PES UNIVERSITY

Department of Computer Science & Engineering

Microprocessor & Computer Architecture Lab

UE23CS251B

WEEK 3 submission

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UE23CS251B

1 Write an ALP using ARM7TDMI to find the remainder of a number.(ie 10/3, remainder is 1)

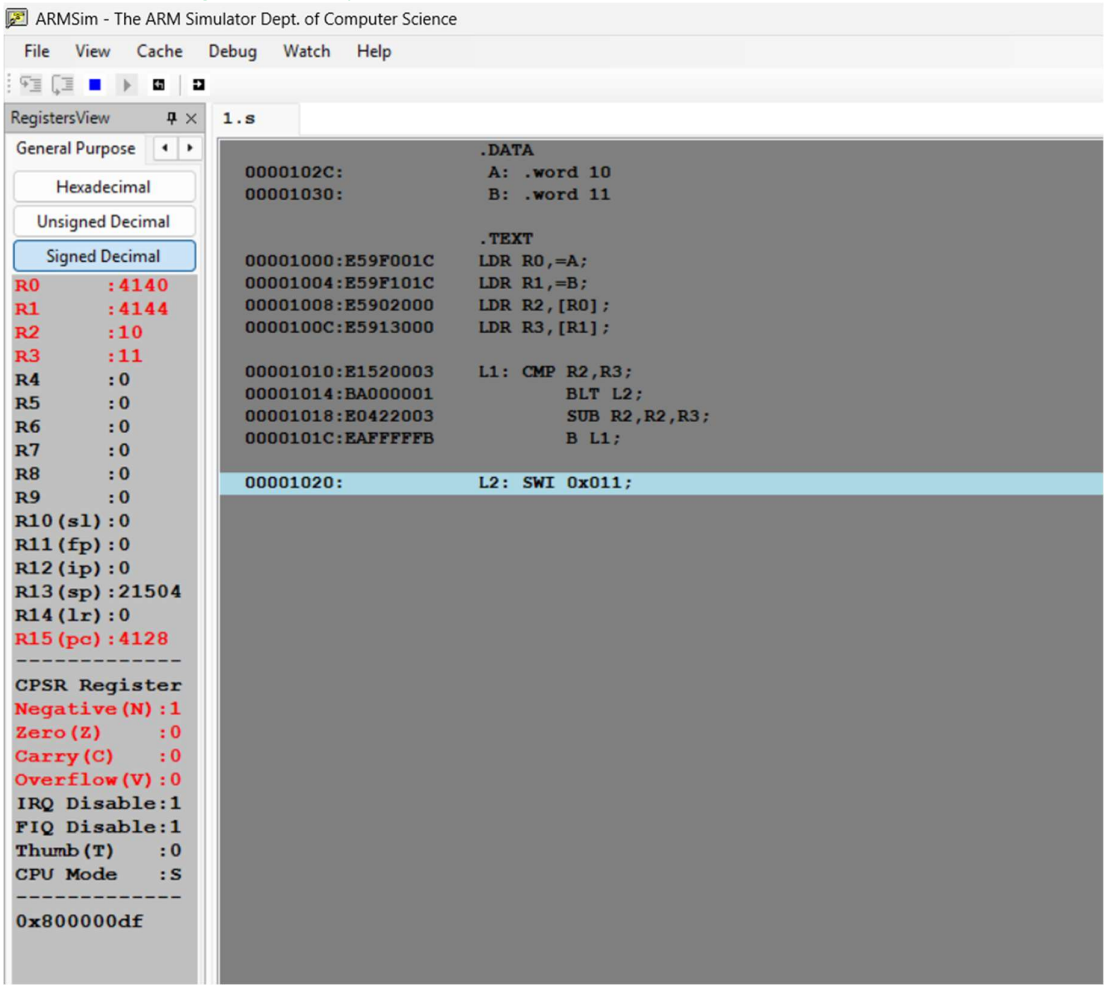
```
.DATA
 A: .word 10
 B: .word 3
```

Program screen shot:

week-3 > 1.s

```
.DATA
 A: .word 10
 B: .word 11

.TEXT
LDR R0,=A;
LDR R1,=B;
LDR R2,[R0];
LDR R3,[R1];

L1: CMP R2,R3;
    BLT L2;
    SUB R2,R2,R3;
    B L1;

L2: SWI 0x011;
```

