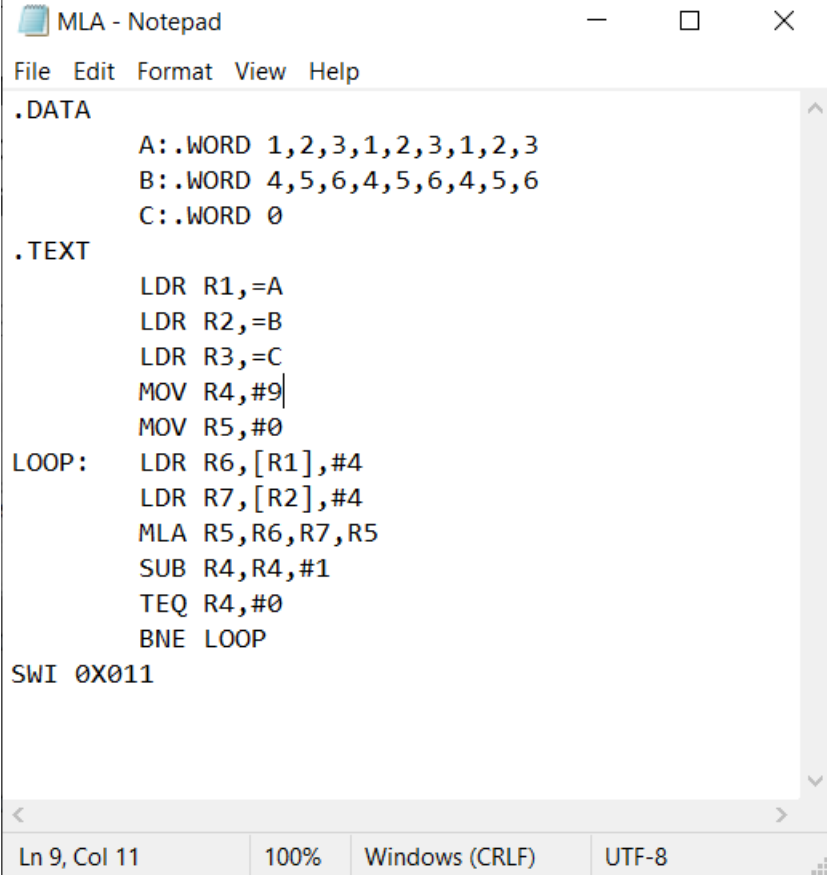




Department of Computer Science & Engineering
Microprocessor & Computer Architecture
MPCA-Laboratory/Assignment/Hands-on/Project
UE20CS252

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Sl. No	Programs
Week No.5	<p>Student exercises:</p> <p>1. Write a program in ARM7TDMI-ISA to multiply 2 matrices of order 3. i.e., implement $c[i][j] = c[i][j] + a[i][j] \times b[i][j]$.</p> <p>a. Use MLA instruction</p>  <pre>.DATA A: .WORD 1,2,3,1,2,3,1,2,3 B: .WORD 4,5,6,4,5,6,4,5,6 C: .WORD 0 .TEXT LDR R1,=A LDR R2,=B LDR R3,=C MOV R4,#9 MOV R5,#0 LOOP: LDR R6,[R1],#4 LDR R7,[R2],#4 MLA R5,R6,R7,R5 SUB R4,R4,#1 TEQ R4,#0 BNE LOOP SWI 0x011</pre>

ARMSim# - The ARM Simulator Dept. of Computer Science

File View Cache Debug Watch Help

RegistersView CodeView

General Purpose Floating Point

Hexadecimal
Unsigned Decimal
Signed Decimal

R0 : 0
R1 : 4192
R2 : 4228
R3 : 4228
R4 : 0
R5 : 96
R6 : 3
R7 : 6
R8 : 0
R9 : 0
R10 (s1) : 0
R11 (fp) : 0
R12 (ip) : 0
R13 (sp) : 70656
R14 (lr) : 0
R15 (pc) : 4136

CPSR Register
Negative (N) : 0
Zero (Z) : 1
Carry (C) : 0
Overflow (V) : 0
IRQ Disable : 1
FIQ Disable : 1
Thumb (T) : 0
CPU Mode : System

