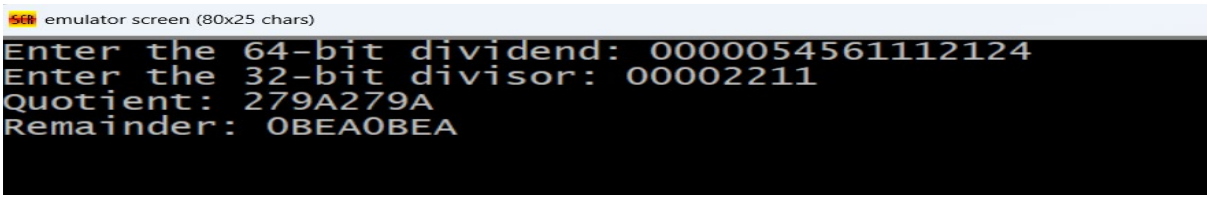
```
 LOOP input1
 ; store the upper nibble to memory
 MOV operandms, BX
 ; clear EBX for holding input
 XOR BX, BX
 ; initialise counter for loop
 MOV CX, 04H
input1a:
 ; shift content of EBX for next byte
 SHL BX, 8
 ; accept first digit
 MOV AH, 01H
 INT 21H
 ; check if it is a valid digit
 CMP AL, 39H
 JBE letter1a
 ; adjust letters to hex
 SUB AL, 37H
letter1a:
 ; adjust hex characters to hex from ascii
 AND AL, 0FH ; mask contents in AL
 SHL AL, 4 ; shift contents in AL
 MOV BL, AL
 ; accept second digit
 MOV AH, 01H
 INT 21H
 ; check if it is a valid digit
 CMP AL, 39H
 JBE letter2a
 ; adjust letters to hex
 SUB AL, 37H
letter2a:
 ; adjust hex characters to hex from ascii
 AND AL, 0FH ; mask contents in AL
 ADD BL, AL ; adjust second digit in chunk
 LOOP input1a
 ; store the lower nibble to memory
 MOV operandls, BX
 ; prompt user for the 32-bit divisor
 MOV DX, OFFSET prompt2
 MOV AH, 09H
 INT 21H
 ; clear EBX for holding input
 XOR BX, BX
 ; initialise counter for loop
 MOV CX, 04H
input2:
 ; shift content of EBX for next byte
 SHL BX, 8
 ; accept first digit of chunk
 MOV AH, 01H
 INT 21H
```

```
 ; check if it is a valid digit
 CMP AL, 39H
JBE letter3
 ; adjust letters to hex
 SUB AL, 37H
letter3:
 ; adjust hex characters to hex from ascii
 AND AL, 0FH ; mask contents in AL
 SHL AL, 4 ; shift contents in AL
 MOV BL, AL
 ; accept second digit of chunk
 MOV AH, 01H
 INT 21H
 ; check if it is a valid digit
 CMP AL, 39H
 JBE letter4
 ; adjust letters to hex
 SUB AL, 37H
letter4:
 ; adjust hex characters to hex from ascii
 AND AL, 0FH ; mask contents in AL
 ADD BL, AL ; adjust second digit in chunk
 LOOP input2
 ; copy first number to EAX and clear EDX
 MOV DX, operandms
 MOV AX, operandls
 ; generate quotient and remainder
 DIV BX
 ; copy quotient to ECX
 MOV CX, AX
 ; move quotient and remainder
 MOV resultq, CX
 MOV resultr, DX
 ; print the quotient
 MOV DX, OFFSET message1
 MOV AH, 09H
 INT 21H
; copy the quotient
 MOV BX, resultq
 ; initialise the counter for loop
 MOV CX, 04H
print1:
 ; rotate the contents of EBX
 ROL BX, 8

 ; convert hex to ascii
 MOV AL, BL
 AND AL, 0F0H ; mask contents in AL
 SHR AL, 4 ; shift msb in AL
 ADD AL, 30H ; adjust hex to ascii
 CMP AL, 39H ; check if it is a digit
 JBE print1sub1
```

```
 ADD AL, 07H ; adjust letters to ascii
print1sub1:
 ; print the first character of chunk
 MOV DL, AL
 MOV AH, 02H
 INT 21H
 ; convert hex to ascii
 MOV AL, BL
 AND AL, 0FH ; mask contents in AL
 ADD AL, 30H ; adjust hex to ascii
 CMP AL, 39H ; check if it is a digit
 JBE print1sub2
 ADD AL, 07H ; adjust letters to ascii
print1sub2:
 ; print the second character of chunk
 MOV DL, AL
 MOV AH, 02H
 INT 21H
 LOOP print1 ; loop until all digits are printed
 ; print the quotient
 MOV DX, OFFSET message2
 MOV AH, 09H
 INT 21H
 ; copy the remainder
 MOV BX, resultr
 ; initalise the counter for loop
 MOV CX, 04H
print2:
 ; rotate the contents of EBX
 ROL BX, 8

 MOV AL, BL
 AND AL, 0F0H ; mask contents in AL
 SHR AL, 4 ; shift msb in AL
 ADD AL, 30H ; adjust hex to ascii
 CMP AL, 39H
 JBE print2sub1
 ADD AL, 07H ; adjust letters to ascii
print2sub1:
 ; print the first character of chunk
 MOV DL, AL
 MOV AH, 02H
 INT 21H
 MOV AL, BL
 AND AL, 0FH ; mask contents in AL
 ADD AL, 30H ; adjust hex to ascii
 CMP AL, 39H ; check if it is a digit
 JBE print2sub2
 ADD AL, 07H ; adjust letter to ascii
print2sub2:
 ; print the second character of chunk
 MOV DL, AL
```

```
 MOV AH, 02H
 INT 21H
 LOOP print2 ; loop until all digits are printed
.EXIT
END
```

