



# National University of Computer and Emerging Sciences

## COAL Lab Midterm

### Computer Organization and Assembly Language

Time Allowed	90 Minutes	Student Name	
Maximum Marks	100	Roll Number	
Lab Instructors		Date	26/

Before you start make sure:

1. Fill word Format on GCR & submit PDF [Only PDF formats accepted]
2. PLAGIARISM WILL BE MARKED ZERO WITH NO RETAKE

#### Activity 1:

[20 Marks]

Initialize a memory array with last 4 digits of **Your Own Roll Number** (for example, if your roll number is **16L-4195** then memory array should be initialized with **{4,1,9,5}**). Then write a subroutine **LoadMN** which stores the matrices **M** and **N** using the values as described in the Code section below:

#### Activity 2:

[50 Marks]

Use the subroutine from **Activity 1**, to initialize matrices **M** and **N**.

#### Theory:

If **M** and **N** are two matrices of order  $2 \times 2$  as shown below

$$M = \begin{bmatrix} a & b \\ c & d \end{bmatrix}$$
$$N = \begin{bmatrix} d & c \\ b & a \end{bmatrix}$$

**Convolution** of two matrices can be calculated by padding first matrix and scrolling the second matrix on it across the rows and columns of **A** and performing dot product:

$$O = MN = \begin{bmatrix} 0 & 0 & 0 & 0 \\ 0 & a & b & 0 \\ 0 & c & d & 0 \\ 0 & 0 & 0 & 0 \end{bmatrix} \odot \begin{bmatrix} d & c \\ b & a \end{bmatrix} = \begin{bmatrix} a^2 & 2ab & b^2 \\ 2ac & 2(ad+bc) & 2bd \\ c^2 & 2cd & d^2 \end{bmatrix}$$

As shown above, convolution of **M** and **N** is the matrix **O**.

Write a subroutine, **MatConv**, which performs  $2 \times 2$  matrix **convolution** using the values of **M** and **N** initialized in the **Activity 1**.

### Activity 3:

[30 Marks]

Make a subroutine for printing the output matrix from Activity 2 on the console as shown below

DOSBox 0.74 Cpu speed: 3000 cycles, Frameskip 0, Program: DOSBOX

The result of Matrix Convolution is:

$$O = \begin{bmatrix} 0 & 1 & 2 \\ 4 & 11 & 4 \\ 0 & 2 & 5 \end{bmatrix}$$

Code:

Your final program structure should look like:

```
[org 0x100]
roll: db 4,1,9,5      ; Change to last 4 digits of your roll number
a: db 0               ; store roll
b: db 0               ; store roll+1
c: db 0               ; store roll+2
d: db 0               ; store roll+3
; rows of M matrix of order 4X4
Mr1: db 0, 0, 0, 0
Mr2: db 0, 0, 0, 0    ; store 0, a, b, 0
Mr3: db 0, 0, 0, 0    ; store 0, c, d, 0
Mr4: db 0, 0, 0, 0
; rows of N matrix of order 2X2
Nr1: db 0, 0           ; store d, c
Nr2: db 0, 0           ; store b, a
; rows of O matrix of order 3X3
Or1: dw 0, 0, 0
Or2: dw 0, 0, 0
Or3: dw 0, 0, 0
LoadMN:
; Write code for LoadMN
MatConv:
; Write code for Matrix Convolution
PrintMat:
; Write code for Printing Matrix
start:
; Write Calls to the subroutines & other codes here

mov ax, 0x4c00
int 0x21
```