Screen shot of Register set output:



2 Write an ALP using ARM7TDMI to search for an element in an array of 16 bit each using Linear search technique

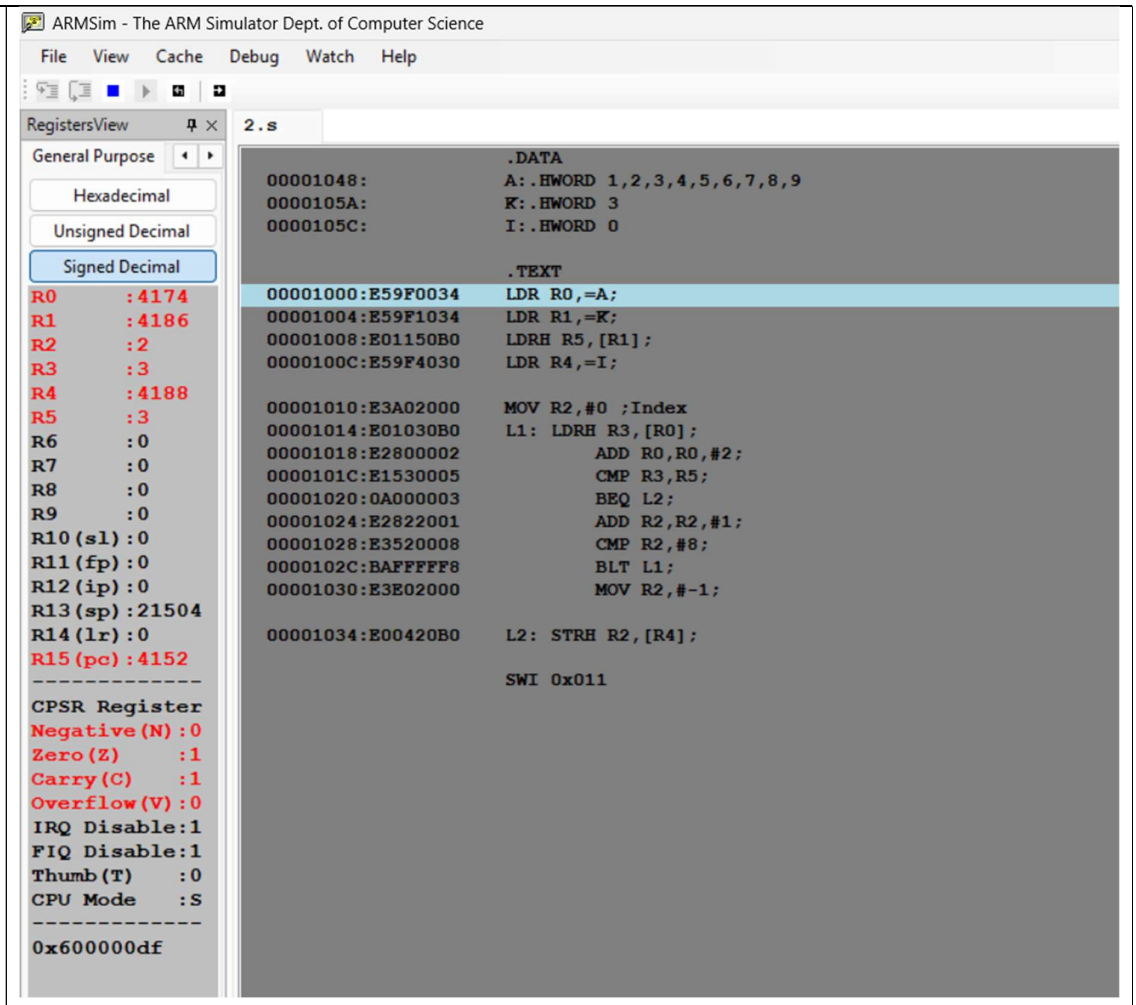
.DATA
A:.hword 1,2,3,4,5,6,7,8,9

Program screen shot:

week-3 > 2.s

```
.DATA
A:.HWORD 1,2,3,4,5,6,7,8,9
K:.HWORD 3
I:.HWORD 0

.TEXT
LDR R0,=A;
LDR R1,=K;
LDRH R5,[R1];
LDR R4,=I;

MOV R2,#0 ;Index
L1: LDRH R3,[R0];
    ADD R0,R0,#2;
    CMP R3,R5;
    BEQ L2;
    ADD R2,R2,#1;
    CMP R2,#8;
    BLT L1;
    MOV R2,#-1;

L2: STRH R2,[R4];

SWI 0x011
```

