

The University of Alabama in Huntsville
ECE Department
CPE 221 01
Spring 2019
Homework #7 Solution

Consider the code given below for a function that calculates a recursive sum, both the C++ and the ARM assembly language versions. Trace the values of the registers shown as they change during program execution. Also, trace the changes to the stack by showing the instruction that affects the stack, the location of the stack and frame pointers, and the full contents of the stack after the instruction has been executed. You may use the file given for tracking or do it on your own paper.

```
int sum (int);

int main()
{
    int x;
    x = sum(5);
}
int sum(int i)
{
    if (i<=1)
        return 1;
    else
        return i + sum(i-1);
}
```

```

AREA      RECURSIVE_SUM, CODE, READONLY
ENTRY
main
    mov     lr, #60                ; (0)
    mov     sp, #0                 ; (4)
    mov     fp, #0x0000C000;      ; (8)
    push    {lr}                   ; (12)
    push    {fp}                   ; (16)
    add     fp, sp, #4              ; (20)
    sub     sp, sp, #8              ; (24)
    mov     r0, #5                  ; (28)
    bl      sum                     ; (32)
    str     r0, [fp, #-8]           ; (36)
    mov     r3, #0                  ; (40)
    mov     r0, r3                  ; (44)
    sub     sp, fp, #4              ; (48)
    pop     {fp}                   ; (52)
    pop     {pc}                   ; (56)
stop
b          stop                     ; (60)
sum
    push    {lr}                   ; (64)
    push    {fp}                   ; (68)
    add     fp, sp, #4              ; (72)
    sub     sp, sp, #8              ; (76)
    str     r0, [fp, #-8]           ; (80)
    ldr     r3, [fp, #-8]           ; (84)
    cmp     r3, #1                  ; (88)
    bgt     L2                      ; (92)
    mov     r3, #1                  ; (96)
    b       L3                      ; (100)
L2
    ldr     r3, [fp, #-8]           ; (104)
    sub     r3, r3, #1              ; (108)
    mov     r0, r3                  ; (112)
    bl      sum                     ; (116)
    mov     r2, r0                  ; (120)
    ldr     r3, [fp, #-8]           ; (124)
    add     r3, r2, r3              ; (128)
L3
    mov     r0, r3                  ; (132)
    sub     sp, fp, #4              ; (136)
    pop     {fp}                   ; (140)
    pop     {pc}                   ; (144)
END

```

1	Address	Value
	FFFF FFA0	
	FFFF FFA4	
	FFFF FFA8	
	FFFF FFAC	
	FFFF FFB0	
	FFFF FFB4	
	FFFF FFB8	
	FFFF FFBC	
	FFFF FFC0	
	FFFF FFC4	
	FFFF FFC8	
	FFFF FFCC	
	FFFF FFD0	
	FFFF FFD4	
	FFFF FFD8	
	FFFF FFDC	
	FFFF FFE0	
	FFFF FFE4	
	FFFF FFE8	
	FFFF FFEC	
	FFFF FFF0	
	FFFF FFF4	
	FFFF FFF8	
	FFFF FFFC	

4 mov sp, #0, sp = 0

4	Address	Value
	FFFF FFA0	
	FFFF FFA4	
	FFFF FFA8	
	FFFF FFAC	
	FFFF FFB0	
	FFFF FFB4	
	FFFF FFB8	
	FFFF FFBC	
	FFFF FFC0	
	FFFF FFC4	
	FFFF FFC8	
	FFFF FFCC	
	FFFF FFD0	
	FFFF FFD4	
	FFFF FFD8	
	FFFF FFDC	
	FFFF FFE0	
	FFFF FFE4	
	FFFF FFE8	
	FFFF FFEC	
	FFFF FFF0	
	FFFF FFF4	
sp	FFFF FFF8	0xC000
	FFFF FFFC	60

16 push {fp}

2	Address	Value
	FFFF FFA0	
	FFFF FFA4	
	FFFF FFA8	
	FFFF FFAC	
	FFFF FFB0	
	FFFF FFB4	
	FFFF FFB8	
	FFFF FFBC	
	FFFF FFC0	
	FFFF FFC4	
	FFFF FFC8	
	FFFF FFCC	
	FFFF FFD0	
	FFFF FFD4	
	FFFF FFD8	
	FFFF FFDC	
	FFFF FFE0	
	FFFF FFE4	
	FFFF FFE8	
	FFFF FFEC	
	FFFF FFF0	
	FFFF FFF4	
	FFFF FFF8	
	FFFF FFFC	

8 mov fp, #0x0000C0000

5	Address	Value
	FFFF FFA0	
	FFFF FFA4	
	FFFF FFA8	
	FFFF FFAC	
	FFFF FFB0	
	FFFF FFB4	
	FFFF FFB8	
	FFFF FFBC	
	FFFF FFC0	
	FFFF FFC4	
	FFFF FFC8	
	FFFF FFCC	
	FFFF FFD0	
	FFFF FFD4	
	FFFF FFD8	
	FFFF FFDC	
	FFFF FFE0	
	FFFF FFE4	
	FFFF FFE8	
	FFFF FFEC	
	FFFF FFF0	
	FFFF FFF4	
sp	FFFF FFF8	0xC000
fp	FFFF FFFC	60

