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.)

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

00000100  Array32:  .word  0xBEEFBEEF          // uint32_t Array[4] ;
00000104            .word  0xC0DEC0DE
00000108            .word  0xF00DF00D
0000010C            .word  0xFACEFACE

00000110  _start:   LDR    R1,=Array32         // *** EXECUTION STARTS HERE ***
00000114            LDR    R0,[R1]             // Address provided by R1
00000118            LDR    R0,[R1,4]           // Address = R1 + 4

0000011C            LDR    R2,=8               // R2 = Offset = 8
00000120            LDR    R0,[R1,R2]          // Address = R1 + R2

00000124            LDR    R2,=3               // R2 = Subscript = 3
00000128            LDR    R0,[R1,R2,LSL 2]    // Address = R1 + 4*R2

0000012C            LDR    R0,[R1],4           // Address = R1; Post-Increment
00000130            LDR    R0,[R1,4]!          // Address = R1 + 4; Pre-Increment

00000134  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 $0000012C_{16}$?

What hex _address_ did that value come from?

What hex _address_ is left in R1 by the LDR instruction at address $0000012C_{16}$?

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}?