Screen shot of Register set output and memory location:



3 Write an ALP using ARM7TDMI to to copy a block 128 bytes of data from location A to location B if the rate of data transfer rate is 16 bytes, LDM and STM instructions.

and

For the same transfer the block with auto-indexing.

.DATA

A:.WORD 1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22,23,24,25,26,27,28,29,30,31,32

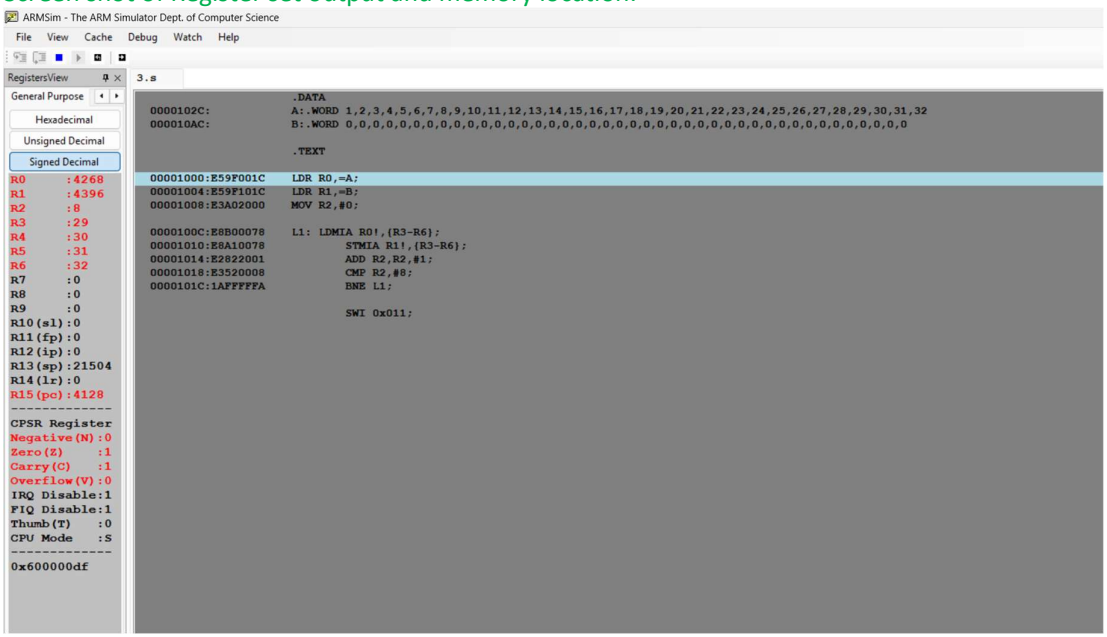
B:.WORD 0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0

Program screen shot:

week-3 > 3.s

```
.DATA
A:.WORD 1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,2
B:.WORD 0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,

.TEXT

LDR R0,=A;
LDR R1,=B;
MOV R2,#0;

L1: LDMIA R0!,{R3-R6};
    STMIA R1!,{R3-R6};
    ADD R2,R2,#1;
    CMP R2,#8;
    BNE L1;

    SWI 0x011;
```

Screen shot of Register set output and memory location:



4	Write an ALP using ARM7TDMI, for the given matric arranged in row major order, find the index of an element if coordinates of a matrix is given and also find the address of the indexed element. (Using MLA instruction)

1	00000000
2	00000001
3	
4	
5	
6	
7	
8	00000020
9	

	1	2	3		A(0,0)	A(0,1)	A(0,2)
A =	4	5	6	=>	A(1,0)	A(1,1)	A(1,2)
	7	8	9		A(2,0)	A(2,1)	A(2,2)

Row Major Order for a 3 x 3 matrix :

A [2, 2] = Row Num. x No. of elements per row + Column Num.