20 add fp, sp, #4

3	Address	Value
	FFFF FFA0	
	FFFF FFA4	
	FFFF FFA8	
	FFFF FFAC	
	FFFF FFB0	
	FFFF FFB4	
	FFFF FFB8	
	FFFF FFBC	
	FFFF FFC0	
	FFFF FFC4	
	FFFF FFC8	
	FFFF FFCC	
	FFFF FFD0	
	FFFF FFD4	
	FFFF FFD8	
	FFFF FFDC	
	FFFF FFE0	
	FFFF FFE4	
	FFFF FFE8	
	FFFF FFEC	
	FFFF FFF0	
	FFFF FFF4	
	FFFF FFF8	
sp	FFFF FFFC	60

12 push {lr}

6	Address	Value
	FFFF FFA0	
	FFFF FFA4	
	FFFF FFA8	
	FFFF FFAC	
	FFFF FFB0	
	FFFF FFB4	
	FFFF FFB8	
	FFFF FFBC	
	FFFF FFC0	
	FFFF FFC4	
	FFFF FFC8	
	FFFF FFCC	
	FFFF FFD0	
	FFFF FFD4	
	FFFF FFD8	
	FFFF FFDC	
	FFFF FFE0	
	FFFF FFE4	
	FFFF FFE8	
	FFFF FFEC	
sp	FFFF FFF0	
	FFFF FFF4	
	FFFF FFF8	0xC000
fp	FFFF FFFC	60

24 sub sp, sp, #8

7	Address	Value
	FFFF FFA0	
	FFFF FFA4	
	FFFF FFA8	
	FFFF FFAC	
	FFFF FFB0	
	FFFF FFB4	
	FFFF FFB8	
	FFFF FFBC	
	FFFF FFC0	
	FFFF FFC4	
	FFFF FFC8	
	FFFF FFCC	
	FFFF FFD0	
	FFFF FFD4	
	FFFF FFD8	
	FFFF FFDC	
	FFFF FFE0	
	FFFF FFE4	
	FFFF FFE8	
sp	FFFF FFEC	36
	FFFF FFF0	
	FFFF FFF4	
	FFFF FFF8	0xC000
fp	FFFF FFFC	60

64 push {lr}

8	Address	Value
	FFFF FFA0	
	FFFF FFA4	
	FFFF FFA8	
	FFFF FFAC	
	FFFF FFB0	
	FFFF FFB4	
	FFFF FFB8	
	FFFF FFBC	
	FFFF FFC0	
	FFFF FFC4	
	FFFF FFC8	
	FFFF FFCC	
	FFFF FFD0	
	FFFF FFD4	
	FFFF FFD8	
	FFFF FFDC	
	FFFF FFE0	
	FFFF FFE4	
sp	FFFF FFE8	0xFFFFC
	FFFF FFEC	36
	FFFF FFF0	
	FFFF FFF4	
	FFFF FFF8	0xC000
fp	FFFF FFFC	60

68 push {fp}

9	Address	Value
	FFFF FFA0	
	FFFF FFA4	
	FFFF FFA8	
	FFFF FFAC	
	FFFF FFB0	
	FFFF FFB4	
	FFFF FFB8	
	FFFF FFBC	
	FFFF FFC0	
	FFFF FFC4	
	FFFF FFC8	
	FFFF FFCC	
	FFFF FFD0	
	FFFF FFD4	
	FFFF FFD8	
	FFFF FFDC	
	FFFF FFE0	
	FFFF FFE4	
sp	FFFF FFE8	0xFFFFC
fp	FFFF FFEC	36
	FFFF FFF0	
	FFFF FFF4	
	FFFF FFF8	0xC000
	FFFF FFFC	60

72 add fp, sp, #4

10	Address	Value
	FFFF FFA0	
	FFFF FFA4	
	FFFF FFA8	
	FFFF FFAC	
	FFFF FFB0	
	FFFF FFB4	
	FFFF FFB8	
	FFFF FFBC	
	FFFF FFC0	
	FFFF FFC4	
	FFFF FFC8	
	FFFF FFCC	
	FFFF FFD0	
	FFFF FFD4	
	FFFF FFD8	
	FFFF FFDC	
sp	FFFF FFE0	
	FFFF FFE4	
	FFFF FFE8	0xFFFFC
fp	FFFF FFEC	36
	FFFF FFF0	
	FFFF FFF4	
	FFFF FFF8	0xC000
	FFFF FFFC	60

76 sub sp, sp, #8

11	Address	Value
	FFFF FFA0	
	FFFF FFA4	
	FFFF FFA8	
	FFFF FFAC	
	FFFF FFB0	
	FFFF FFB4	
	FFFF FFB8	
	FFFF FFBC	
	FFFF FFC0	
	FFFF FFC4	
	FFFF FFC8	
	FFFF FFCC	
	FFFF FFD0	
	FFFF FFD4	
	FFFF FFD8	
	FFFF FFDC	
sp	FFFF FFE0	
	FFFF FFE4	5
	FFFF FFE8	0xFFFFC
fp	FFFF FFEC	36
	FFFF FFF0	
	FFFF FFF4	
	FFFF FFF8	0xC000
	FFFF FFFC	60

80 str r0, [fp, #-8]

