

Assignment 4 - CT213 Computer Systems & Organization

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1 Source Code

```
.data

.balign 4

Size : .word 6

Fib : .word 0,0,0,0,0,0

.text

.global main

main:
    PUSH {lr}          /*Save return address from main on stack*/
    LDR r0, addr_Size /*r0 has the Address of Size*/
    LDR r0, [r0]        /*r0 has the value of Size*/
    PUSH {r0}          /*Push Size to stack*/
    LDR r0, addr_Fib /*r0 has address of array*/
    PUSH {r0}          /*Push address of the array*/
    BL generate_fib_series /*Call fucntion to generate fib series and populate in array*/
    POP {lr}           /*Repopulate return value with inital exit value*/
    bx lr              /*Terminate the program*/

addr_Size : .word Size

addr_Fib : .word Fib

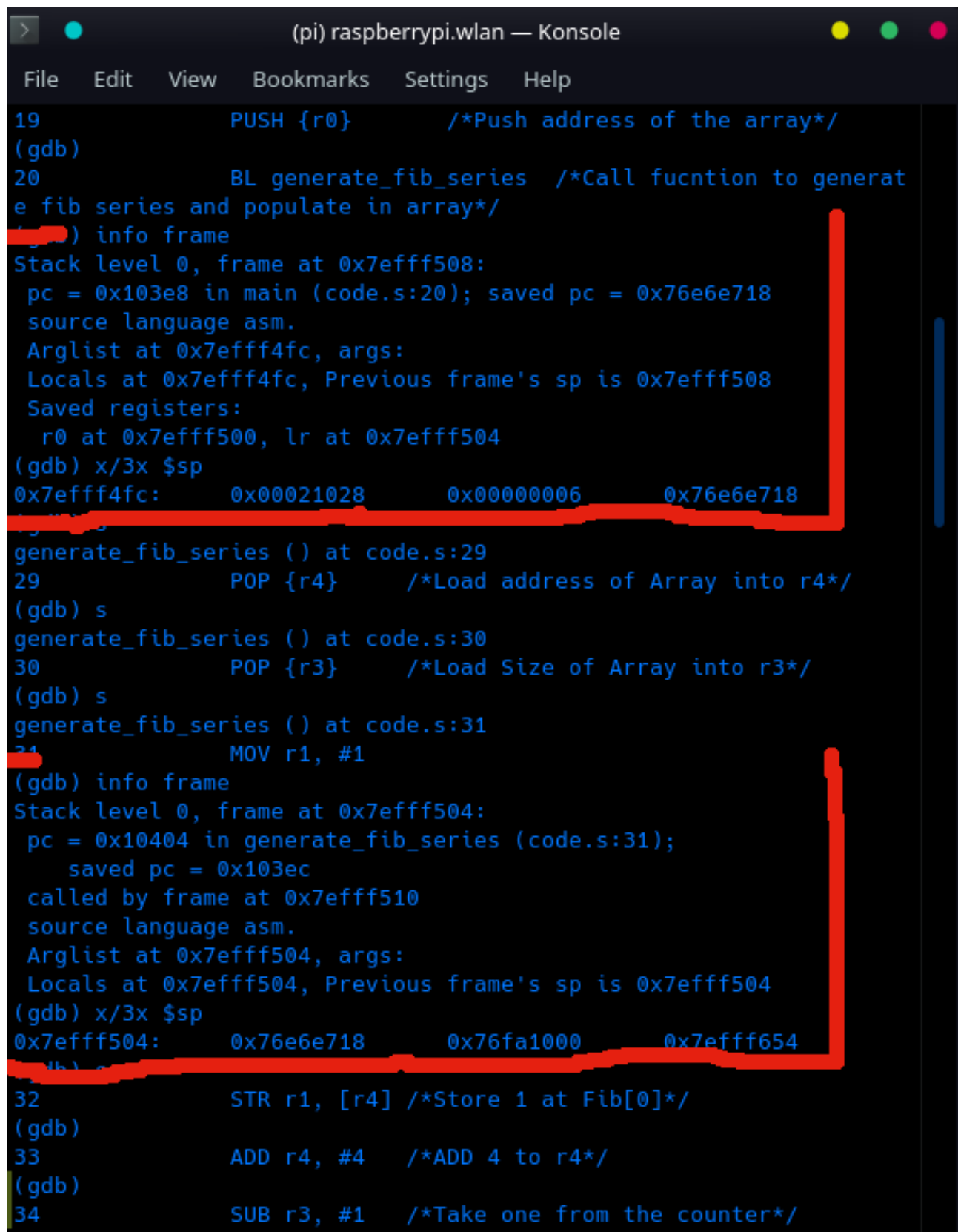
generate_fib_series:
    POP {r4}          /*Load address of Array into r4*/
    POP {r3}          /*Load Size of Array into r3*/
    MOV r1, #1
    STR r1, [r4] /*Store 1 at Fib[0]*/
    ADD r4, #4 /*ADD 4 to r4*/
    SUB r3, #1 /*Take one from the counter*/
    MOV r2, #0 /*Populate r2 with 0*/
    B fib

fib:
    ADD r0, r1, r2 /*Fib[i-1] and Fib[i-2] store in r0*/
    MOV r2, r1 /*Copies r1 into r2*/
    MOV r1, r0 /*Copies r0 into r1*/
    STR r0, [r4] /*Stores r0 into Fib[i]*/
    ADD r4, #4 /*Add 4 to array pointer*/
    SUB r3, #1 /*Take one away from the counter*/
    CMP r3, #0 /*If else counter>0 leave loop if 0 return to start otherwise*/
    BGT fib
    BEQ exit

exit:
    BX lr /*return to main*/
```