OUTPUT



B)BINARY MULTIPLICATION

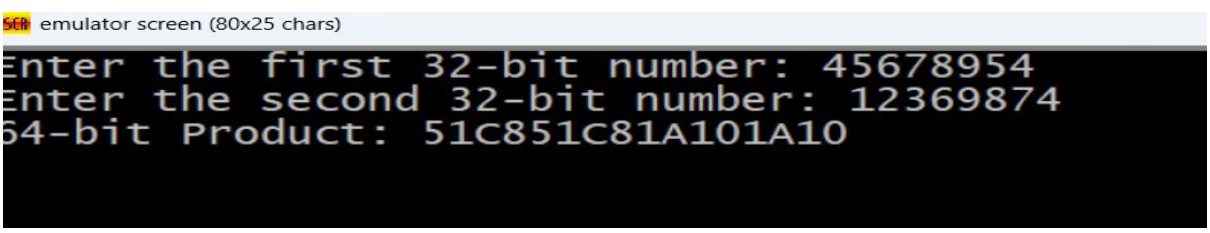
```
.MODEL SMALL

.DATA
 prompt1 DB 'Enter the first 32-bit number: $'
 prompt2 DB 13, 10, 'Enter the second 32-bit number: $'
 message DB 13, 10, '64-bit Product: $'
 operand DD ?
 resultms DD ?
 resultls DD ?
.CODE
.STARTUP
 ; prompt user for first number
 MOV DX, OFFSET prompt1
 MOV AH, 09H
 INT 21H
 ; clear EBX for holding input
 XOR BX, BX
 ; initialise counter for loop
 MOV CX, 04H
input1:
 ; shift content of EBX for next byte
 SHL BX, 8
 ; accept first digit
 MOV AH, 01H
 INT 21H
 ; check if it is a valid digit
 CMP AL, 39H
 JBE letter1
 ; adjust letters to hex
 SUB AL, 37H
letter1:
 ; adjust hex characters to hex from ascii
 AND AL, 0FH ; mask contents in AL
 SHL AL, 4 ; shift contents in AL
```

```
 MOV BL, AL
 ; accept second digit
 MOV AH, 01H
 INT 21H
 ; check if it is a valid digit
 CMP AL, 39H
 JBE letter2
 ; adjust letters to hex
 SUB AL, 37H
letter2:
 ; adjust hex characters to hex from ascii
 AND AL, 0FH ; mask contents in AL
 ADD BL, AL ; adjust second digit in chunk
 LOOP input1
 MOV operand, BX
 ; prompt user for second number
 MOV DX, OFFSET prompt2
 MOV AH, 09H
 INT 21H
 ; clear EBX for holding input
 XOR BX, BX
 ; initialise counter for loop
 MOV CX, 04H
input2:
 ; shift content of EBX for next byte
 SHL BX, 8
 ; accept first digit of chunk
 MOV AH, 01H
 INT 21H
 ; check if it is a valid digit
 CMP AL, 39H
 JBE letter3
 ; adjust letters to hex
 SUB AL, 37H
letter3:
 ; adjust hex characters to hex from ascii
 AND AL, 0FH ; mask contents in AL
 SHL AL, 4 ; shift contents in AL
 MOV BL, AL
 ; accept second digit of chunk
 MOV AH, 01H
 INT 21H
 ; check if it is a valid digit
 CMP AL, 39H
 JBE letter4
 ; adjust letters to hex
 SUB AL, 37H
letter4:
 ; adjust hex characters to hex from ascii
 AND AL, 0FH ; mask contents in AL