12	Address	Value
	FFFF FFA0	
	FFFF FFA4	
	FFFF FFA8	
	FFFF FFAC	
	FFFF FFB0	
	FFFF FFB4	
	FFFF FFB8	
	FFFF FFBC	
	FFFF FFC0	
	FFFF FFC4	
	FFFF FFC8	
	FFFF FFCC	
	FFFF FFD0	
	FFFF FFD4	
	FFFF FFD8	
sp	FFFF FFDC	120
	FFFF FFE0	
	FFFF FFE4	5
	FFFF FFE8	0xFFFFC
fp	FFFF FFEC	36
	FFFF FFF0	
	FFFF FFF4	
	FFFF FFF8	0xC000
	FFFF FFFC	60

64 push {lr}

13	Address	Value
	FFFF FFA0	
	FFFF FFA4	
	FFFF FFA8	
	FFFF FFAC	
	FFFF FFB0	
	FFFF FFB4	
	FFFF FFB8	
	FFFF FFBC	
	FFFF FFC0	
	FFFF FFC4	
	FFFF FFC8	
	FFFF FFCC	
	FFFF FFD0	
	FFFF FFD4	
sp	FFFF FFD8	0xFFEC
	FFFF FFDC	120
	FFFF FFE0	
	FFFF FFE4	5
	FFFF FFE8	0xFFFFC
fp	FFFF FFEC	36
	FFFF FFF0	
	FFFF FFF4	
	FFFF FFF8	0xC000
	FFFF FFFC	60

68 push {fp}

14	Address	Value
	FFFF FFA0	
	FFFF FFA4	
	FFFF FFA8	
	FFFF FFAC	
	FFFF FFB0	
	FFFF FFB4	
	FFFF FFB8	
	FFFF FFBC	
	FFFF FFC0	
	FFFF FFC4	
	FFFF FFC8	
	FFFF FFCC	
	FFFF FFD0	
	FFFF FFD4	
sp	FFFF FFD8	0xFFEC
fp	FFFF FFDC	120
	FFFF FFE0	
	FFFF FFE4	5
	FFFF FFE8	0xFFFFC
	FFFF FFEC	36
	FFFF FFF0	
	FFFF FFF4	
	FFFF FFF8	0xC000
	FFFF FFFC	60

72 add fp, sp, #4

15	Address	Value
	FFFF FFA0	
	FFFF FFA4	
	FFFF FFA8	
	FFFF FFAC	
	FFFF FFB0	
	FFFF FFB4	
	FFFF FFB8	
	FFFF FFBC	
	FFFF FFC0	
	FFFF FFC4	
	FFFF FFC8	
	FFFF FFCC	
sp	FFFF FFD0	
	FFFF FFD4	
	FFFF FFD8	0xFFEC
fp	FFFF FFDC	120
	FFFF FFE0	
	FFFF FFE4	5
	FFFF FFE8	0xFFFFC
	FFFF FFEC	36
	FFFF FFF0	
	FFFF FFF4	
	FFFF FFF8	0xC000
	FFFF FFFC	60

76 sub sp, sp, #8

16	Address	Value
	FFFF FFA0	
	FFFF FFA4	
	FFFF FFA8	
	FFFF FFAC	
	FFFF FFB0	
	FFFF FFB4	
	FFFF FFB8	
	FFFF FFBC	
	FFFF FFC0	
	FFFF FFC4	
	FFFF FFC8	
	FFFF FFCC	
sp	FFFF FFD0	
	FFFF FFD4	4
	FFFF FFD8	0xFFEC
fp	FFFF FFDC	120
	FFFF FFE0	
	FFFF FFE4	5
	FFFF FFE8	0xFFFFC
	FFFF FFEC	36
	FFFF FFF0	
	FFFF FFF4	
	FFFF FFF8	0xC000
	FFFF FFFC	60

80 str r0, [fp, #-8]

17	Address	Value
	FFFF FFA0	
	FFFF FFA4	
	FFFF FFA8	
	FFFF FFAC	
	FFFF FFB0	
	FFFF FFB4	
	FFFF FFB8	
	FFFF FFBC	
	FFFF FFC0	
	FFFF FFC4	
	FFFF FFC8	
sp	FFFF FFCC	120
	FFFF FFD0	
	FFFF FFD4	4
	FFFF FFD8	0xFFEC
fp	FFFF FFDC	120
	FFFF FFE0	
	FFFF FFE4	5
	FFFF FFE8	0xFFFFC
	FFFF FFEC	36
	FFFF FFF0	
	FFFF FFF4	
	FFFF FFF8	0xC000
	FFFF FFFC	60

64 push {lr}

18	Address	Value
	FFFF FFA0	
	FFFF FFA4	
	FFFF FFA8	
	FFFF FFAC	
	FFFF FFB0	
	FFFF FFB4	
	FFFF FFB8	
	FFFF FFBC	
	FFFF FFC0	
	FFFF FFC4	
sp	FFFF FFC8	0xFFDC
	FFFF FFCC	120
	FFFF FFD0	
	FFFF FFD4	4
	FFFF FFD8	0xFFEC
fp	FFFF FFDC	120
	FFFF FFE0	
	FFFF FFE4	5
	FFFF FFE8	0xFFFFC
	FFFF FFEC	36
	FFFF FFF0	
	FFFF FFF4	
	FFFF FFF8	0xC000
	FFFF FFFC	60

