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MPCA-Lab Week-5

Task 1: Multiply 2 matrices of order 3

Code:

```
.DATA
    A: .WORD 9,8,7,6,5,4,3,2,1
    B: .WORD 1,2,3,4,5,6,7,8,9
    C: .WORD 0,0,0,0,0,0,0,0,0
```

.TEXT

```
LDR R0,=A
LDR R1,=B
LDR R2,=C
MOV R3,#0
MOV R4,#0
MOV R10,#3
MOV R8,#0
```

LOOP1:

```
    MLA R11,R3,R10,R8
    MOV R11,R11,LSL #2
    LDR R5,[R0,R11]
    MLA R12,R8,R10,R4
    MOV R12,R12,LSL #2
    LDR R6,[R1,R12]
    MUL R11,R5,R6
    ADD R9,R9,R11
    ADD R8,R8,#1
    CMP R8,#3
    BNE LOOP1
    MLA R12,R3,R10,R4
    MOV R12,R12,LSL #2
    STR R9,[R2,R12]
    MOV R8,#0
    MOV R9,#0
    ADD R4,R4,#1
    CMP R4,#3
    BNE LOOP1
    MOV R4,#0
    ADD R3,R3,#1
    CMP R3,#3
    BNE LOOP1
    SWI 0X011
```

.END

The screenshot shows a debugger interface with two main windows: RegistersView and CodeView.

RegistersView: This window displays the state of the ARM registers. The 'General Purpose' tab is selected, showing registers R0 through R15. The values are as follows:

Register	Value
R0	4232
R1	4268
R2	4304
R3	0
R4	1
R5	8
R6	5
R7	0
R8	1
R9	18
R10 (s1)	3
R11 (fp)	40
R12 (ip)	16
R13 (sp)	70656
R14 (lr)	0
R15 (pc)	4152

Below the registers, the CPSR Register is shown with the following values:

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

The CPU Mode is set to System, and the memory address 0x800000df is displayed.

CodeView: This window shows the assembly code being executed. The current instruction is highlighted in blue. The code includes data definitions for matrices A, B, and C, and a loop for multiplying them.

```
000010AC:00000001      B: .WORD 1,2,3,4,5,6,7,8,9
:00000002
:00000003
:00000004
:00000005
000010D0:00000000      C: .WORD 0,0,0,0,0,0,0,0,0
:00000000
:00000000
:00000000
:00000000

.TEXT
00001000:E59F0074      LDR R0,=A
00001004:E59F1074      LDR R1,=B
00001008:E59F2074      LDR R2,=C
0000100C:E3A03000      MOV R3,#0
00001010:E3A04000      MOV R4,#0
00001014:E3A0A003      MOV R10,#3
00001018:E3A08000      MOV R8,#0

LOOP1:
0000101C:E02B8A93      MLA R11,R3,R10,R8
00001020:E1A0B10B      MOV R11,R11,LSL #2
00001024:E790500B      LDR R5,[R0,R11]
00001028:E02C4A98      MLA R12,R8,R10,R4
0000102C:E1A0C10C      MOV R12,R12,LSL #2
00001030:E791600C      LDR R6,[R1,R12]
00001034:E08B0695      MUL R11,R5,R6
00001038:E089900B      ADD R9,R9,R11
0000103C:E2888001      ADD R8,R8,#1
00001040:E3580003      CMP R8,#3
00001044:1AFFFFF4      BNE LOOP1
00001048:E02C4A93      MLA R12,R3,R10,R4
0000104C:E1A0C10C      MOV R12,R12,LSL #2
00001050:E782900C      STR R9,[R2,R12]
00001054:E3A08000      MOV R8,#0
00001058:E3A09000      MOV R9,#0
0000105C:E2844001      ADD R4,R4,#1
00001060:E3540003      CMP R4,#3
00001064:1AFFFEFC      BNE LOOP1
00001068:E3A04000      MOV R4,#0
0000106C:E2833001      ADD R3,R3,#1
00001070:E3530003      CMP R3,#3
00001074:1AFFFEF8      BNE LOOP1
00001078:EF000011      SWI 0X011
0000107C:00000000      .END...
:00000024
:00000048
```

Task 2: Write a program in ARM7TDMI-ISA to find the NORM of a square matrix of order n.

Code:

```
.DATA
    A: .WORD 5,10,15,20,25,30,35,40,45
    SUMVAL: .WORD 0,0,0
.TEXT
    LDR R0,=A
    LDR R5,=SUMVAL
    MOV R1,#0
    MOV R2,#0
    MOV R7,#0
LOOP:
    CMP R7,#3
    BEQ ENDL
    LDR R6,[R0]
    ADD R1,R1,R6
    ADD R2,R2,#1
    ADD R0,R0,#4
    CMP R2,#3
    BEQ L1
    BNE LOOP
L1:
    STR R1,[R5]
    ADD R5,R5,#4
    ADD R7,R7,#1
    MOV R1,#0
    MOV R2,#0
    B LOOP
ENDL:
    SWI 0X011
```

The screenshot displays two windows from an ARM7TDMI-ISA development environment. The **RegistersView** window on the left shows the state of the processor registers. The **CodeView** window on the right shows the assembly code for the program.

