

Zack Rimshnick

I pledge my honor that I have abided by the Stevens Honor System.

HW2 Report

### Task 1: Copy String

Using X23 as my starting string, and X24 as my destination string, after each loop through the program, it adds a new char from my string "zack" to the X24 register. As you can see, after the program is finished, "zack" is stored in X24 destination register

```
Register group: general
x18      0x0      0
x19      0x0      0
x20      0x0      0
x21      0x0      0
x22      0x0      0
x23      0x4100dc  4260060
x24      0x4100e1  4260065
x25      0x0      0
x26      0x0      0
x27      0x0      0

23
24 After:
25
26
27     MOV X0, 0      /* status :=0 */
28     MOV X8, 93     /* exit is syscall #1 */
> 29     SVC 0         /* invoke syscall */
30
31
32 .data
33     src_str: .string "zack" // source string

Remote Thread 1.3033 In: After L29 PC: 0x4000d8
> 0x00000000004000bc <Begin+0>: f4 6a 61 38 ldrb w20, [x23, x1]
> 0x00000000004000c0 <Begin+4>: 14 6b 21 38 strb w20, [x24, x1]
> 0x00000000004000c4 <Begin+8>: 74 00 00 34 cbz w20, 0x4000d0 <After>
After () at strcpy.s:27
> 0x00000000004000d0 <After+0>: 00 00 80 d2 mov x0, #0x0
// #0
> 0x00000000004000d4 <After+4>: a8 0b 80 d2 mov x8, #0x5d
// #93
> 0x00000000004000d8 <After+8>: 01 00 00 d4 svc #0x0
gdb) x/s 4260065
x4100e1: "zack"
gdb) □
```

## Task 2: Reversing Nibbles

First, my program reverses each nibble and stores it in its original location in memory, but with its 2 digits flipped:

```
Register group: general
x21      0x1      1
x22      0x0      0
x23      0x410128 4260136
x24      0x4      4
x25      0x4      4
x26      0x0      0
x27      0x0      0
x28      0x0      0

reverse.s
33      LSL    W5, W4, 4      // left shift 4 removes the 0s from right
34      ORR    W5, W5, W3     // logical OR to combine the two into a nibble
35      STRB    W5, [X1, X25] // stores flipped nibble in its old place
36
37      ADD    X25, X25, 1
38      ADD    X20, X20, 1     // increment counter
> 39      SUB    X19, X24, X20
40      CBZ    X19, StartNibble // if counter-4 is 0, then do next nibble
41
42      B      DoNibble       // Does donibble again

remote Thread 1.4918 In: DoNibble L39 PC: 0x400104
=> 0x00000000004000e8 <DoNibble+8>: 44 0c 04 53 lsl w4, w2, #28
=> 0x00000000004000ec <DoNibble+12>: 84 7c 1c 53 lsr w4, w4, #28
=> 0x00000000004000f0 <DoNibble+16>: 85 6c 1c 53 lsl w5, w4, #4
=> 0x00000000004000f4 <DoNibble+20>: a5 00 03 2a orr w5, w5, w3
=> 0x00000000004000f8 <DoNibble+24>: 25 68 39 38 strb w5, [x1, x25]
=> 0x00000000004000fc <DoNibble+28>: 39 07 00 91 add x25, x25, #0x1
=> 0x0000000000400100 <DoNibble+32>: 94 06 00 91 add x20, x20, #0x1
=> 0x0000000000400104 <DoNibble+36>: 13 03 14 cb sub x19, x24, x20
(gdb) x/3xw &arr
0x41011c: 0x21fbad90 0x0998dcab 0x65879801
(gdb)
```

Next, it swaps the first and last nibbles in each word as well as the middle two nibbles in each word:

```
Register group: general
x0      0x0      0
x1      0x41015c 4260188
x2      0x12     18
x3      0x1      1
x4      0x2      2
x5      0x21     33
x6      0x21     33
x7      0x90     144

reverse.s
64      Swapping:
65
66
67
68
B+> 69      MOV    X0, 0      /* status :=0 */
70      MOV    X8, 93       /* exit is syscall #1 */
71      SVC    0           /* invoke syscall */
72
73

remote Thread 1.5456 In: Swapping L69 PC: 0x400150
(gdb) b 64
Breakpoint 1 at 0x400150: file reverse.s, line 69.
(gdb) c
Continuing.

Breakpoint 1, Swapping () at reverse.s:69
=> 0x0000000000400150 <Swapping+0>: 00 00 80 d2 mov x0, #0x0
// #0
(gdb) x/3xw &arr
0x41015c: 0x90adfb21 0xabdc9809 0x01988765
(gdb)
```

Then, as a result in reverses the order of words:

```
Register group: general
x0      0x0      0
x1      0x4101a0 4260256
x2      0x12     18
x3      0x1      1
x4      0x2      2
x5      0x21     33
x6      0x21     33
x7      0x90     144

87      B      SwappingWords // loops back and does again
88
89      Done:
90
B+> 91      MOV X0, 0 /* status :=0 */
92      MOV X8, 93 /* exit is syscall #1 */
93      SVC 0 /* invoke syscall */
94
95
96      .data

remote Thread 1.6021 In: Done L91 PC: 0x400194
(gdb) b 89
Breakpoint 1 at 0x400194: file reverse.s, line 91.
(gdb) c
Continuing.

Breakpoint 1, Done () at reverse.s:91
=> 0x000000000000400194 <Done+0>: 00 00 80 d2 mov x0, #0x0
// #0
(gdb) x/3xw &arr
0x4101a0: 0x01988765 0xabdc9809 0x90adfb21
(gdb)
```

And gets the correct answer