68 push {fp}

19	Address	Value
	FFFF FFA0	
	FFFF FFA4	
	FFFF FFA8	
	FFFF FFAC	
	FFFF FFB0	
	FFFF FFB4	
	FFFF FFB8	
	FFFF FFBC	
	FFFF FFC0	
	FFFF FFC4	
sp	FFFF FFC8	0xFFDC
fp	FFFF FFCC	120
	FFFF FFD0	
	FFFF FFD4	4
	FFFF FFD8	0xFFEC
	FFFF FFDC	120
	FFFF FFE0	
	FFFF FFE4	5
	FFFF FFE8	0xFFFFC
	FFFF FFEC	36
	FFFF FFF0	
	FFFF FFF4	
	FFFF FFF8	0xC000
	FFFF FFFC	60

72 add fp, sp, #4

22	Address	Value
	FFFF FFA0	
	FFFF FFA4	
	FFFF FFA8	
	FFFF FFAC	
	FFFF FFB0	
	FFFF FFB4	
	FFFF FFB8	
sp	FFFF FFBC	120
	FFFF FFC0	
	FFFF FFC4	3
	FFFF FFC8	0xFFDC
fp	FFFF FFCC	120
	FFFF FFD0	
	FFFF FFD4	4
	FFFF FFD8	0xFFEC
	FFFF FFDC	120
	FFFF FFE0	
	FFFF FFE4	5
	FFFF FFE8	0xFFFFC
	FFFF FFEC	36
	FFFF FFF0	
	FFFF FFF4	
	FFFF FFF8	0xC000
	FFFF FFFC	60

64 push {lr}

20	Address	Value
	FFFF FFA0	
	FFFF FFA4	
	FFFF FFA8	
	FFFF FFAC	
	FFFF FFB0	
	FFFF FFB4	
	FFFF FFB8	
	FFFF FFBC	
sp	FFFF FFC0	
	FFFF FFC4	
	FFFF FFC8	0xFFDC
fp	FFFF FFCC	120
	FFFF FFD0	
	FFFF FFD4	4
	FFFF FFD8	0xFFEC
	FFFF FFDC	120
	FFFF FFE0	
	FFFF FFE4	5
	FFFF FFE8	0xFFFFC
	FFFF FFEC	36
	FFFF FFF0	
	FFFF FFF4	
	FFFF FFF8	0xC000
	FFFF FFFC	60

76 sub sp, sp, #8

23	Address	Value
	FFFF FFA0	
	FFFF FFA4	
	FFFF FFA8	
	FFFF FFAC	
	FFFF FFB0	
	FFFF FFB4	
sp	FFFF FFB8	0xFFCC
	FFFF FFBC	120
	FFFF FFC0	
	FFFF FFC4	3
	FFFF FFC8	0xFFDC
fp	FFFF FFCC	120
	FFFF FFD0	
	FFFF FFD4	4
	FFFF FFD8	0xFFEC
	FFFF FFDC	120
	FFFF FFE0	
	FFFF FFE4	5
	FFFF FFE8	0xFFFFC
	FFFF FFEC	36
	FFFF FFF0	
	FFFF FFF4	
	FFFF FFF8	0xC000
	FFFF FFFC	60

68 push (fp)

21	Address	Value
	FFFF FFA0	
	FFFF FFA4	
	FFFF FFA8	
	FFFF FFAC	
	FFFF FFB0	
	FFFF FFB4	
	FFFF FFB8	
	FFFF FFBC	
sp	FFFF FFC0	
	FFFF FFC4	3
	FFFF FFC8	0xFFDC
fp	FFFF FFCC	120
	FFFF FFD0	
	FFFF FFD4	4
	FFFF FFD8	0xFFEC
	FFFF FFDC	120
	FFFF FFE0	
	FFFF FFE4	5
	FFFF FFE8	0xFFFFC
	FFFF FFEC	36
	FFFF FFF0	
	FFFF FFF4	
	FFFF FFF8	0xC000
	FFFF FFFC	60

80 str r0, [fp, #-8]

24	Address	Value
	FFFF FFA0	
	FFFF FFA4	
	FFFF FFA8	
	FFFF FFAC	
	FFFF FFB0	
	FFFF FFB4	
sp	FFFF FFB8	0xFFCC
fp	FFFF FFBC	120
	FFFF FFC0	
	FFFF FFC4	3
	FFFF FFC8	0xFFDC
	FFFF FFCC	120
	FFFF FFD0	
	FFFF FFD4	4
	FFFF FFD8	0xFFEC
	FFFF FFDC	120
	FFFF FFE0	
	FFFF FFE4	5
	FFFF FFE8	0xFFFFC
	FFFF FFEC	36
	FFFF FFF0	
	FFFF FFF4	
	FFFF FFF8	0xC000
	FFFF FFFC	60

72 add fp, sp, #4

25	Address	Value
	FFFF FFA0	
	FFFF FFA4	
	FFFF FFA8	
	FFFF FFAC	
sp	FFFF FFB0	
	FFFF FFB4	
	FFFF FFB8	0xFFCC
fp	FFFF FFBC	120
	FFFF FFC0	
	FFFF FFC4	3
	FFFF FFC8	0xFFDC
	FFFF FFCC	120
	FFFF FFD0	
	FFFF FFD4	4
	FFFF FFD8	0xFFEC
	FFFF FFDC	120
	FFFF FFE0	
	FFFF FFE4	5
	FFFF FFE8	0xFFFFC
	FFFF FFEC	36
	FFFF FFF0	
	FFFF FFF4	
	FFFF FFF8	0xC000
	FFFF FFFC	60

