ARM Instructions Worksheet #3
Addressing Modes

Prerequisite Reading: Chapter 4
Revised: March 26, 2020

Objectives: To use the web-based simulator (“CPUlator”) to better understand the four addressing modes:

1. Immediate Offset Addressing: [R1] and [R1,4]
2. Register Offset Addressing: [R1,R2] and [R1,R2,LSL 2]
3. Post-Indexed Addressing: [R1],4
4. Pre-Indexed Addressing: [R1,4]!

To do offline: Answer the questions that follow the listing below. (Numbers at far left are memory addresses.)

```assembly
.syntax unified
.global _start
.skip 0x100

Array32: .word 0xBEEFBEEF  // uint32_t Array[4];
Array32 .word 0xC0DEC0DE
Array32 .word 0xF00DF00D
Array32 .word 0xFACEFACE

_start: LDR R1,=Array32  // *** EXECUTION STARTS HERE ***
_start LDR R0,[R1]   // Address provided by R1
_start LDR R0,[R1,4]  // Address = R1 + 4

_R1: LDR R2,=8         // R2 = Offset = 8
_start LDR R0,[R1,R2] // Address = R1 + R2
_start LDR R2,=3       // R2 = Subscript = 3
_start LDR R0,[R1,R2,LSL 2] // Address = R1 + 4*R2
_start LDR R0,[R1],4   // Address = R1; Post-Increment
_start LDR R0,[R1,4]!  // Address = R1 + 4; Pre-Increment

done: B done          // infinite loop
.end
```

What hex **address** is copied into R1 by the LDR instruction at address 00000110_{16}?

What hex **data** is copied from the address in R1 by the LDR at address 00000114_{16}?

What hex **data** is copied into R0 by the LDR instruction at address 00000118_{16}?

What hex **address** did that value come from?

What hex **data** is copied into R0 by the LDR instruction at address 00000120_{16}?

What hex **address** did that value come from?
What hex _data_ is copied into R0 by the LDR instruction at address 00000128\(_{16}\)?

What hex _address_ did that value come from?

What hex _data_ is copied into R0 by the LDR instruction at address 0000012C\(_{16}\)?

What hex _address_ did that value come from?

What hex _address_ is left in R1 by the LDR instruction at address 0000012C\(_{16}\)?

What hex _data_ is copied into R0 by the LDR instruction at address 00000130\(_{16}\)?

What hex _address_ did that value come from?

What hex _address_ is left in R1 by the LDR instruction at address 00000130\(_{16}\)?

**Getting ready: Now use the simulator to collect the following information and compare to your earlier answers.**

1. Click [here](#) to open a browser for the ARM instruction simulator with pre-loaded code.
2. Press Ctrl-M to open the memory display window and drag-n-drop it about halfway to the right.
3. In the “Memory” window, enter 0x100 into the search box and press Enter to highlight that address for easy reference.

**Step 1:** Press F2 exactly 2 times to execute the first two LDR instructions. (The 3rd LDR should be highlighted in yellow.)

What hex _address_ is copied into R1 by the LDR instruction at address 00000110\(_{16}\)?

What hex _data_ is copied from the address in R1 by the LDR at address 00000114\(_{16}\)?

**Step 2:** Press F2 exactly once to execute the LDR R0, [R1, #4]

What hex _data_ is copied into R0 by the LDR instruction at address 00000118\(_{16}\)?

What hex _address_ did that value come from?

**Step 3:** Press F2 exactly 2 times to execute the LDR R2, =8 (MOV R2, #8) and the LDR R0, [R1, R2]

What hex _data_ is copied into R0 by the LDR instruction at address 00000120\(_{16}\)?

What hex _address_ did that value come from?

**Step 4:** Press F2 exactly 2 times to execute the LDR R2, =3 (MOV R2, #3) and the LDR R0, [R1, R2, LSL #2]

What hex _data_ is copied into R0 by the LDR instruction at address 00000128\(_{16}\)?

What hex _address_ did that value come from?

**Step 5:** Press F2 exactly once to execute the LDR R0, [R1], #4

What hex _data_ is copied into R0 by the LDR instruction at address 00000130\(_{16}\)?

What hex _address_ did that value come from?

What hex _address_ is left in R1 by the LDR instruction at address 00000130\(_{16}\)?

**Step 6:** Press F2 exactly once to execute the LDR R0, [R1, #4]!

What hex _data_ is copied into R0 by the LDR instruction at address 00000130\(_{16}\)?

What hex _address_ did that value come from?

What hex _address_ is left in R1 by the LDR instruction at address 00000130\(_{16}\)?