 ADD BL, AL ; adjust second digit in chunk
 LOOP input2
```

```
 ; copy first number to EAX
 MOV AX, operand
 ; multiply with the second number in EBX
 MUL BX
 ; copy results to memory
 MOV resultms, DX
 MOV resultls, AX
 ; print the result
 MOV DX, OFFSET message
 MOV AH, 09H
 INT 21H
 ; copy the most significant part of product
 MOV BX, resultms
 ; initalise the counter for loop
 MOV CX, 04H
print1:
 ; rotate the contents of EBX
 ROL BX, 8

 ; convert hex to ascii
 MOV AL, BL
 AND AL, 0F0H ; mask contents in AL
 SHR AL, 4 ; shift msb in AL
 ADD AL, 30H ; adjust hex to ascii
 CMP AL, 39H ; check if it is a digit
 JBE print1sub1
 ADD AL, 07H ; adjust letters to ascii
print1sub1:
 ; print the first character of chunk
 MOV DL, AL
 MOV AH, 02H
 INT 21H
 ; convert hex to ascii
 MOV AL, BL
 AND AL, 0FH ; mask contents in AL
 ADD AL, 30H ; adjust hex to ascii
 CMP AL, 39H ; check if it is a digit
 JBE print1sub2
 ADD AL, 07H ; adjust letters to ascii
print1sub2:
 ; print the second character of chunk
 MOV DL, AL
 MOV AH, 02H
 INT 21H
 LOOP print1 ; loop until all digits are printed
 ; copy the least significant part of product
 MOV BX, resultls
 ; initialise the counter for loop
 MOV CX, 04H
print2:
 ; rotate the contents of EBX
 ROL BX, 8
```

```
 MOV AL, BL
 AND AL, 0F0H ; mask contents in AL
 SHR AL, 4 ; shift msb in AL
 ADD AL, 30H ; adjust hex to ascii
 CMP AL, 39H
 JBE print2sub1
 ADD AL, 07H ; adjust letters to ascii
print2sub1:
 ; print the first character of chunk
 MOV DL, AL
 MOV AH, 02H
 INT 21H
 MOV AL, BL
 AND AL, 0FH ; mask contents in AL
 ADD AL, 30H ; adjust hex to ascii
 CMP AL, 39H ; check if it is a digit
 JBE print2sub2
 ADD AL, 07H ; adjust letter to ascii
print2sub2:
 ; print the second character of chunk
 MOV DL, AL
 MOV AH, 02H
 INT 21H
 LOOP print2 ; loop until all digits are printed
.EXIT
END
```