76 sub sp, sp, #8

26	Address	Value
	FFFF FFA0	
	FFFF FFA4	
	FFFF FFA8	
	FFFF FFAC	
sp	FFFF FFB0	
	FFFF FFB4	2
	FFFF FFB8	0xFFCC
fp	FFFF FFBC	120
	FFFF FFC0	
	FFFF FFC4	3
	FFFF FFC8	0xFFDC
	FFFF FFCC	120
	FFFF FFD0	
	FFFF FFD4	4
	FFFF FFD8	0xFFEC
	FFFF FFDC	120
	FFFF FFE0	
	FFFF FFE4	5
	FFFF FFE8	0xFFFFC
	FFFF FFEC	36
	FFFF FFF0	
	FFFF FFF4	
	FFFF FFF8	0xC000
	FFFF FFFC	60

80 str r0, [fp, #-8]

27	Address	Value
	FFFF FFA0	
	FFFF FFA4	
	FFFF FFA8	
sp	FFFF FFAC	120
	FFFF FFB0	
	FFFF FFB4	2
	FFFF FFB8	0xFFCC
fp	FFFF FFBC	120
	FFFF FFC0	
	FFFF FFC4	3
	FFFF FFC8	0xFFDC
	FFFF FFCC	120
	FFFF FFD0	
	FFFF FFD4	4
	FFFF FFD8	0xFFEC
	FFFF FFDC	120
	FFFF FFE0	
	FFFF FFE4	5
	FFFF FFE8	0xFFFFC
	FFFF FFEC	36
	FFFF FFF0	
	FFFF FFF4	
	FFFF FFF8	0xC000
	FFFF FFFC	60

64 push {lr}

28	Address	Value
	FFFF FFA0	
	FFFF FFA4	
sp	FFFF FFA8	0xFFBC
	FFFF FFAC	120
	FFFF FFB0	
	FFFF FFB4	2
	FFFF FFB8	0xFFCC
fp	FFFF FFBC	120
	FFFF FFC0	
	FFFF FFC4	3
	FFFF FFC8	0xFFDC
	FFFF FFCC	120
	FFFF FFD0	
	FFFF FFD4	4
	FFFF FFD8	0xFFEC
	FFFF FFDC	120
	FFFF FFE0	
	FFFF FFE4	5
	FFFF FFE8	0xFFFFC
	FFFF FFEC	36
	FFFF FFF0	
	FFFF FFF4	
	FFFF FFF8	0xC000
	FFFF FFFC	60

68 push {fp}

29	Address	Value
	FFFF FFA0	
	FFFF FFA4	
sp	FFFF FFA8	0xFFBC
fp	FFFF FFAC	120
	FFFF FFB0	
	FFFF FFB4	2
	FFFF FFB8	0xFFCC
	FFFF FFBC	120
	FFFF FFC0	
	FFFF FFC4	3
	FFFF FFC8	0xFFDC
	FFFF FFCC	120
	FFFF FFD0	
	FFFF FFD4	4
	FFFF FFD8	0xFFEC
	FFFF FFDC	120
	FFFF FFE0	
	FFFF FFE4	5
	FFFF FFE8	0xFFFFC
	FFFF FFEC	36
	FFFF FFF0	
	FFFF FFF4	
	FFFF FFF8	0xC000
	FFFF FFFC	60

72 add fp, sp, #4

30	Address	Value
sp	FFFF FFA0	
	FFFF FFA4	
	FFFF FFA8	0xFFBC
fp	FFFF FFAC	120
	FFFF FFB0	
	FFFF FFB4	2
	FFFF FFB8	0xFFCC
	FFFF FFBC	120
	FFFF FFC0	
	FFFF FFC4	3
	FFFF FFC8	0xFFDC
	FFFF FFCC	120
	FFFF FFD0	
	FFFF FFD4	4
	FFFF FFD8	0xFFEC
	FFFF FFDC	120
	FFFF FFE0	
	FFFF FFE4	5
	FFFF FFE8	0xFFFFC
	FFFF FFEC	36
	FFFF FFF0	
	FFFF FFF4	
	FFFF FFF8	0xC000
	FFFF FFFC	60

76 sub sp, sp, #8

31	Address	Value
sp	FFFF FFA0	
	FFFF FFA4	1
	FFFF FFA8	0xFFBC
fp	FFFF FFAC	120
	FFFF FFB0	
	FFFF FFB4	2
	FFFF FFB8	0xFFCC
	FFFF FFBC	120
	FFFF FFC0	
	FFFF FFC4	3
	FFFF FFC8	0xFFDC
	FFFF FFCC	120
	FFFF FFD0	
	FFFF FFD4	4
	FFFF FFD8	0xFFEC
	FFFF FFDC	120
	FFFF FFE0	
	FFFF FFE4	5
	FFFF FFE8	0xFFFFC
	FFFF FFEC	36
	FFFF FFF0	
	FFFF FFF4	
	FFFF FFF8	0xC000
	FFFF FFFC	60

```
80 str r0, [fp, #-8]
```

34	Address	Value
	FFFF FFA0	
	FFFF FFA4	1
	FFFF FFA8	0xFFBC
	FFFF FFAC	120
sp	FFFF FFB0	
	FFFF FFB4	2
	FFFF FFB8	0xFFCC
fp	FFFF FFBC	120
	FFFF FFC0	
	FFFF FFC4	3
	FFFF FFC8	0xFFDC
	FFFF FFCC	120
	FFFF FFD0	
	FFFF FFD4	4
	FFFF FFD8	0xFFEC
	FFFF FFDC	120
	FFFF FFE0	
	FFFF FFE4	5
	FFFF FFE8	0xFFFFC
	FFFF FFEC	36
	FFFF FFF0	
	FFFF FFF4	
	FFFF FFF8	0xC000
	FFFF FFFC	60

```
144 pop {pc}
```

