

## Assignment 3 Solution

### Programming questions (16 marks total):

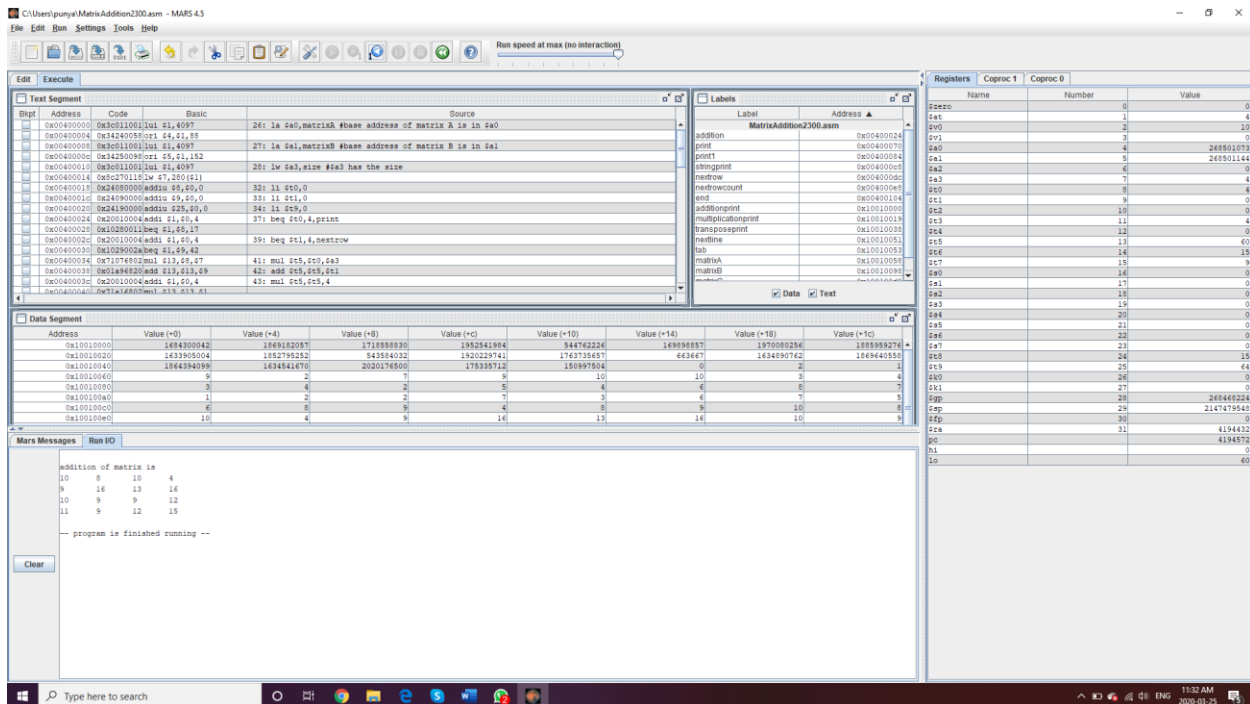
#### Question 3: 2D array Programming (12 marks):

There are 2 matrices

A =  $\begin{bmatrix} 2 & 1 & 9 & 2 \\ 7 & 9 & 10 & 10 \\ 3 & 4 & 3 & 4 \\ 2 & 5 & 4 & 6 \end{bmatrix}$

B =  $\begin{bmatrix} 8 & 7 & 1 & 2 \\ 2 & 7 & 3 & 6 \\ 7 & 5 & 6 & 8 \\ 9 & 4 & 8 & 9 \end{bmatrix}$

The addition of these two matrices are printed correctly :



The multiplication of these two matrices are printed correctly:

The screenshot shows the Mars 4.5 IDE with the assembly file `MatrixMultiplication2300.asm` open. The code defines two matrices, A and B, and calculates their product. The output window shows the result of the multiplication.

```
1 .data
2 multiplicationprint: .ascii "multiplication of matrix is \n"
3 zero: .zero 1
4 tab: .ascii "\t"
5
6 matrixA: .word 2,1,9,2
7           .word 7,5,10,10
8           .word 3,6,3,4
9           .word 2,5,4,6
10
11 matrixB: .word 8,7,1,2
12           .word 2,7,3,6
13           .word 7,5,6,8
14           .word 9,4,8,9
15 matrixC: .word 0:4
16           .word 0:4
17           .word 0:4
18           .word 0:4
19
20 size: .word 4
21 .eqv DATA_SIZE 4 #defining constant - since integers, thus data size is 4
22
23 .text
24 la $a0, matrixA #base address of matrix A is in $a0
25 la $a1, matrixB #base address of matrix B is in $a1
26 lw $a3, size #size has the size
27
28
29
30
```

Output:

```
multiplication of matrix is
99 74 75 100
234 202 176 235
89 80 65 90
100 93 89 120
-- program is finished running --
```

The transpose of the matrix A and B are printed correctly:

The screenshot shows the Mars 4.5 IDE with the assembly file `MatrixTranspose2300.asm` open. The code defines two matrices, A and B, and calculates their transposes. The output window shows the result of the transposition.

```
1 .data
2 transposeprint: .ascii "transpose of matrix is \n"
3 zero: .zero 1
4 tab: .ascii "\t"
5
6 matrixA: .word 2,1,9,2
7           .word 7,5,10,10
8           .word 3,6,3,4
9           .word 2,5,4,6
10
11 matrixB: .word 8,7,1,2
12           .word 2,7,3,6
13           .word 7,5,6,8
14           .word 9,4,8,9
15 matrixC: .word 0:4
16           .word 0:4
17           .word 0:4
18           .word 0:4
19
20 size: .word 4
21 .eqv DATA_SIZE 4 #defining constant - since integers, thus data size is 4
22
23 .text
24 la $a0, matrixA #base address of matrix A is in $a0
25 la $a1, matrixB #base address of matrix B is in $a1
26 lw $a3, size #size has the size
27
28
29
30
```

Output:

```
transpose of matrix is
2 7 3 2
1 9 4 8
9 10 3 4
2 10 4 6
-- program is finished running --

transpose of matrix is
8 2 7 9
7 7 5 4
1 3 6 8
2 6 8 9
-- program is finished running --
```

## Question 4: Floating point Programming (4 marks)

The screenshot shows the MARS MIPS simulator interface. The assembly code in the editor is as follows:

```
1 .data
2 float0: float 0.00
3 float1: float 0.01
4 float2: float 0.02
5 float3: float 0.03
6
7 floatadd: .word 0x00000000
8 secondadd: .word 0x00000000
9 error: .word 0x00000000
10
11 .text
12 lw $t0, float0
13 lw $t1, float1
14 lw $t2, float2
15 lw $t3, float3
16
17 add $t4, $t2, $t3
18 add $t5, $t1, $t4
19 add $t6, $t0, $t5
20
21 li $v0, 4
22 la $a0, floatadd
23 syscall
24 li $v0, 2
25 syscall
26
27 li $v0, 4
28 la $a0, secondadd
29 syscall
30
31 li $v0, 4
32 la $a0, error
33 syscall
```

The Registers window shows the following values:

Register	Value
\$zero	0
\$at	26850992
\$v0	2
\$v1	0
\$a0	268501032
\$a1	0
\$a2	0
\$a3	0
\$a4	0
\$a5	0
\$a6	0
\$a7	0
\$t0	0
\$t1	0
\$t2	0
\$t3	0
\$t4	0
\$t5	0
\$t6	0
\$t7	0
\$s0	0
\$s1	0
\$s2	0
\$s3	0
\$s4	0
\$s5	0
\$s6	0
\$s7	0
\$s8	0
\$s9	0
\$t8	0
\$t9	0
\$d0	0
\$d1	0
\$d2	0
\$d3	0
\$d4	0
\$d5	0
\$d6	0
\$d7	0
\$d8	0
\$d9	0
\$d10	0
\$d11	0
\$d12	0
\$d13	0
\$d14	0
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\$d23	0
\$d24	0
\$d25	0
\$d26	0
\$d27	0
\$d28	0
\$d29	0
\$d30	0
\$d31	0
\$f0	0
\$f1	0
\$f2	0
\$f3	0
\$f4	0
\$f5	0
\$f6	0
\$f7	0
\$f8	0
\$f9	0
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