RegistersView:

- General Purpose: Floating Point
- Hexadecimal
- Unsigned Decimal
- Signed Decimal
- R0: 4212
- R1: 75
- R2: 3
- R3: 0
- R4: 0
- R5: 4232
- R6: 30
- R7: 1
- R8: 0
- R9: 0
- R10 (s1): 0
- R11 (fp): 0
- R12 (ip): 0
- R13 (sp): 70656
- R14 (lr): 0
- R15 (pc): 4160
-
- 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:

week5_prg5.o

```
.DATA
0000105C:00000005      A: .WORD 5,10,15,20,25,30,35,40,45
:0000000A
:0000000F
:00000014
:00000019
00001080:00000000      SUMVAL: .WORD 0,0,0
:00000000
:00000000

.TEXT
00001000:E59F004C      LDR R0,=A
00001004:E59F504C      LDR R5,=SUMVAL
00001008:E3A01000      MOV R1,#0
0000100C:E3A02000      MOV R2,#0
00001010:E3A07000      MOV R7,#0

LOOP:
00001014:E3570003      CMP R7,#3
00001018:0A00000C      BEQ ENDL
0000101C:E5906000      LDR R6,[R0]
00001020:E0811006      ADD R1,R1,R6
00001024:E2822001      ADD R2,R2,#1
00001028:E2800004      ADD R0,R0,#4
0000102C:E3520003      CMP R2,#3
00001030:0A000000      BEQ L1
00001034:1AFFFFF6      BNE LOOP

L1:
00001038:E5851000      STR R1,[R5]
0000103C:E2855004      ADD R5,R5,#4
00001040:E2877001      ADD R7,R7,#1
00001044:E3A01000      MOV R1,#0
00001048:E3A02000      MOV R2,#0
0000104C:EAF0FFF0      B LOOP

ENDL:
00001050:EF000011      SWI 0X011...
:00000000
:00000024
```

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

Code:

```
.DATA
    A: .WORD 5,10,15,20,25,30,35,40,45
    SUMVAL: .WORD 0,0,0

.TEXT
    LDR R0,=A
    LDR R5,=SUMVAL
    MOV R1,#0
    MOV R2,#0
    MOV R7,#0
    MOV R6,R0

LOOP:
    CMP R7,#3
    BEQ ENDL
    LDR R4,[R0]
    ADD R1,R1,R4
    ADD R2,R2,#1
    ADD R0,R0,#12
    CMP R2,#3
    BEQ L1
    BNE LOOP

L1: ADD R5,R5,#4
    STR R1,[R5]
    ADD R6,R6,#4
    ADD R7,R7,#1
    MOV R1,#0
    MOV R2,#0
    MOV R0,R6
    B LOOP

L2:
    MOV R1,R0
    ADD R0,R0,#4
    B LOOP2

ENDL:
    LDR R0,=SUMVAL
    LDR R1,[R0]
    ADD R0,R0,#4
    MOV R6,#0
    LOOP2:
    CMP R6,#3
    ADD R6,R6,#1
    BEQ ENDL1
    CMP R0,R1
    BGT L2

ENDL1:
    SWI 0X011
```

RegistersView	
General Purpose	Floating Point
Hexadecimal	
Unsigned Decimal	
Signed Decimal	
R0	: 4280
R1	: 90
R2	: 3
R3	: 0
R4	: 45
R5	: 4292
R6	: 4256
R7	: 2
R8	: 0
R9	: 0
R10 (s1)	: 0
R11 (fp)	: 0
R12 (ip)	: 0
R13 (sp)	: 70656
R14 (lr)	: 0
R15 (pc)	: 4140

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

0x800000df	

CodeView	
week5_prg6.o	
.DATA	
00001098:00000005	A: .WORD 5,10,15,20,25,30,35,40,45
:0000000A	
:0000000F	
:00000014	
:00000019	
000010BC:00000000	SUMVAL: .WORD 0,0,0
:00000000	
:00000000	
.TEXT	
00001000:E59F0088	LDR R0,=A
00001004:E59F5088	LDR R5,=SUMVAL
00001008:E3A01000	MOV R1,#0
0000100C:E3A02000	MOV R2,#0
00001010:E3A07000	MOV R7,#0
00001014:E1A06000	MOV R6,R0
LOOP:	
00001018:E3570003	CMP R7,#3
0000101C:0A000011	BEQ ENDL
00001020:E5904000	LDR R4,[R0]
00001024:E0811004	ADD R1,R1,R4
00001028:E2822001	ADD R2,R2,#1
0000102C:E280000C	ADD R0,R0,#12
00001030:E3520003	CMP R2,#3
00001034:0A000000	BEQ L1
00001038:1AFFFFFFF6	BNE LOOP
L1: ADD R5,R5,#4	
0000103C:E2855004	STR R1,[R5]
00001040:E5851000	ADD R6,R6,#4
00001044:E2866004	ADD R7,R7,#1
00001048:E2877001	MOV R1,#0
0000104C:E3A01000	MOV R2,#0
00001050:E3A02000	MOV R0,R6
00001054:E1A00006	B LOOP
00001058:EAEFFFFEE	
L2:	
0000105C:E1A01000	MOV R1,R0
00001060:E2800004	ADD R0,R0,#4
00001064:EA000003	B LOOP2
ENDL:	
00001068:E59F0024	LDR R0,=SUMVAL
0000106C:E5901000	LDR R1,[R0]
00001070:E2800004	ADD R0,R0,#4
00001074:E3A06000	MOV R6,#0
LOOP2:	
00001078:E3560003	CMP R6,#3