2 x 3 + 2 = 8th location.

- Since each location is of 4 bytes, the address of the 3rd element in the 2nd
- row is
  8 x 4 = 32.
- This is achieved in ARM processor, using MLA instruction as follows.

MLA	R1,	R2,	R3,	R4
Mnemonic	Dst	Row #	# of elements per row	col #

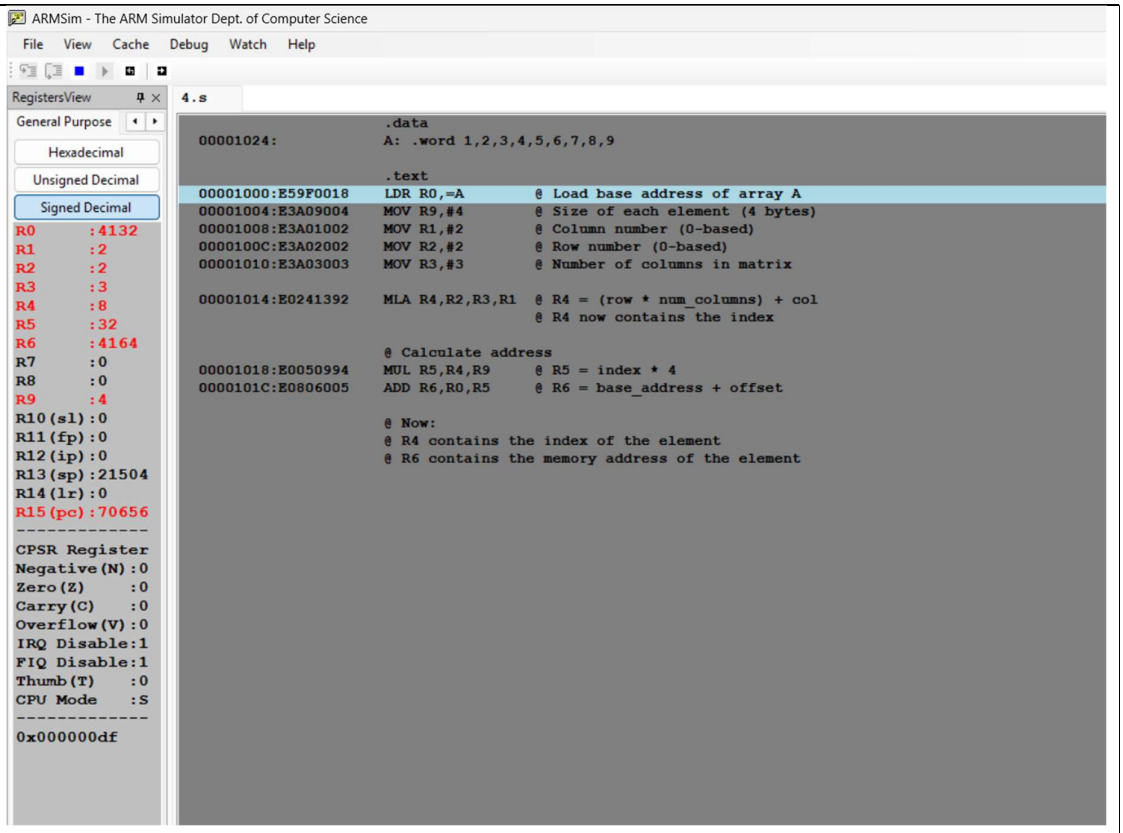
- To get consecutive data elements in a @D Array.

