Microprocessor and Computer Architecture Laboratory

UE19CS256

4th Semester, Academic Year 2020-21

Date: 12/02/2021

Name: Pranav R. Hegde	SRN: PES1UG19CS343	Section: F

Week#_____3_____   Program Number: ___1___
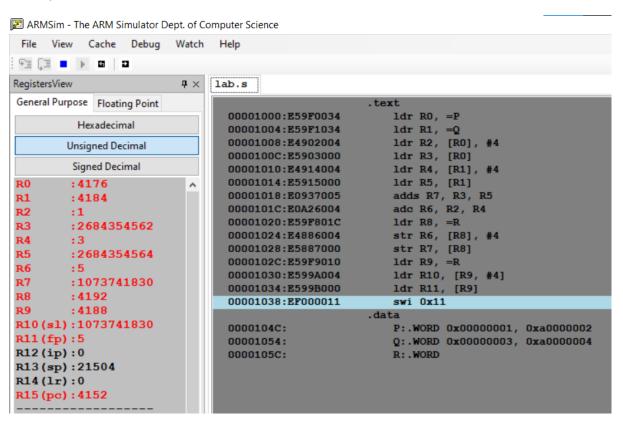
Title of the Program

    I.   ARM Assembly Code for each program
   II.   Output Screen Shot

Problem statement:

1. Write an ALP to add two 64bit numbers loaded from memory and store the result in memory

ARM assembly code:

```
.text
    ldr R0, =P
    ldr R1, =Q
    ldr R2, [R0], #4
    ldr R3, [R0]
    ldr R4, [R1], #4
    ldr R5, [R1]
    adds R7, R3, R5
    adc R6, R2, R4
    ldr R8, =R
    str R6, [R8], #4
    str R7, [R8]
    ldr R9, =R
    ldr R10, [R9, #4]
    ldr R11, [R9]
    swi 0x11
.data
    P:.WORD 0x00000001, 0xa0000002
    Q:.WORD 0x00000003, 0xa0000004
    R:.WORD
```

Output:

ARMSim - The ARM Simulator Dept. of Computer Science

File   View   Cache   Debug   Watch   Help

RegistersView   lab.s

General Purpose   Floating Point

Hexadecimal
Unsigned Decimal
Signed Decimal

R0	:4176
R1	:4184
R2	:1
R3	:2684354562
R4	:3
R5	:2684354564
R6	:5
R7	:1073741830
R8	:4192
R9	:4188
R10(sl)	:1073741830
R11(fp)	:5
R12(ip)	:0
R13(sp)	:21504
R14(lr)	:0
R15(pc)	:4152

```
                                    .text
00001000:E59F0034         ldr R0, =P
00001004:E59F1034         ldr R1, =Q
00001008:E4902004         ldr R2, [R0], #4
0000100C:E5903000         ldr R3, [R0]
00001010:E4914004         ldr R4, [R1], #4
00001014:E5915000         ldr R5, [R1]
00001018:E0937005         adds R7, R3, R5
0000101C:E0A26004         adc R6, R2, R4
00001020:E59F801C         ldr R8, =R
00001024:E4886004         str R6, [R8], #4
00001028:E5887000         str R7, [R8]
0000102C:E59F9010         ldr R9, =R
00001030:E599A004         ldr R10, [R9, #4]
00001034:E599B000         ldr R11, [R9]
00001038:EF000011         swi 0x11
                                    .data
0000104C:                 P:.WORD 0x00000001, 0xa0000002
00001054:                 Q:.WORD 0x00000003, 0xa0000004
0000105C:                 R:.WORD
```

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Name: Pranav R. Hegde	SRN: PES1UG19CS343	Section: F

Week#_____3_____   Program Number: ___2___

Title of the Program

    I.   ARM Assembly Code for each program

  II.   Output Screen Shot

Problem statement:

2. Write an ALP to copy n numbers from Memory Location A to Memory Location B.

Code:

```
.text
    ldr R0, =P
    ldr R1, =Q
    mov R2, #10
    L1:
        ldr R3, [R0]
        str R3, [R1]
        sub R2, R2, #1
        add R0, R0, #4
        add R1, R1, #4
    cmp R2, #0
    bne L1
    swi 0x11
.data
    P:.WORD 2, 4, 6, 40, 10, 12, 14, 16, 18, 20
    Q:.WORD
```

Output:

Microprocessor and Computer Architecture Laboratory

UE19CS256

4th Semester, Academic Year 2020-21

Date: 12/02/2021

Name: Pranav R. Hegde	SRN: PES1UG19CS343	Section: F

Week#____3_____   Program Number: ___3___

Title of the Program

  I.   ARM Assembly Code for each program
 II.   Output Screen Shot

Problem statement:

3. Write an ALP to find smallest number in an array of n – 32 bit numbers.

Code:

```
.text
    ldr R0,=A
    ldr R1,=B
    ldr R4,[R0],#4
    ldr R3,[R1]
    beq L1
    sub R3,R3,#1
    mov R6,R4 ; Smallest number to be stored in R6
    L2:
        ldr R4,[R0],#4
        cmp R4,R6
        movlt R6,R4
        sub R3,R3,#1
    cmp R3,#0
    bne L2
    L1:
        SWI 0x11
.data
    A:.WORD 5,13,21,4,3,19,30,8,16,42
    B:.WORD 10
```

Output:

ARMSim - The ARM Simulator Dept. of Computer Science

File   View   Cache   Debug   Watch   Help

RegistersView   lab.s

General Purpose   Floating Point

Hexadecimal

Unsigned Decimal

Signed Decimal

```
R0        :4200
R1        :4200
R2        :0
R3        :0
R4        :42
R5        :0
R6        :3
R7        :0
R8        :0
R9        :0
R10(sl):0
R11(fp):0
R12(ip):0
R13(sp):21504
R14(lr):0
R15(pc):4148
```

```
                                      .text
00001000:E3A00D41         ldr R0,=A
00001004:E59F102C         ldr R1,=B
00001008:E4904004         ldr R4,[R0],#4
0000100C:E5913000         ldr R3,[R1]
00001010:0A000007         beq L1
00001014:E2433001         sub R3,R3,#1
00001018:E1A06004         mov R6,R4 ; Smallest number to be stored in R6
0000101C:                 L2:
0000101C:E4904004             ldr R4,[R0],#4
00001020:E1540006             cmp R4,R6
00001024:B1A06004             movlt R6,R4
00001028:E2433001             sub R3,R3,#1
0000102C:E3530000         cmp R3,#0
00001030:1AFFFFF9         bne L2
00001034:                 L1:
00001034:EF000011             SWI 0x11
                                      .data
00001040:                 A:.WORD 5,13,21,4,3,19,30,8,16,42
00001068:                 B:.WORD 10
```

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Date: 12/02/2021

Name: Pranav R. Hegde	SRN: PES1UG19CS343	Section: F

Week#_____3_____   Program Number: ___4a_____

Title of the Program

    I.   ARM Assembly Code for each program

  II.   Output Screen Shot

Problem statement:

4a. Write an ALP to count the number of 1's and 0's in a given 32 bit number.

Code:

```
.text
    ldr R0,=0b11110010100101001101001100110111
    mov R1,#32
    mov R5,#0
    mov R6,#0
    L1:
        and R2,R0,#1
    cmp R2,#1
    addeq R5,R5,#1 ;Number of 1's is stored in R5
    addne R6,R6,#1 ;Number of 0's is stored in R6
    mov R0,R0,LSR #1
    sub R1,R1,#1
    cmp R1,#0
    bne L1
    swi 0x11
.end
```

Output:

Microprocessor and Computer Architecture Laboratory

UE19CS256

4th Semester, Academic Year 2020-21

Date: 12/02/2021

Name: Pranav R. Hegde	SRN: PES1UG19CS343	Section: F

Week#____3_____   Program Number: ___4b___

Title of the Program

    I.   ARM Assembly Code for each program
  II.   Output Screen Shot

Problem statement:

4b. Write an ALP to find the number of zeroes, positive and negative numbers in a given array.