32	Address	Value
	FFFF FFA0	
	FFFF FFA4	1
sp	FFFF FFA8	0xFFBC
fp	FFFF FFAC	120
	FFFF FFB0	
	FFFF FFB4	2
	FFFF FFB8	0xFFCC
	FFFF FFBC	120
	FFFF FFC0	
	FFFF FFC4	3
	FFFF FFC8	0xFFDC
	FFFF FFCC	120
	FFFF FFD0	
	FFFF FFD4	4
	FFFF FFD8	0xFFEC
	FFFF FFDC	120
	FFFF FFE0	
	FFFF FFE4	5
	FFFF FFE8	0xFFFFC
	FFFF FFEC	36
	FFFF FFF0	
	FFFF FFF4	
	FFFF FFF8	0xC000
	FFFF FFFC	60

```
136 sub sp, fp, #4
```

35	Address	Value
	FFFF FFA0	
	FFFF FFA4	1
	FFFF FFA8	0xFFBC
	FFFF FFAC	120
	FFFF FFB0	
	FFFF FFB4	2
sp	FFFF FFB8	0xFFCC
fp	FFFF FFBC	120
	FFFF FFC0	
	FFFF FFC4	3
	FFFF FFC8	0xFFDC
	FFFF FFCC	120
	FFFF FFD0	
	FFFF FFD4	4
	FFFF FFD8	0xFFEC
	FFFF FFDC	120
	FFFF FFE0	
	FFFF FFE4	5
	FFFF FFE8	0xFFFFC
	FFFF FFEC	36
	FFFF FFF0	
	FFFF FFF4	
	FFFF FFF8	0xC000
	FFFF FFFC	60

```
136 sub sp, fp, #4
```

33	Address	Value
	FFFF FFA0	
	FFFF FFA4	1
	FFFF FFA8	0xFFBC
sp	FFFF FFAC	120
	FFFF FFB0	
	FFFF FFB4	2
	FFFF FFB8	0xFFCC
fp	FFFF FFBC	120
	FFFF FFC0	
	FFFF FFC4	3
	FFFF FFC8	0xFFDC
	FFFF FFCC	120
	FFFF FFD0	
	FFFF FFD4	4
	FFFF FFD8	0xFFEC
	FFFF FFDC	120
	FFFF FFE0	
	FFFF FFE4	5
	FFFF FFE8	0xFFFFC
	FFFF FFEC	36
	FFFF FFF0	
	FFFF FFF4	
	FFFF FFF8	0xC000
	FFFF FFFC	60

```
140 pop {fp}
```

36	Address	Value
	FFFF FFA0	
	FFFF FFA4	1
	FFFF FFA8	0xFFBC
	FFFF FFAC	120
	FFFF FFB0	
	FFFF FFB4	2
	FFFF FFB8	0xFFCC
sp	FFFF FFBC	120
	FFFF FFC0	
	FFFF FFC4	3
	FFFF FFC8	0xFFDC
fp	FFFF FFCC	120
	FFFF FFD0	
	FFFF FFD4	4
	FFFF FFD8	0xFFEC
	FFFF FFDC	120
	FFFF FFE0	
	FFFF FFE4	5
	FFFF FFE8	0xFFFFC
	FFFF FFEC	36
	FFFF FFF0	
	FFFF FFF4	
	FFFF FFF8	0xC000
	FFFF FFFC	60

```
140 pop {fp}
```


37	Address	Value
	FFFF FFA0	
	FFFF FFA4	1
	FFFF FFA8	0xFFBC
	FFFF FFAC	120
	FFFF FFB0	
	FFFF FFB4	2
	FFFF FFB8	0xFFCC
	FFFF FFBC	120
sp	FFFF FFC0	
	FFFF FFC4	3
	FFFF FFC8	0xFFDC
fp	FFFF FFCC	120
	FFFF FFD0	
	FFFF FFD4	4
	FFFF FFD8	0xFFEC
	FFFF FFDC	120
	FFFF FFE0	
	FFFF FFE4	5
	FFFF FFE8	0xFFFFC
	FFFF FFEC	36
	FFFF FFF0	
	FFFF FFF4	
	FFFF FFF8	0xC000
	FFFF FFFC	60

144 pop {pc}

38	Address	Value
	FFFF FFA0	
	FFFF FFA4	1
	FFFF FFA8	0xFFBC
	FFFF FFAC	120
	FFFF FFB0	
	FFFF FFB4	2
	FFFF FFB8	0xFFCC
	FFFF FFBC	120
	FFFF FFC0	
	FFFF FFC4	3
sp	FFFF FFC8	0xFFDC
fp	FFFF FFCC	120
	FFFF FFD0	
	FFFF FFD4	4
	FFFF FFD8	0xFFEC
	FFFF FFDC	120
	FFFF FFE0	
	FFFF FFE4	5
	FFFF FFE8	0xFFFFC
	FFFF FFEC	36
	FFFF FFF0	
	FFFF FFF4	
	FFFF FFF8	0xC000
	FFFF FFFC	60