Program screen shot:

week-3 > 4.s

```
.data
A: .word 1,2,3,4,5,6,7,8,9

.text
LDR R0,=A          @ Load base address of array A
MOV R9,#4          @ Size of each element (4 bytes)
MOV R1,#2          @ Column number (0-based)
MOV R2,#2          @ Row number (0-based)
MOV R3,#3          @ Number of columns in matrix

MLA R4,R2,R3,R1    @ R4 = (row * num_columns) + col
                   @ R4 now contains the index

@ Calculate address
MUL R5,R4,R9       @ R5 = index * 4
ADD R6,R0,R5       @ R6 = base_address + offset

@ Now:
@ R4 contains the index of the element
@ R6 contains the memory address of the element
```

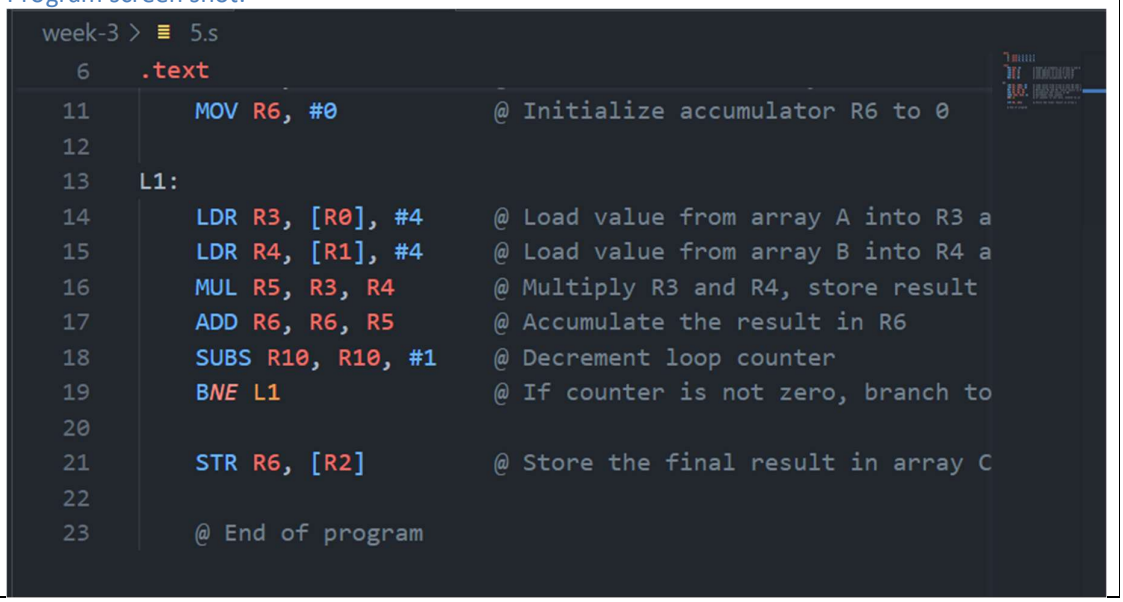
Screen shot of Register set output and memory location:



Assignments Questions

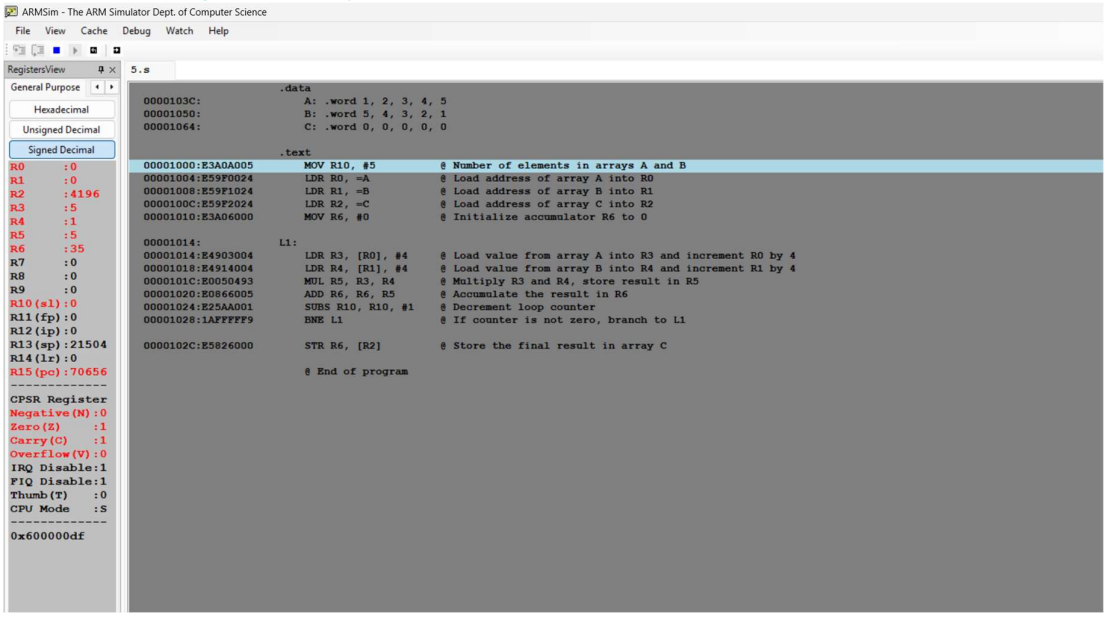
5 a)Write an ALP using ARM7TDMI to perform Convolution using MUL instruction (Addition of multiplication of respective numbers of loc A and loc B)
b Write an ALP using ARM7TDMI to perform Convolution using MLA instruction (Addition of multiplication of respective numbers of loc A and loc B).