Code:

```
.text
    ldr R1,=A
    ldr R2,=B
    ldr R3,[R2]
    mov R7,#0
    mov R8,#0
    mov R9,#0
    L1:
        ldr R4,[R1],#4
    cmp R4,#0
    addeq R7,R7,#1 ;Number of 0's is stored in R7
    addlt R8,R8,#1 ;Number of negative numbers is stored in R8
    addgt R9,R9,#1 ;Number of positive numbers is stored in R9
    sub R3,R3,#1
    cmp R3,#0
    bne L1
    swi 0x11
.data
    A:.WORD -1,-2,-3,0,1,2,0,4,5,6
    B:.WORD 10
```

Output:

Microprocessor and Computer Architecture Laboratory

UE19CS256

4th Semester, Academic Year 2020-21

Date: 12/02/2021

Name: Pranav R. Hegde	SRN: PES1UG19CS343	Section: F

Week#____3_____   Program Number: ___5___

Title of the Program

    I.   ARM Assembly Code for each program

   II.   Output Screen Shot

Problem statement:

5. Write an ALP to check whether a given number is present in array using Linear Search (Without SWI 0x02), if found move +1 to R6 and key position to R7 else move -1 to R6 (if number not found).

Code:

```
.text
    ldr R0,=A
    mov R1,#10
    mov R3,R1
    L1:
        ldr R2,[R0],#4
    cmp R2,#16 ;Element 16 is to be searched in the array
    beq L2
    subs R1,R1,#1
    cmp R1,#0
    bne L1
    mov R6,#-1
    swi 0x11
    L2:
        mov R6,#1
        sub R1,R1,#1
        sub R7,R3,R1
        swi 0x11
.data
    A:.WORD 2,4,6,8,12,20,25,30,40,50
```

Case1: Element found

File   View   Cache   Debug   Watch   Help

RegistersView   lab.s

General Purpose Floating Point

| Hexadecimal |
| Unsigned Decimal |
| Signed Decimal |

Register	Value
R0	:4188
R1	:3
R2	:25
R3	:10
R4	:0
R5	:0
R6	:1
R7	:7
R8	:0
R9	:0
R10(sl)	:0
R11(fp)	:0
R12(ip)	:0
R13(sp)	:21504
R14(lr)	:0
R15(pc)	:4152

```
                                .text
00001000:E3A00D41              ldr R0,=A
00001004:E3A0100A              mov R1,#10
00001008:E1A03001              mov R3,R1
0000100C:                      L1:
0000100C:E4902004              ldr R2,[R0],#4
00001010:E3520019              cmp R2,#25 ;Element 25 is to be searched in the array
00001014:0A000004              beq L2
00001018:E2511001              subs R1,R1,#1
0000101C:E3510000              cmp R1,#0
00001020:1AFFFFF9              bne L1
00001024:E3E06000              mov R6,#-1
00001028:EF000011              swi 0x11
0000102C:                      L2:
0000102C:E3A06001              mov R6,#1
00001030:E2411001              sub R1,R1,#1
00001034:E0437001              sub R7,R3,R1
00001038:EF000011              swi 0x11
                                .data
00001040:                      A:.WORD 2,4,6,8,12,20,25,30,40,50
```