0x400000df

MUL.o

```

.DATA
0000103C:00000001      A: .WORD 1,2,3,1,2,3,1,2,3
:00000002
:00000003
:00000001
:00000002
00001060:00000004      B: .WORD 4,5,6,4,5,6,4,5,6
:00000005
:00000006
:00000004
:00000005
00001084:00000000      C: .WORD 0
.TEXT
00001000:E59F1028      LDR R1,=A
00001004:E59F2028      LDR R2,=B
00001008:E59F3028      LDR R3,=C
0000100C:E3A04009      MOV R4,#9
00001010:E3A05000      MOV R5,#0
00001014:E4916004      LOOP: LDR R6,[R1],#4
00001018:E4927004      LDR R7,[R2],#4
0000101C:E0255796      MLA R5,R6,R7,R5
00001020:E2444001      SUB R4,R4,#1
00001024:E3340000      TEQ R4,#0
00001028:1AFFFFF9      BNE LOOP
0000102C:EF000011      SWI 0X011...
:00000000
:00000024
:00000048

```

b. Use MUL instruction

MUL - Notepad

File Edit Format View Help

```

.DATA
    A: .WORD 1,2,3,1,2,3,1,2,3
    B: .WORD 4,5,6,4,5,6,4,5,6
    C: .WORD 0

.TEXT
    LDR R1,=A
    LDR R2,=B
    LDR R3,=C
    MOV R4,#9
    MOV R5,#0
LOOP:  LDR R6,[R1],#4
        LDR R7,[R2],#4
        MUL R8,R6,R7
        ADD R5,R5,R8
        SUB R4,R4,#1
        TEQ R4,#0
        BNE LOOP
SWI 0X011

```

100%

Windows (CRLF)

UTF-8

ARMSim# - The ARM Simulator Dept. of Computer Science

File View Cache Debug Watch Help

RegistersView

General Purpose Floating Point

Hexadecimal

Unsigned Decimal

Signed Decimal

R0 : 0

R1 : 0

R2 : 4232

R3 : 4232

R4 : 0

R5 : 96

R6 : 3

R7 : 6

R8 : 18

R9 : 0

R10 (s1) : 0

R11 (fp) : 0

R12 (ip) : 0

R13 (sp) : 70656

R14 (lr) : 0

R15 (pc) : 70656

CPSR Register

Negative (N) : 0

Zero (Z) : 1

Carry (C) : 0

Overflow (V) : 0

IRQ Disable : 1

FIQ Disable : 1

Thumb (T) : 0

CPU Mode : System

0x400000df

CodeView

MUL.o

```

00001040:00000001      .DATA      A: .WORD 1,2,3,1,2,3,1,2,3
:00000002
:00000003
:00000001
:00000002
00001064:00000004      B: .WORD 4,5,6,4,5,6,4,5,6
:00000005
:00000006
:00000004
:00000005
00001088:00000000      C: .WORD 0

00001000:E59F102C      .TEXT      LDR R1,=A
00001004:E59F202C      LDR R2,=B
00001008:E59F302C      LDR R3,=C
0000100C:E3A04009      MOV R4,#9
00001010:E3A05000      MOV R5,#0
00001014:E4916004      LOOP:     LDR R6,[R1],#4
00001018:E4927004      LDR R7,[R2],#4
0000101C:E080796      MUL R8,R6,R7
00001020:E0855008      ADD R5,R5,R8
00001024:E2444001      SUB R4,R4,#1
00001028:E3340000      TEQ R4,#0
0000102C:1AFFFF8      BNE LOOP
00001030:EF000011      SWI 0X011...
:00000000
:00000024
:00000048

```

- Write a program in ARM7TDMI-ISA to find the NORM of a square matrix of order n.

```
*norm - Notepad
File Edit Format View Help
.DATA
    A: .WORD 1,2,3,4,5,6,7,8,9
    SUM: .WORD

.TEXT

    LDR R0,=A
    LDR R9,=SUM
    MOV R1,#0
    MOV R2,#0
    MOV R3,#3
    MOV R4,#0
    MOV R8,#0

LOOP:
    MLA R5,R3,R1,R2
    MOV R5,R5,LSL #2
    LDR R6,[R0,R5]
    ADD R4,R4,R6
    ADD R2,R2,#1
    CMP R2,#3
    BNE LOOP
    CMP R4,R8
    MOVGT R8,R4
    ADD R1,R1,#1
    MOV R2,#0
    MOV R4,#0
    CMP R1,#3
    BNE LOOP
    STR R8,[R9]
```

ARMSim# - The ARM Simulator Dept. of Computer Science

File View Cache Debug Watch Help

RegistersView Floating Point

General Purpose	Floating Point
Hexadecimal	
Unsigned Decimal	
Signed Decimal	

R0 : 0
R1 : 0
R2 : 0
R3 : 3
R4 : 0
R5 : 32
R6 : 9
R7 : 0
R8 : 24
R9 : 4228
R10 (s1) : 0
R11 (fp) : 0
R12 (ip) : 0
R13 (sp) : 70656
R14 (lr) : 0
R15 (pc) : 70656