136 sub sp, fp, #4

39	Address	Value
	FFFF FFA0	
	FFFF FFA4	1
	FFFF FFA8	0xFFBC
	FFFF FFAC	120
	FFFF FFB0	
	FFFF FFB4	2
	FFFF FFB8	0xFFCC
	FFFF FFBC	120
	FFFF FFC0	
	FFFF FFC4	3
	FFFF FFC8	0xFFDC
sp	FFFF FFCC	120
	FFFF FFD0	
	FFFF FFD4	4
	FFFF FFD8	0xFFEC
fp	FFFF FFDC	120
	FFFF FFE0	
	FFFF FFE4	5
	FFFF FFE8	0xFFFFC
	FFFF FFEC	36
	FFFF FFF0	
	FFFF FFF4	
	FFFF FFF8	0xC000
	FFFF FFFC	60

140 pop {fp}

40	Address	Value
	FFFF FFA0	
	FFFF FFA4	1
	FFFF FFA8	0xFFBC
	FFFF FFAC	120
	FFFF FFB0	
	FFFF FFB4	2
	FFFF FFB8	0xFFCC
	FFFF FFBC	120
	FFFF FFC0	
	FFFF FFC4	3
	FFFF FFC8	0xFFDC
	FFFF FFCC	120
sp	FFFF FFD0	
	FFFF FFD4	4
	FFFF FFD8	0xFFEC
fp	FFFF FFDC	120
	FFFF FFE0	
	FFFF FFE4	5
	FFFF FFE8	0xFFFFC
	FFFF FFEC	36
	FFFF FFF0	
	FFFF FFF4	
	FFFF FFF8	0xC000
	FFFF FFFC	60

144 pop {pc}

41	Address	Value
	FFFF FFA0	
	FFFF FFA4	1
	FFFF FFA8	0xFFBC
	FFFF FFAC	120
	FFFF FFB0	
	FFFF FFB4	2
	FFFF FFB8	0xFFCC
	FFFF FFBC	120
	FFFF FFC0	
	FFFF FFC4	3
	FFFF FFC8	0xFFDC
	FFFF FFCC	120
	FFFF FFD0	
	FFFF FFD4	4
sp	FFFF FFD8	0xFFEC
fp	FFFF FFDC	120
	FFFF FFE0	
	FFFF FFE4	5
	FFFF FFE8	0xFFFFC
	FFFF FFEC	36
	FFFF FFF0	
	FFFF FFF4	
	FFFF FFF8	0xC000
	FFFF FFFC	60

136 sub sp, fp, #4

42	Address	Value
	FFFF FFA0	
	FFFF FFA4	1
	FFFF FFA8	0xFFBC
	FFFF FFAC	120
	FFFF FFB0	
	FFFF FFB4	2
	FFFF FFB8	0xFFCC
	FFFF FFBC	120
	FFFF FFC0	
	FFFF FFC4	3
	FFFF FFC8	0xFFDC
	FFFF FFCC	120
	FFFF FFD0	
	FFFF FFD4	4
	FFFF FFD8	0xFFEC
sp	FFFF FFDC	120
	FFFF FFE0	
	FFFF FFE4	5
	FFFF FFE8	0xFFFFC
fp	FFFF FFEC	36
	FFFF FFF0	
	FFFF FFF4	
	FFFF FFF8	0xC000
	FFFF FFFC	60

140 pop {fp}

43	Address	Value
	FFFF FFA0	
	FFFF FFA4	1
	FFFF FFA8	0xFFBC
	FFFF FFAC	120
	FFFF FFB0	
	FFFF FFB4	2
	FFFF FFB8	0xFFCC
	FFFF FFBC	120
	FFFF FFC0	
	FFFF FFC4	3
	FFFF FFC8	0xFFDC
	FFFF FFCC	120
	FFFF FFD0	
	FFFF FFD4	4
	FFFF FFD8	0xFFEC
	FFFF FFDC	120
sp	FFFF FFE0	
	FFFF FFE4	5
	FFFF FFE8	0xFFFFC
fp	FFFF FFEC	36
	FFFF FFF0	
	FFFF FFF4	
	FFFF FFF8	0xC000
	FFFF FFFC	60

144 pop {pc}

44	Address	Value
	FFFF FFA0	
	FFFF FFA4	1
	FFFF FFA8	0xFFBC
	FFFF FFAC	120
	FFFF FFB0	
	FFFF FFB4	2
	FFFF FFB8	0xFFCC
	FFFF FFBC	120
	FFFF FFC0	
	FFFF FFC4	3
	FFFF FFC8	0xFFDC
	FFFF FFCC	120
	FFFF FFD0	
	FFFF FFD4	4
	FFFF FFD8	0xFFEC
	FFFF FFDC	120
	FFFF FFE0	
	FFFF FFE4	5
sp	FFFF FFE8	0xFFFFC
fp	FFFF FFEC	36
	FFFF FFF0	
	FFFF FFF4	
	FFFF FFF8	0xC000
	FFFF FFFC	60

136 sub sp, fp, #4

45	Address	Value
	FFFF FFA0	
	FFFF FFA4	1
	FFFF FFA8	0xFFBC
	FFFF FFAC	120
	FFFF FFB0	
	FFFF FFB4	2
	FFFF FFB8	0xFFCC
	FFFF FFBC	120
	FFFF FFC0	
	FFFF FFC4	3
	FFFF FFC8	0xFFDC
	FFFF FFCC	120
	FFFF FFD0	
	FFFF FFD4	4
	FFFF FFD8	0xFFEC
	FFFF FFDC	120
	FFFF FFE0	
	FFFF FFE4	5
	FFFF FFE8	0xFFFFC
sp	FFFF FFEC	36
	FFFF FFF0	
	FFFF FFF4	
	FFFF FFF8	0xC000
fp	FFFF FFFC	60