Case2: Element NOT found

File   View   Cache   Debug   Watch   Help

RegistersView   lab.s

General Purpose Floating Point

| Hexadecimal |
| Unsigned Decimal |
| Signed Decimal |

Register	Value
R0	:4200
R1	:0
R2	:50
R3	:10
R4	:0
R5	:0
R6	:4294967295
R7	:0
R8	:0
R9	:0
R10(sl)	:0
R11(fp)	:0
R12(ip)	:0
R13(sp)	:21504
R14(lr)	:0
R15(pc)	:4136

```
                                .text
00001000:E3A00D41              ldr R0,=A
00001004:E3A0100A              mov R1,#10
00001008:E1A03001              mov R3,R1
0000100C:                      L1:
0000100C:E4902004              ldr R2,[R0],#4
00001010:E3520010              cmp R2,#16 ;Element 16 is to be searched in the array
00001014:0A000004              beq L2
00001018:E2511001              subs R1,R1,#1
0000101C:E3510000              cmp R1,#0
00001020:1AFFFFF9              bne L1
00001024:E3E06000              mov R6,#-1
00001028:EF000011              swi 0x11
0000102C:                      L2:
0000102C:E3A06001              mov R6,#1
00001030:E2411001              sub R1,R1,#1
00001034:E0437001              sub R7,R3,R1
00001038:EF000011              swi 0x11
                                .data
00001040:                      A:.WORD 2,4,6,8,12,20,25,30,40,50
```

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UE19CS256

4th Semester, Academic Year 2020-21

Date: 12/02/2021

Name: Pranav R. Hegde	SRN: PES1UG19CS343	Section: F

Week#____3_____   Program Number: ___6___

Title of the Program

I.   ARM Assembly Code for each program
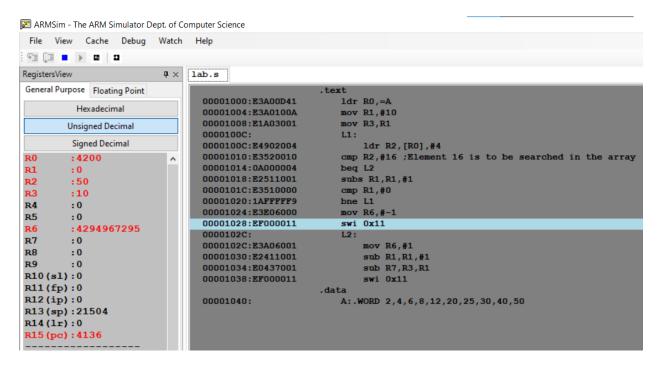II. Output Screen Shot

Problem statement:

6. Write an ALP to generate Fibonacci Series and store them in an array.

Code:

```
.text
    ldr R1,=A
    mov R2,#0
    str R2,[R1]
    add R1,R1,#4
    mov R3,#1
    str R3,[R1]
    mov R5,#8 ;  8 fibonacci numbers will be stored after 0 and 1(So,total=10) in the array
    L1:
        add R4,R2,R3
        add R1,R1,#4
        str R4,[R1]
        mov R2,R3
        mov R3,R4
        subs R5,R5,#1
        mov R4,#0
        bne L1
    swi 0x11
.data
    A:.WORD
```

Output:

ARMSim - The ARM Simulator Dept. of Computer Science

File   View   Cache   Debug   Watch   Help

RegistersView   lab.s

General Purpose Floating Point   .text

Hexadecimal	00001000:E59F1038 ldr R1,=A
Unsigned Decimal	00001004:E3A02000 mov R2,#0
Signed Decimal	00001008:E5812000 str R2,[R1]

```
00001000:E59F1038       ldr R1,=A
00001004:E3A02000       mov R2,#0
00001008:E5812000       str R2,[R1]
0000100C:E2811004       add R1,R1,#4
00001010:E3A03001       mov R3,#1
00001014:E5813000       str R3,[R1]
00001018:E3A05008       mov R5,#8 ; 8 fibonacci numbers will be stored after 0 and 1(So,total=10) in the array
0000101C:                   L1:
0000101C:E0824003           add R4,R2,R3
00001020:E2811004           add R1,R1,#4
00001024:E5814000           str R4,[R1]
00001028:E1A02003           mov R2,R3
0000102C:E1A03004           mov R3,R4
00001030:E2555001           subs R5,R5,#1
00001034:E3A04000           mov R4,#0
00001038:1AFFFFF7           bne L1
0000103C:EF000011       swi 0x11
                            .data
00001044:                   A:.WORD
```

RO   :0
R1   :4200
R2   :21
R3   :34
R4   :0
R5   :0
R6   :0
R7   :0
R8   :0
R9   :0
R10(sl):0
R11(fp):0
R12(ip):0
R13(sp):21504
R14(lr):0
R15(pc):4156