OUTPUT



2) Write a program for 32-bit BCD addition and subtraction

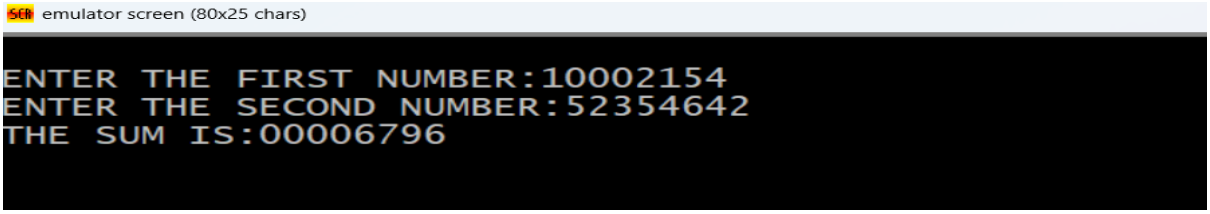
A) BCD ADDITION

```
.MODEL SMALL

.DATA
MESS0 DB 10,13,"ENTER THE FIRST NUMBER:$"
MESS1 DB 10,13,"ENTER THE SECOND NUMBER:$"
MESS2 DB 10,13,"THE SUM IS:$"
A DD ?
B DD ?
```

```
C DD ?
COUNT DB 04h
.CODE
.STARTUP
LEA DX,MESS0
MOV AH,09
INT 21H

MOV BX,0
MOV CX,8
AGAIN:
MOV AH,01
INT 21H
CMP AL,'A'
JGE L5
SUB AL,30H
JMP L6
L5: SUB AL,37H
L6: SHL BX,4
ADD BL,AL
LOOP AGAIN
MOV A,BX

LEA DX,MESS1
MOV AH,09
INT 21H

MOV BX,0
MOV CX,8
AGAINS:
MOV AH,01
INT 21H
CMP AL,'A'
JGE L51
SUB AL,30H
JMP L61
L51: SUB AL,37H
L61: SHL BX,4
ADD BL,AL
LOOP AGAINS
MOV B,BX


MOV AX,WORD PTR A
MOV BX,WORD PTR B

ADD AL,BL
DAA
MOV BL,AL

ADC AH,BH
MOV AL,AH
```

```
DAA
MOV BH,AL

MOV WORD PTR C,BX

MOV AX,WORD PTR A+2
MOV BX,WORD PTR B+2
ADC AL,BL
DAA
MOV BL,AL
ADC AH,BH
MOV AL,AH
DAA
MOV BH,AL
MOV WORD PTR C+2,BX

LEA DX,MESS2
MOV AH,09
INT 21H

MOV BX,WORD PTR C+2
MOV DH,2

L1: MOV CH,04H
MOV CL,04H
L2: ROL BX,CL
MOV DL,BL
AND DL,0FH
CMP DL,09
JBE L4
ADD DL,07
L4: ADD DL,30H
MOV AH,02
INT 21H
DEC CH
JNZ L2
DEC DH
CMP DH,0
MOV BX,WORD PTR C
JNZ L1

MOV AH,4CH
INT 21H
END
```