2 GDB Screenshots

2.1 First and Second Stack States



```
(pi) raspberrypi.wlan — Konsole
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19          PUSH {r0}          /*Push address of the array*/
(gdb)
20          BL generate_fib_series /*Call fucntion to generate fib series and populate in array*/
(gdb) info frame
Stack level 0, frame at 0x7efff508:
pc = 0x103e8 in main (code.s:20); saved pc = 0x76e6e718
source language asm.
Arglist at 0x7efff4fc, args:
Locals at 0x7efff4fc, Previous frame's sp is 0x7efff508
Saved registers:
r0 at 0x7efff500, lr at 0x7efff504
(gdb) x/3x $sp
0x7efff4fc: 0x00021028 0x00000006 0x76e6e718
(gdb) s
generate_fib_series () at code.s:29
29          POP {r4}          /*Load address of Array into r4*/
(gdb) s
generate_fib_series () at code.s:30
30          POP {r3}          /*Load Size of Array into r3*/
(gdb) s
generate_fib_series () at code.s:31
31          MOV r1, #1
(gdb) info frame
Stack level 0, frame at 0x7efff504:
pc = 0x10404 in generate_fib_series (code.s:31);
saved pc = 0x103ec
called by frame at 0x7efff510
source language asm.
Arglist at 0x7efff504, args:
Locals at 0x7efff504, Previous frame's sp is 0x7efff504
(gdb) x/3x $sp
0x7efff504: 0x76e6e718 0x76fa1000 0x7efff654
(gdb) s
32          STR r1, [r4] /*Store 1 at Fib[0]*/
(gdb)
33          ADD r4, #4 /*ADD 4 to r4*/
(gdb)
34          SUB r3, #1 /*Take one from the counter*/
```

2.2 Final Stack State and Array Values

```
(pi) raspberrypi.wlan — Konsole
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(gdb)
44          CMP r3, #0 /*If else counter>0 leave loop if 0 ret
urn to start otherwise*/
(gdb)
45          BGT fib
(gdb)
46          BEQ exit
(gdb)
exit () at code.s:48
48          BX lr /*return to main*/
(gdb)
main () at code.s:21
21          POP {lr}          /*Repopulate return value with ini
tal exit value*/
(gdb)
main () at code.s:22
22          bx lr          /*Terminate the program*/
(gdb) info frame
Stack level 0, frame at 0x7efff508:
pc = 0x103f0 in main (code.s:22); saved pc = 0x76e6e718
source language asm.
Arglist at 0x7efff508, args:
Locals at 0x7efff508, Previous frame's sp is 0x7efff508
Saved registers:
r0 at 0x7efff500, lr at 0x7efff504
(gdb) x/3x $sp
0x7efff508:    0x76fa1000    0x7efff654    0x00000001
(gdb) x/6 &Fib
0x21028:    0x00000001    0x00000001    0x00000002    0x
00000003
0x21038:    0x00000005    0x00000008
(gdb) s
__libc_start_main (main=0x7efff654, argc=1996099584,
    argv=0x76e6e718 <__libc_start_main+268>,
    init=<optimized out>, fini=0x104a4 <__libc_csu_fini>,
    rtld_fini=0x76fde4c4 <_dl_fini>, stack_end=0x7efff654)
    at libc-start.c:342
342      libc-start.c: No such file or directory.
(gdb)
```

starting at the line with x/6 &Fib the contents of the array are clearly shown

3 Stack State Diagrams

ADDRESS	VALUE
0x7efff504	lr
0x7efff500	Count Value
SP 0x7efff4fc	Fib pointer

Immediately before function call

ADDRESS	VALUE
SP 0x7EFFF504	Return Address
0x7EFFF500	Old Count Value
0x7EFF4FC	Fib Address

Immediately after the variables in the stack are unloaded

ADDRESS	VALUE
SP 0x7EFFF508	
0x7EFFF504	Return Address
0x7EFFF500	Old Count Value
0x7EFF4FC	Fib Address

Final position of the stack pointer