140 pop {fp}

46	Address	Value
	FFFF FFA0	
	FFFF FFA4	1
	FFFF FFA8	0xFFBC
	FFFF FFAC	120
	FFFF FFB0	
	FFFF FFB4	2
	FFFF FFB8	0xFFCC
	FFFF FFBC	120
	FFFF FFC0	
	FFFF FFC4	3
	FFFF FFC8	0xFFDC
	FFFF FFCC	120
	FFFF FFD0	
	FFFF FFD4	4
	FFFF FFD8	0xFFEC
	FFFF FFDC	120
	FFFF FFE0	
	FFFF FFE4	5
	FFFF FFE8	0xFFFFC
sp	FFFF FFEC	36
	FFFF FFF0	
	FFFF FFF4	15
	FFFF FFF8	0xC000
fp	FFFF FFFC	60

36 str r0, [fp, #-8]

47	Address	Value
	FFFF FFA0	
	FFFF FFA4	1
	FFFF FFA8	0xFFBC
	FFFF FFAC	120
	FFFF FFB0	
	FFFF FFB4	2
	FFFF FFB8	0xFFCC
	FFFF FFBC	120
	FFFF FFC0	
	FFFF FFC4	3
	FFFF FFC8	0xFFDC
	FFFF FFCC	120
	FFFF FFD0	
	FFFF FFD4	4
	FFFF FFD8	0xFFEC
	FFFF FFDC	120
	FFFF FFE0	
	FFFF FFE4	5
	FFFF FFE8	0xFFFFC
	FFFF FFEC	36
	FFFF FFF0	
	FFFF FFF4	
sp	FFFF FFF8	0xC000
fp	FFFF FFFC	60

48 sub sp, fp, #4

48	Address	Value
	FFFF FFA0	
	FFFF FFA4	1
	FFFF FFA8	0xFFBC
	FFFF FFAC	120
	FFFF FFB0	
	FFFF FFB4	2
	FFFF FFB8	0xFFCC
	FFFF FFBC	120
	FFFF FFC0	
	FFFF FFC4	3
	FFFF FFC8	0xFFDC
	FFFF FFCC	120
	FFFF FFD0	
	FFFF FFD4	4
	FFFF FFD8	0xFFEC
	FFFF FFDC	120
	FFFF FFE0	
	FFFF FFE4	5
	FFFF FFE8	0xFFFFC
	FFFF FFEC	36
	FFFF FFF0	
	FFFF FFF4	
	FFFF FFF8	0xC000
sp	FFFF FFFC	60

52 pop {fp}, fp = 0xC000

49	Address	Value
	FFFF FFA0	
	FFFF FFA4	1
	FFFF FFA8	0xFFBC
	FFFF FFAC	120
	FFFF FFBO	
	FFFF FFB4	2
	FFFF FFB8	0xFFCC
	FFFF FFBC	120
	FFFF FFC0	
	FFFF FFC4	3
	FFFF FFC8	0xFFDC
	FFFF FFCC	120
	FFFF FFD0	
	FFFF FFD4	4
	FFFF FFD8	0xFFEC
	FFFF FFDC	120
	FFFF FFE0	
	FFFF FFE4	5
	FFFF FFE8	0xFFFC
	FFFF FFEC	36
	FFFF FFF0	
	FFFF FFF4	
	FFFF FFF8	0xC000
	FFFF FFFC	60

56 pop {pc} sp = 0

Register Contents

r0	5	4	3	2	1	3	6	10	15	0			
r2	1	3	6	10									
r3	5	4	3	2	1	2	3	6	4	10	5	15	0
lr	60	36	120	120	120	120	120						

sp	0x0000 0000	0xFFFF FFFC	0xFFFF FFF8	0xFFFF FFF0	0xFFFF FFEC	0xFFFF FFE8
sp	0xFFFF FFE0	0xFFFF FFDC	0xFFFF FFD8	0xFFFF FFD0	0xFFFF FFCC	0xFFFF FFC8
sp	0xFFFF FFC0	0xFFFF FFBC	0xFFFF FFB8	0xFFFF FFB0	0xFFFF FFAC	0xFFFF FFA8
sp	0xFFFF FFA0	0xFFFF FFA8	0xFFFF FFAC	0xFFFF FFB0	0xFFFF FFB8	0xFFFF FFBC
sp	0xFFFF FFC0	0xFFFF FFC8	0xFFFF FFCC	0xFFFF FFD0	0xFFFF FFD8	0xFFFF FFDC
sp	0xFFFF FFE0	0xFFFF FFE8	0xFFFF FFEC	0xFFFF FFF0	0xFFFF FFF8	0xFFFF FFFC
sp	0x0000 0000					

fp	0x0000 C000	0xFFFF FFFC	0xFFFF FFEC	0xFFFF FFDC	0xFFFF FFCC	0xFFFF FFBC
fp	0xFFFF FFAC	0xFFFF FFBC	0xFFFF FFCC	0xFFFF FFDC	0xFFFF FFEC	0xFFFF FFFC
fp	0x0000 C000					
fp						