OUTPUT



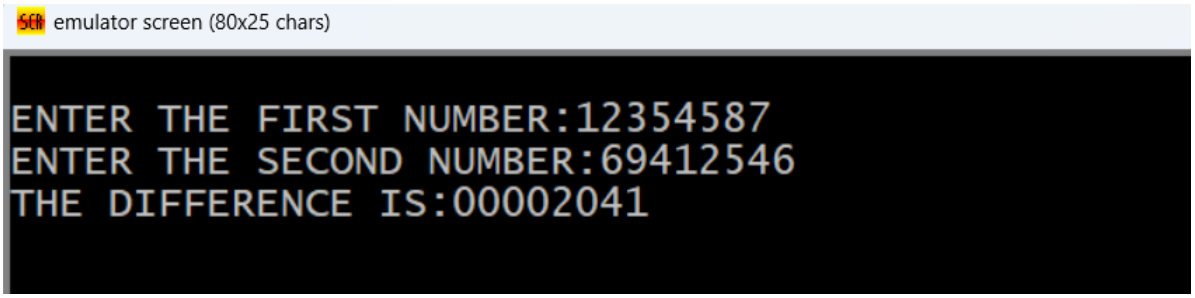
B) BCD SUBTRACTION

```
.MODEL SMALL

.DATA
MESS0 DB 10,13,"ENTER THE FIRST NUMBER:$"
MESS1 DB 10,13,"ENTER THE SECOND NUMBER:$"
MESS2 DB 10,13,"THE DIFFERENCE IS:$"
A DD ?
B DD ?
C DD ?
COUNT DB 04h
.CODE
.STARTUP

LEA DX,MESS0
MOV AH,09
INT 21H

MOV BX,0
MOV CX,8
AGAIN:
MOV AH,01
INT 21H
CMP AL,'A'
JGE L5
SUB AL,30H
JMP L6
L5: SUB AL,37H
L6: SHL BX,4
ADD BL,AL
LOOP AGAIN
MOV A,BX

LEA DX,MESS1
MOV AH,09
INT 21H

MOV BX,0
MOV CX,8
AGAINS:
MOV AH,01
INT 21H
```

```
CMP AL,'A'
JGE L51
SUB AL,30H
JMP L61
L51: SUB AL,37H
L61: SHL BX,4
ADD BL,AL
LOOP AGAINS
MOV B,BX


MOV AX,WORD PTR A
MOV BX,WORD PTR B

SUB AL,BL
DAS
MOV BL,AL

SBB AH,BH
MOV AL,AH
DAS
MOV BH,AL

MOV WORD PTR C,BX

MOV AX,WORD PTR A+2
MOV BX,WORD PTR B+2
SBB AL,BL
DAS
MOV BL,AL
SBB AH,BH
MOV AL,AH
DAS
MOV BH,AL
MOV WORD PTR C+2,BX

LEA DX,MESS2
MOV AH,09
INT 21H

MOV BX,WORD PTR C+2
MOV DH,2

L1: MOV CH,04H
MOV CL,04H
L2: ROL BX,CL
MOV DL,BL
AND DL,0FH
CMP DL,09
JBE L4
ADD DL,07
L4: ADD DL,30H
```

```
MOV AH,02
INT 21H
DEC CH
JNZ L2
DEC DH
CMP DH,0
MOV BX,WORD PTR C
JNZ L1

MOV AH,4CH
INT 21H
END
```

OUTPUT



3.Write a program for Linear search and binary search.