Program screen shot:

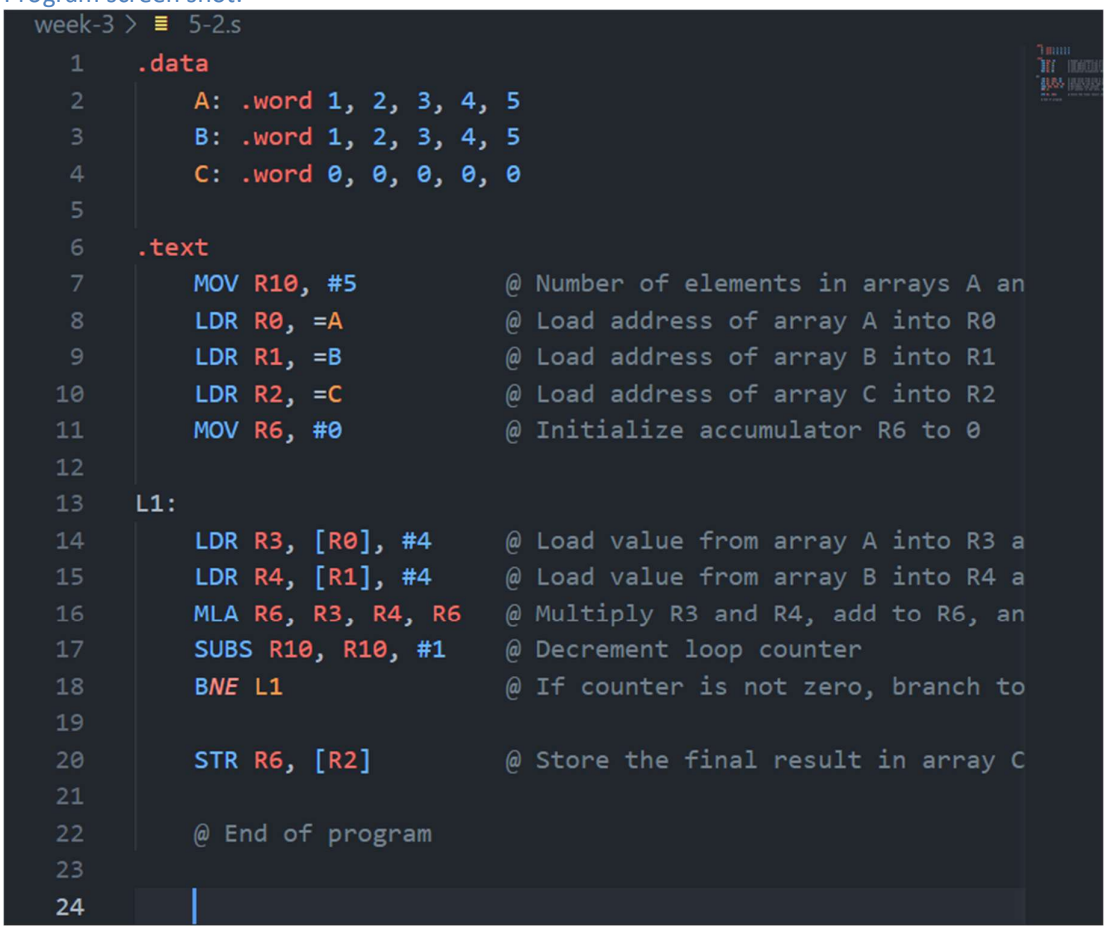


```
week-3 > 5.s
.text
    MOV R6, #0          @ Initialize accumulator R6 to 0

L1:
    LDR R3, [R0], #4    @ Load value from array A into R3 a
    LDR R4, [R1], #4    @ Load value from array B into R4 a
    MUL R5, R3, R4      @ Multiply R3 and R4, store result
    ADD R6, R6, R5      @ Accumulate the result in R6
    SUBS R10, R10, #1   @ Decrement loop counter
    BNE L1              @ If counter is not zero, branch to

    STR R6, [R2]        @ Store the final result in array C

    @ End of program
```

