CPE 233 Software Assignment 1

Introduction to Assembly Language Programming

Report by:
Ethan Vosburg (evosburg@calpoly.edu)
Lawrence Nichols (lnicho06@calpoly.edu)

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1 Flow Charts

Figure 1: Adding Three Numbers Flow Chart

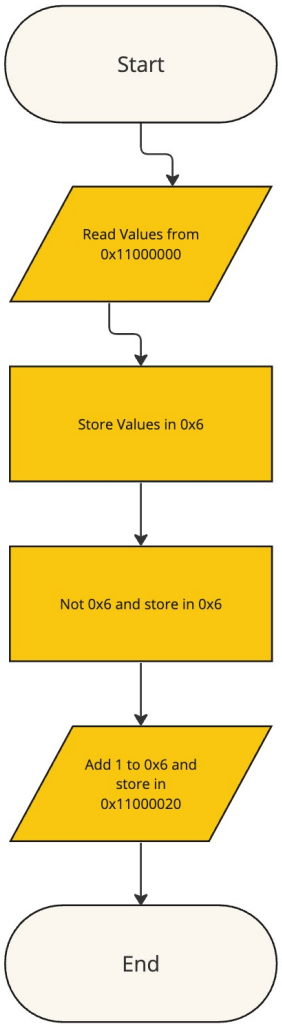

Figure 2: RC Number Flow Chart

2 Assembly Instructions

Below is the assembly instructions for each flow chart.

Listing 1: Assembly instructions for Adding Three Numbers in Figure 1

```
1 lui     x5, 0x11000     // Load Upper immediate
2 lh      x6, 0(x5)       // Load Halfword at Switches Register
3 lh      x7, 0(x5)       // Load Halfword at Switches Register
4 lh      x8, 0(x5)       // Load Halfword at Switches Register
5 add     x9, x6, x7      // Add x6 to x7 and store in x9
6 add     x9, x9, x8      // Add x9 to x8 and store in x9
7 sh      x9, 0x20(x5)    // Store Half Word into LED Register
```

Table 1: Adding Three Numbers Machine Code

Address	Machine Code (Hex)	Assembly Instruction
0000	0x110002b7	lui x5, 0x11000
0004	0x00029303	lh x6, 0(x5)
0008	0x00029383	lh x7, 0(x5)
000c	0x00029403	lh x8, 0(x5)
0010	0x007304b3	add x9, x6, x7
0014	0x008484b3	add x9, x9, x8
0018	0x02929023	sh x9, 0x20(x5)

Listing 2: Assembly instructions for RC Number in Figure 2

```
1 lui     x5, 0x11000     // Load Upper Immediate
2 lh      x6, 0(x5)       // Load Halfword at Switches Register
3 not     x6, x6          // Not Value at Register Six
4 addi    x6, x6, 0x1     // Add One to Register Six
5 sh      x6, 0x20(x5)    // Store Changed Value
```

Table 2: RC Number Machine Code

Address	Machine Code (Hex)	Assembly Instruction
0x00000000	0x00000000	0x00000000
0x00000004	0x0000fffc	0x0000fffc
0x00001010	0x0000eff0	0x0000eff0)
0x00007fff	0x00008001	0x00008001
0x00008001	0x00007fff	0x00007fff

3 RARS Verification

Table 3: Flow Chart 1 Test Cases

Input (0x6)	Input (0x7)	Input (0x8)	Expected Output	Actual Output
0x00000000	0x00000000	0x00000000	0x00000000	0x00000000
0x00005555	0x00005555	0x00005555	0x0000ffff	0x0000ffff
0x00000064	0x00000064	0x00000064	0x0000012c	0x0000012c
0x00000173	0x00000173	0x00000173	0x00000459	0x00000459
0x0000555A	0x0000555A	0x0000555A	0x0000000e	0x0000000e

The test cases above demonstrate the code performs the desired outputs.
Test case 1 shows the zero case.
Test case 2 shows the upper limit of the writing capability of sh.
Test case 3-4 shows simple addition of three inputs
Test case 5 shows an overflow situation where the writing capability of sh is exceeded.

Table 4: Flow Chart 2 Test Cases

Input	Expected Output	Actual Output
0x00000000	0x00000000	0x00000000
0x00000004	0x0000fffc	0x0000fffc
0x00001010	0x0000eff0	0x0000eff0
0x00007fff	0x00008001	0x00008001
0x00008001	0x00007fff	0x00007fff

The test cases above demonstrate the code performs the desired outputs.
Test case 1 shows the zero case.
Test case 2 shows a positive value outputs a negative one
Test case 3 shows a negative which outputs a positive value
Test case 4 shows the max positive value output
Test case 5 shows the max negative value output