

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 00000110₁₆?

What hex data is copied from the address in R1 by the LDR at address 00000114₁₆?

What hex data is copied into R0 by the LDR instruction at address 00000118₁₆?

What hex address did that value come from?

What hex data is copied into R0 by the LDR instruction at address 00000120₁₆?

What hex address did that value come from?

What hex data is copied into R0 by the LDR instruction at address 00000128₁₆?

0xFACEFACE

What hex address did that value come from?

0000010C

What hex data is copied into R0 by the LDR instruction at address 0000012C₁₆?

0xBEEFBEEF

What hex address did that value come from?

00000100

What hex address is left in R1 by the LDR instruction at address 0000012C₁₆?

00000104

What hex data is copied into R0 by the LDR instruction at address 00000130₁₆?

0xF00DF00D

What hex address did that value come from?

00000108

What hex address is left in R1 by the LDR instruction at address 00000130₁₆?

00000108

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 00000110₁₆?

00000100

What hex data is copied from the address in R1 by the LDR at address 00000114₁₆?

beefbeef

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 00000118₁₆?

c0dec0de

What hex address did that value come from?

00000104

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 00000120₁₆?

f00df00d

What hex address did that value come from?

00000108

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 00000128₁₆?

faceface

What hex address did that value come from?

0000010c

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 0000012C₁₆?

beefbeef

What hex address did that value come from?

00000100

What hex address is left in R1 by the LDR instruction at address 0000012C₁₆?

00000104

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 00000130₁₆?

f00df00d

What hex address did that value come from?

00000108

What hex address is left in R1 by the LDR instruction at address 00000130₁₆?

00000108