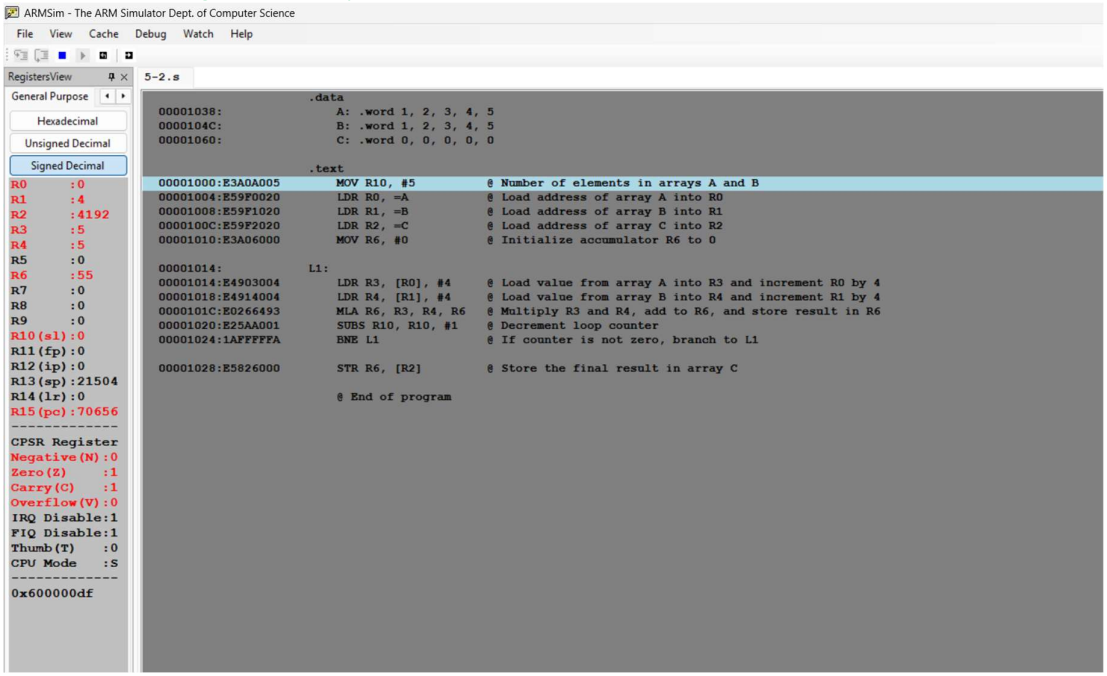
Screen shot of Register set output:



Program screen shot:



Screen shot of Register set output:



6 Write an ALP using ARM7TDMI to find the sum of all the BCD digits of a given 32 bit number. (hint:788 =7+8+8)

Program screen shot:

week-3 > 6.s

```
.text
.global main
main:
    LDR R0, =Number
    LDR R1, [R0]
    MOV R2, #0
    MOV R3, #8

L1:
    AND R4, R1, #0xF
    ADD R2, R2, R4
    MOV R1, R1, LSR #4
    SUBS R3, R3, #1
    BNE L1

    LDR R0, =Sum
    STR R2, [R0]
```

Screen shot of Register set output: