COMPUTER ORGANIZATION AND ARCHITECTURE

1. (a) Write a program in assembly language to find L.C.M of two single-digit numbers.

CODE:

```
.model small
.stack 100h
.data
    num1 db 8          ; First number (single byte)
    num2 db 4          ; Second number (single byte)
    gcd_res db 0       ; To store GCD result (single byte)
    lcm_res dw 0       ; To store LCM result (two bytes for larger result)
    msg db 'LCM is: $' ; Message to display before the result
.code
main:
    mov ax, @data
    mov ds, ax         ; Initialize data segment
    ; Load num1 and num2 into AL and BL for GCD calculation
    mov al, num1
    mov bl, num2
    call gcd           ; Calculate GCD of num1 and num2
    mov gcd_res, al    ; Store GCD in gcd_res
    ; Calculate LCM using (num1 * num2) / GCD
    mov al, num1       ; Load num1 into AL
    mov ah, 0          ; Clear AH for 16-bit multiplication
    mov dl, num2       ; Load num2 into DL
    mul dl             ; AX = num1 * num2 (result in AX)
    ; Divide AX by the GCD (stored in gcd_res)
```

```
    mov cl, gcd_res    ; Load GCD into CL
    div cl             ; AX = (num1 * num2) / GCD
    ; Store the result in lcm_res
    mov lcm_res, ax
    ; Display "LCM is: "
    mov ah, 09h        ; DOS interrupt to display string
    lea dx, msg        ; Load the address of the message into DX
    int 21h
    ; Display the LCM result (convert to ASCII and print)
    mov ax, lcm_res    ; Load LCM result into AX
    call print_num     ; Call function to print number
    ; End the program
    mov ah, 4Ch
    int 21h
; Function to calculate GCD using the Euclidean algorithm
gcd proc
    cmp bl, 0
    je end_gcd         ; If BL = 0, GCD is in AL
gcd_loop:
    mov ah, 0
    div bl             ; Divide AL by BL, remainder in AH
    mov al, bl         ; Move BL to AL (new A)
    mov bl, ah         ; Move remainder to BL (new B)
    cmp bl, 0
    jne gcd_loop       ; Repeat until remainder (B) = 0
end_gcd:
    ret                ; Final GCD is in AL
```

```
gcd endp

; Function to print a number in AX
print_num proc
    ; Divide the number by 10 and print each digit
    mov cx, 0          ; Clear CX (will store digits)
    mov bx, 10         ; Divisor for base-10
convert_loop:
    xor dx, dx         ; Clear DX before division
    div bx             ; AX / 10, quotient in AX, remainder in DX
    push dx            ; Save remainder (digit) on the stack
    inc cx             ; Increment digit count
    cmp ax, 0
    jne convert_loop   ; Repeat until the quotient is 0
print_digits:
    pop dx             ; Get digit from stack
    add dl, '0'        ; Convert digit to ASCII
    mov ah, 02h        ; DOS interrupt to print character
    int 21h
    loop print_digits  ; Repeat for all digits
    ret
print_num endp
end main
```

OUTPUT:

(b) Write an assembly language program to display the nth term of a fibonacci series. “n” must be a single digit number which may be taken from the user.

CODE:

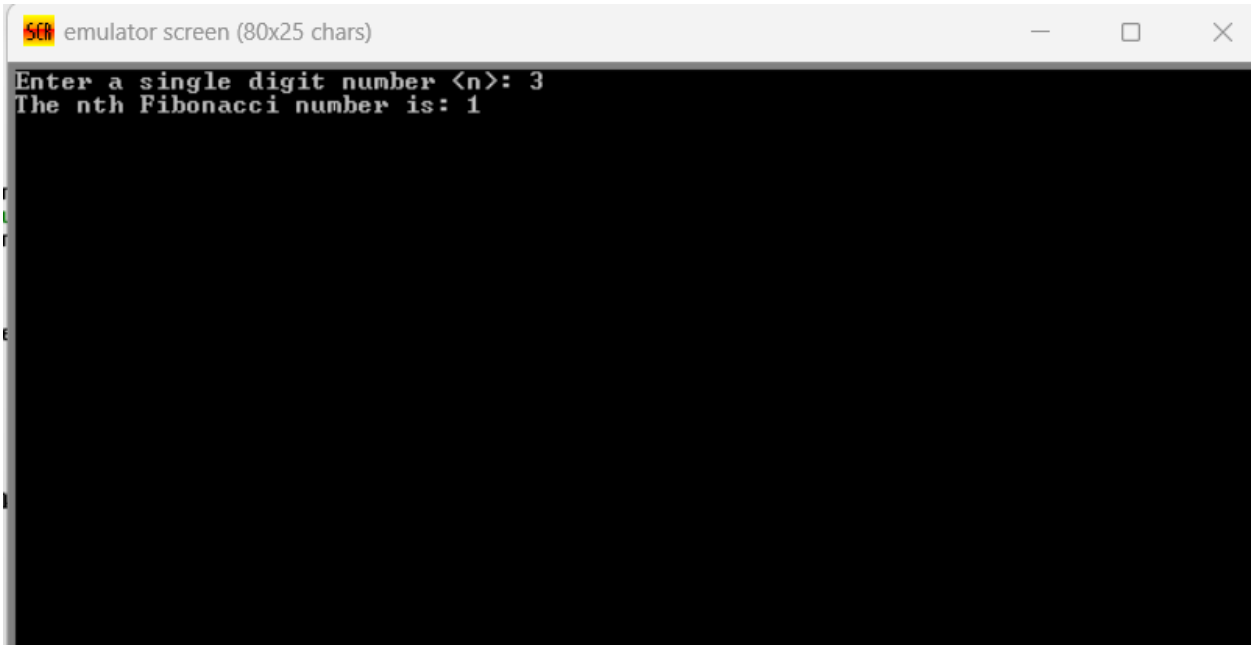
```
.model small

.stack 100h

.data

    prompt db 'Enter a single digit number <n>: $'

    result_msg db 0Dh,0Ah,'The nth Fibonacci number is: $'

    fib dw 0        ; Store the nth Fibonacci number in a word (16 bits)

.code

main proc

    ; Initialize data segment

    mov ax, @data

    mov ds, ax

    ; Prompt the user for input
```

```
    mov ah, 09h
    lea dx, prompt
    int 21h
    ; Read a single character input
    mov ah, 01h
    int 21h
    sub al, '0'    ; Convert ASCII to integer
    mov cl, al     ; Store n in cl
    ; Check for n = 0 or n = 1 directly
    cmp cl, 1
    jbe single_digit_fib
    ; For n > 1, calculate Fibonacci using loop
    ; Initialize Fibonacci values
    mov ax, 0      ; First Fibonacci number (16-bit for larger values)
    mov bx, 1      ; Second Fibonacci number (16-bit)
fib_loop:
    dec cl         ; Decrease count
    jz store_result ; If count reaches zero, store result
    ; Calculate next Fibonacci number
    add ax, bx     ; F_n = F_(n-1) + F_(n-2)
    xchg ax, bx    ; Move F_(n-1) to F_(n-2) and update F_(n-1)
    jmp fib_loop   ; Repeat loop until cl = 0
store_result:
    mov fib, ax    ; Store the result in fib
single_digit_fib:
    ; For n = 0 or 1, bx already contains the correct Fibonacci number
    cmp cl, 0
```

```
    je show_fib0
    mov fib, bx    ; For n=1, F_1 is 1
    jmp display_result
show_fib0:
    mov fib, ax    ; For n=0, F_0 is 0
display_result:
    ; Display result message
    mov ah, 09h
    lea dx, result_msg
    int 21h
    ; Convert the result in fib to ASCII and display
    mov ax, fib        ; Load result into ax
    call print_number  ; Call subroutine to print the number
    ; Exit program
    mov ah, 4Ch
    int 21h
main endp
; Subroutine to print a number in AX as ASCII
print_number proc
    ; Divide ax by 10 repeatedly to extract each digit in reverse
    mov cx, 10        ; Set base to 10
    mov bx, 0         ; Initialize bx as digit storage
reverse_digits:
    xor dx, dx        ; Clear dx for division
    div cx            ; AX / 10, quotient in AX, remainder in DX
    push dx           ; Push remainder onto stack (digit)
    inc bx            ; Count digits
```

```
    test ax, ax       ; Check if quotient is 0
    jnz reverse_digits
display_digits:
    pop dx            ; Get last pushed digit
    add dl, '0'       ; Convert to ASCII
    mov ah, 02h       ; DOS print character function
    int 21h           ; Display character
    dec bx            ; Decrement digit count
    jnz display_digits
    ret
print_number endp
end main
```

OUTPUT:



2. Write an assembly language program to find the factorial of a given single-digit number.

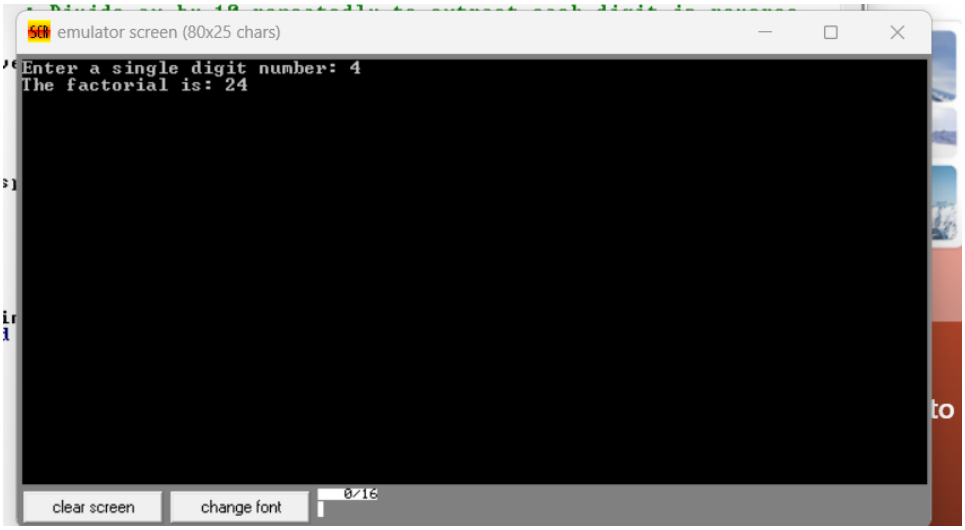
CODE:

```
.model small
.stack 100h
.data
    prompt db 'Enter a single digit number: $'
    result_msg db 0Dh,0Ah,'The factorial is: $'
    factorial dw 1    ; 16-bit variable to store factorial result
.code
main proc
    ; Initialize data segment
    mov ax, @data
    mov ds, ax
    ; Display prompt to enter a number
    mov ah, 09h
    lea dx, prompt
    int 21h
    ; Read a single character input
    mov ah, 01h
    int 21h
    sub al, '0'        ; Convert ASCII to integer
    mov bl, al         ; Store the number in BL for calculation
    ; Special case for 0! which is 1
    cmp bl, 0
    jne calculate_factorial
    mov factorial, 1
    jmp display_result
calculate_factorial:
    mov cx, bx         ; Set loop counter to the number entered (n)
```

```
    mov ax, 1          ; AX will store the ongoing factorial result
factorial_loop:
    mul cx             ; AX = AX * CX (calculate factorial)
    loop factorial_loop ; Decrement CX and repeat until CX = 0
    mov factorial, ax  ; Store final factorial result in 'factorial'
display_result:
    ; Display result message
    mov ah, 09h
    lea dx, result_msg
    int 21h
    ; Convert the result in factorial to ASCII and display
    mov ax, factorial  ; Load factorial result into AX
    call print_number  ; Call subroutine to print the number
    ; Exit program
    mov ah, 4Ch
    int 21h
main endp
; Subroutine to print a number in AX as ASCII
print_number proc
    ; Divide ax by 10 repeatedly to extract each digit in reverse
    mov cx, 10         ; Set base to 10
    mov bx, 0          ; Initialize bx as digit storage
reverse_digits:
    xor dx, dx         ; Clear dx for division
    div cx             ; AX / 10, quotient in AX, remainder in DX
    push dx            ; Push remainder onto stack (digit)
    inc bx             ; Count digits
```

```
    test ax, ax       ; Check if quotient is 0
    jnz reverse_digits
display_digits:
    pop dx            ; Get last pushed digit
    add dl, '0'       ; Convert to ASCII
    mov ah, 02h       ; DOS print character function
    int 21h           ; Display character
    dec bx            ; Decrement digit count
    jnz display_digits
    ret
print_number endp
end main
```

OUTPUT:



GITHUB: https://github.com/vishnupriyavavyya/COA-LAB-TASK-11