A)LINEAR SEARCH

```
.model small

.stack

.386

.data

ARRAY DB 10 DUP(?)

MESS0 DB 13,10,"ENTER THE NUMBER: $"

MESS1 DB 13,10,"ENTER THE NUMBER OF ELEMENTS: $"

MESS2 DB 13,10,"ENTER THE ELEMENT TO BE SEARCHED: $"

MESS3 DB 13,10,"VALUE FOUND AT LOCATION- $"

MESS4 DB 13,10,"VALUE NOT FOUND!!!$"

ErrMess DB 13,10,"ERROR IN INPUT DIGIT$"
```

```
DAT DB ?
number dw ?

.code
.startup

MOV DX,OFFSET MESS1
MOV AH,09
INT 21H

MOV AH,01
INT 21H
cmp al,39h
jbe abc

MOV DX,OFFSET ErrMess
MOV AH,09
INT 21H
jmp myexit
abc:
and al,0fh
mov ah,0
mov number,ax
MOV CX,AX
MOV DI,0

MYLOOP:
MOV DX,OFFSET MESS0
MOV AH,09
```

```
INT 21H
MOV AH,01
INT 21H
cmp al,39h
jbe abc2
MOV DX,OFFSET ErrMess
MOV AH,09
INT 21H
jmp myexit
abc2:
and al,0fh
MOV ARRAY[DI],AL
INC DI
LOOP MYLOOP

MOV DX,OFFSET MESS2
MOV AH,09
INT 21H
MOV AH,01
INT 21H
cmp al,39h
jbe abc3
MOV DX,OFFSET ErrMess
MOV AH,09
INT 21H
jmp myexit
abc3:
and al,0fh
MOV DAT,AL
```

```
mov ax,ds
mov es,ax
mov al,dat
CLD
mov cx,number
INC CX
mov DI, offset ARRAY
repne SCASB

CMP CX,0
JE NTFOUND
MOV DX,OFFSET MESS3
MOV AH,09
INT 21H
SUB NUMBER,CX ;FIND ELEMENT LOCATION
ADD NUMBER,30H
MOV DX,NUMBER
INC DX
MOV AH,02
INT 21H
JMP myexit
NTFOUND:
MOV DX,OFFSET MESS4
MOV AH,09
INT 21H
myexit:
MOV AH,4CH
INT 21H
```

END

OUTPUT

```
ENTER THE NUMBER OF ELEMENTS: 4
ENTER THE NUMBER: 2
ENTER THE NUMBER: 4
ENTER THE NUMBER: 5
ENTER THE NUMBER: 6
ENTER THE ELEMENT TO BE SEARCHED: 5
VALUE FOUND AT LOCATION- 3


Program successfully executed !
Press any key to continue.
```

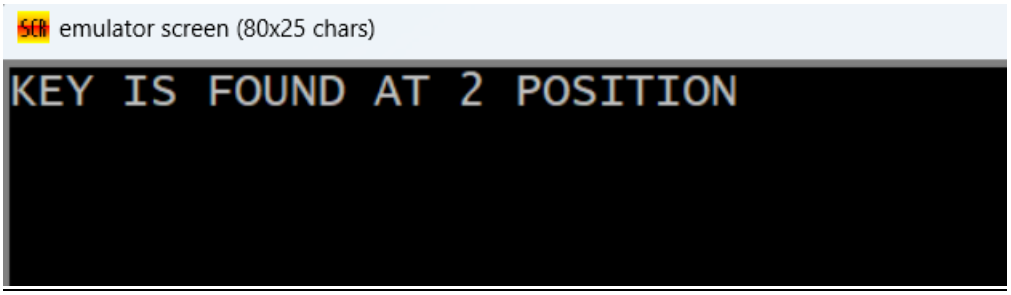
B) **BINARY SEARCH**

```
.MODEL SMALL

.DATA

ARR DW 0000H,1111H,2222H,3333H,4444H,5555H,6666H,7777H,8888H,9999H

LEN DW ($-ARR)/2

KEY EQU 1111H

MSG1 DB "KEY IS FOUND AT "

RES DB "  POSITION",13,10," $"

MSG2 DB 'KEY NOT FOUND!!!.$'


.CODE

.STARTUP


    MOV BX,00

    MOV DX,LEN
```

```
    MOV CX,KEY
AGAIN: CMP BX,DX
    JA FAIL
    MOV AX,BX
    ADD AX,DX
    SHR AX,1
    MOV SI,AX
    ADD SI,SI
    CMP CX,ARR[SI]
    JAE BIG
    DEC AX
    MOV DX,AX
    JMP AGAIN
BIG:   JE SUCCESS
    INC AX
    MOV BX,AX
    JMP AGAIN
SUCCESS: ADD AL,01
      ADD AL,'0'
      MOV RES,AL
      LEA DX,MSG1
      JMP DISP
FAIL: LEA DX,MSG2
DISP: MOV AH,09H
    INT 21H

    MOV AH,4CH
    INT 21H
```