CPSR Register
Negative (N) : 0
Zero (Z) : 1
Carry (C) : 1
Overflow (V) : 0
IRQ Disable : 1
FIQ Disable : 1
Thumb (T) : 0
CPU Mode : System
0x600000df

CodeView

norm.o

```
.DATA
00001060:00000001 A: .WORD 1,2,3,4,5,6,7,8,9
:00000002
:00000003
:00000004
:00000005 SUM: .WORD

.TEXT

00001000:E59F0050 LDR R0,=A
00001004:E59F9050 LDR R9,=SUM
00001008:E3A01000 MOV R1,#0
0000100C:E3A02000 MOV R2,#0
00001010:E3A03003 MOV R3,#3
00001014:E3A04000 MOV R4,#0
00001018:E3A08000 MOV R8,#0

LOOP:
0000101C:E0252193 MLA R5,R3,R1,R2
00001020:E1A05105 MOV R5,R5,LSL #2
00001024:E7906005 LDR R6,[R0,R5]
00001028:E0844006 ADD R4,R4,R6
0000102C:E2822001 ADD R2,R2,#1
00001030:E3520003 CMP R2,#3
00001034:1AFFFFF8 BNE LOOP
00001038:E1540008 CMP R4,R8
0000103C:C1A08004 MOVGT R8,R4
00001040:E2811001 ADD R1,R1,#1
00001044:E3A02000 MOV R2,#0
00001048:E3A04000 MOV R4,#0
0000104C:E3510003 CMP R1,#3
00001050:1AFFFFF1 BNE LOOP
00001054:E5898000 STR R8,[R9]

00001058:00000000
```

3. Write a program in ARM7TDMI-ISA to find the ROWSUM of a matrix.

rowsum - Notepad

File Edit Format View Help

```
MOV R1,#0
```

```
MOV R2,#0
```

```
MOV R3,#3
```

```
MOV R4,#0
```

LOOP:

```
MLA R5,R3,R1,R2
```

```
MOV R5,R5,LSL #2
```

```
LDR R6,[R0,R5]
```

```
ADD R4,R4,R6
```

```
ADD R2,R2,#1
```

```
CMP R2,#3
```

```
BNE LOOP
```

```
STR R4,[R9],#4
```

```
ADD R1,R1,#1
```

```
MOV R2,#0
```

```
MOV R4,#0
```

```
CMP R1,#3
```

```
BNE LOOP
```

Ln 14, Col 2 100% Windows (

ARMSim# - The ARM Simulator Dept. of Computer Science

File View Cache Debug Watch Help

RegistersView CodeView

General Purpose Floating Point

Hexadecimal
Unsigned Decimal
Signed Decimal

R0 : 0
R1 : 0
R2 : 0
R3 : 3
R4 : 0
R5 : 32
R6 : 9
R7 : 0
R8 : 0
R9 : 4228
R10 (s1): 0
R11 (fp): 0
R12 (ip): 0
R13 (sp): 70656
R14 (lr): 0
R15 (pc): 70656

CPSR Register
Negative (N): 0
Zero (Z): 1
Carry (C): 1
Overflow (V): 0
IRQ Disable: 1
FIQ Disable: 1
Thumb (T): 0
CPU Mode : System

0x600000df

rowsum.o

.DATA
00001054:00000001 A: .WORD 1,2,3,4,5,6,7,8,9
:00000002
:00000003
:00000004
:00000005
00001078:00000000 SUM: .WORD 0,0,0
:00000000
:00000000

.TEXT
00001000:E59F0044 LDR R0,=A
00001004:E59F9044 LDR R9,=SUM
00001008:E3A01000 MOV R1,#0
0000100C:E3A02000 MOV R2,#0
00001010:E3A03003 MOV R3,#3
00001014:E3A04000 MOV R4,#0

LOOP:
00001018:E0252193 MLA R5,R3,R1,R2
0000101C:E1A05105 MOV R5,R5,LSL #2
00001020:E7906005 LDR R6,[R0,R5]
00001024:E0844006 ADD R4,R4,R6
00001028:E2822001 ADD R2,R2,#1
0000102C:E3520003 CMP R2,#3
00001030:1AFFFFF8 BNE LOOP
00001034:E4894004 STR R4,[R9],#4
00001038:E2811001 ADD R1,R1,#1
0000103C:E3A02000 MOV R2,#0
00001040:E3A04000 MOV R4,#0
00001044:E3510003 CMP R1,#3
00001048:1AFFFFF2 BNE LOOP

OutputView
Console stdin/stdout/stderr