END

OUTPUT:



4) Write a program to add and subtract two arrays

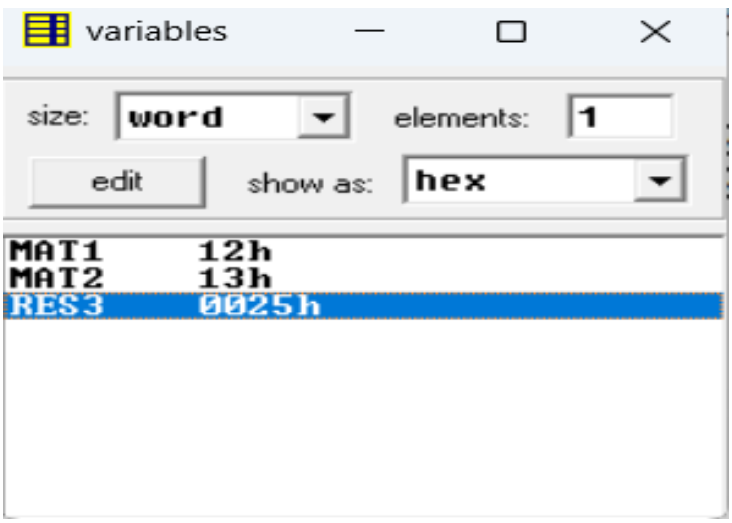
A) ADDITION OF ARRAYS

```
.model small
.data
mat1 db 12h, 11h, 12h, 10h, 11h, 12h, 10h, 11h, 12h
mat2 db 13h, 02h, 02h, 02h, 02h, 02h, 02h, 02h, 02h
res3 dw 9 dup(?)
.code


     mov   ax, @data
     mov   ds, ax


     mov   cx, 09h


     mov   di, offset mat1


     mov   bx, offset mat2


     mov   si, offset res3


back :   mov   ah, 0


     mov   al, [di]


     add   al, [bx]
```

```
     adc   ah, 00

     mov   [si], ax

     inc   di

     inc   bx

     inc   si
     inc   si

     loop   back
     mov   si, offset res3
     mov   dh, 9

l10:    mov   ch, 04h

     mov   cl, 04h

     mov   bx, [si]

l2:    rol   bx, cl

     mov   dl, bl

     and   dl, 0fh

     cmp   dl, 09
     jbe   l4

     add   dl, 07
l4:    add   dl, 30h

     mov   ah, 02
     int   21h

     dec   ch
     jnz   l2
```

```
    mov   dl, ' '    ;ye space h
    int   21h


    inc   si
    inc   si


    dec   dh
    jnz   l10


    mov   ah, 4ch
    int   21h
  end
```

OUTPUT



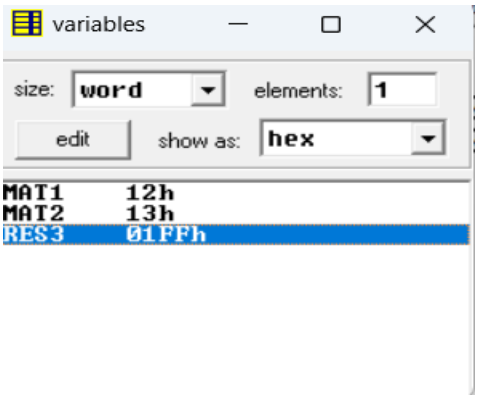
B)SUBTRACTION OF ARRAYS

```
.model small
.data
mat1 db 12h, 11h, 12h, 10h, 11h, 12h, 10h, 11h, 12h
mat2 db 13h, 02h, 02h, 02h, 02h, 02h, 02h, 02h, 02h
res3 dw 9 dup(?)
.code


    mov   ax, @data
    mov   ds, ax
```

```
     mov   cx, 09h

     mov   di, offset mat1

     mov   bx, offset mat2

     mov   si, offset res3

back :   mov   ah, 0

     mov   al, [di]

     sub   al, [bx]

     adc   ah, 00

     mov   [si], ax

     inc   di

     inc   bx

     inc   si
     inc   si

     loop   back
     mov   si, offset res3
     mov   dh, 9

l10:    mov   ch, 04h

     mov   cl, 04h

     mov   bx, [si]
```

```
l2:    rol   bx, cl

     mov   dl, bl

     and   dl, 0fh

     cmp   dl, 09
     jbe   l4

     add   dl, 07
l4:    add   dl, 30h

     mov   ah, 02
     int   21h

     dec   ch
     jnz   l2

     mov   dl, ' '    ;ye space h
     int   21h

     inc   si
     inc   si

     dec   dh
     jnz   l10

     mov   ah, 4ch
     int   21h
   end
```

OUTPUT

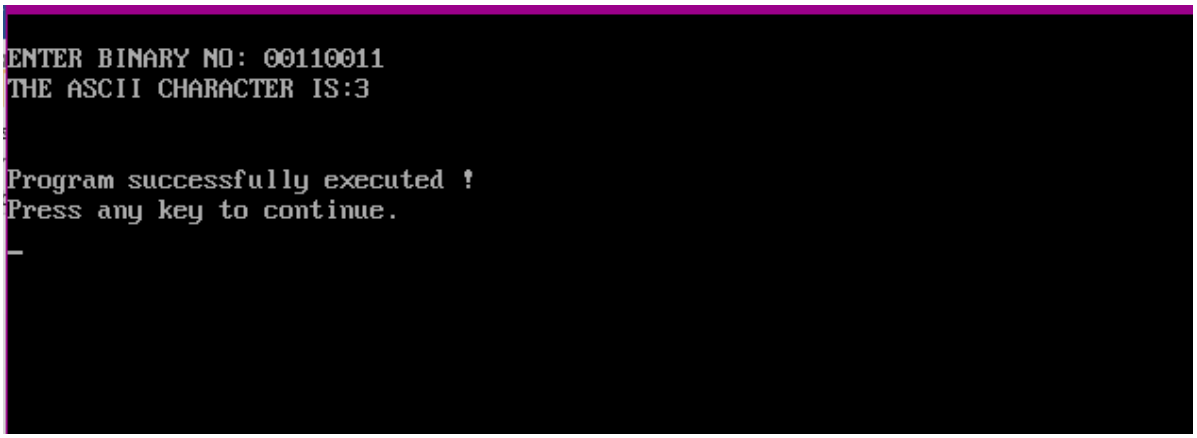


5) Write a program for binary to ascii conversion

```
.MODEL SMALL

.DATA

INPUT DB 10,13 , 'ENTER BINARY NO: $'

OUTPUT DB 10,13, 'THE ASCII CHARACTER IS:$'

ARR DB ?

.CODE

.STARTUP

MOV AH,09H

MOV DX,OFFSET INPUT

INT 21H


MOV BL, 00H

MOV CL,08H

INPUT1: MOV AH,01H

INT 21H

SUB AL,30H

SHL BL,1

ADD BL,AL

LOOP INPUT1
```

```
MOV AH,09H
LEA DX,OUTPUT
INT 21H
MOV AH,02H
MOV DL,BL
INT 21H


MOV AH,4CH
INT 21H
END
```

OUTPUT



6) Write a program for ascii to binary conversion

```
.model small
.data
MESS0 DB 10,13,"ENTER THE NUMBER:$"

 ORG 1000H
 MOV SI,1100H
```

```
 MOV DI,1400H
 CLD
 MOV BL,20H

NEXT:LODSB
    CMP AL,BL
    JE EXIT
    SUB AL,30H
    CMP AL,0AH
    JC STORE
    SUB AL,07H
STORE:STOSB
    JMP NEXT
EXIT:HLT
```

OUTPUT