### ARM Instructions Worksheet #7

#### Shift Instructions

**LSL, LSR, ASR, ROR, and RRX**

Prerequisite Reading: Chapter 7  
Revised: March 26, 2020

**Objectives:** To use the web-based simulator ("CPUlator") to better understand ...

1. The operation of the basic shift instructions (LSL, LSR, ASR, ROR, and RRX)
2. The relationship between the shift instructions and the carry flag (C)

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

```assembly
.syntax unified
.global _start

00000000  _start:  LDR  R0,=0x00000001  //*** EXECUTION STARTS HERE ***
00000004  LSLS  R1,R0,1
00000008  LDR  R0,=0x80000000
0000000C  LSLS  R1,R0,1
00000010  LDR  R0,=0x00000000
00000014  LSR  R1,R0,1
00000018  ASR  R1,R0,1
0000001C  LDR  R0,=0x80000000
00000020  LSR  R1,R0,1
00000024  ASR  R1,R0,1
00000028  ROR  R1,R0,1
0000002C  RRX  R1,R0
00000030  done:  B  done

.end
```

What is in R1 and R0 after the instructions at 0000000016 and 0000000416?  
R1 (as hexadecimal)  
R0 (as hexadecimal)

What is in the carry flag (CPSR bit 29) by the LSLS instruction at address 0000000416?  
Carry Flag (C)

What is in R1 and R0 after the instructions at 0000000816 and 0000000C16?  
R1 (as hexadecimal)  
R0 (as hexadecimal)

What is in the carry flag (CPSR bit 29) by the LSLS instruction at address 0000000C16?  
Carry Flag (C)

What is in R1 and R0 after the instructions at 0000001016 and 0000001416?  
R1 (as hexadecimal)  
R0 (as hexadecimal)
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.

Step 1: Press F2 exactly 2 times to execute the instructions at addresses 00000000\(_{16}\) and 00000004\(_{16}\)

What is in R1 and R0 after the instructions at 00000000\(_{16}\) and 00000004\(_{16}\)?

What is in the carry flag (CPSR bit 29) by the LSLS instruction at address 00000004\(_{16}\)?

Step 2: Press F2 exactly 2 times to execute the instructions at addresses 00000008\(_{16}\) and 0000000C\(_{16}\)

What is in R1 and R0 after the instructions at 00000008\(_{16}\) and 0000000C\(_{16}\)?

What is in the carry flag (CPSR bit 29) by the LSLS instruction at address 0000000C\(_{16}\)?

Step 3: Press F2 exactly 2 times to execute the instructions at addresses 00000010\(_{16}\) and 00000014\(_{16}\)

What is in R1 and R0 after the instructions at 00000010\(_{16}\) and 00000014\(_{16}\)?

Step 4: Press F2 exactly once to execute the ASR R1, R0, 1 instruction at address 00000018\(_{16}\).

What is in R1 and R0 after the ASR instruction at address 00000018\(_{16}\)?

Step 5: Press F2 exactly 2 times to execute the instructions at addresses 0000001C\(_{16}\) and 00000020\(_{16}\).

What is in R1 and R0 after the instructions at 0000001C\(_{16}\) and 00000020\(_{16}\)?

Step 6: Press F2 exactly once to execute the second ASR R1, R0, 1 instruction at address 00000024\(_{16}\).

What is in R1 and R0 after the ASR instruction at address 00000024\(_{16}\)?

Step 7: Press F2 exactly once to execute the ROR R1, R0, 1 instruction at address 00000028\(_{16}\).

What is in R1 and R0 after the ROR instruction at address 00000028\(_{16}\)?

Step 8: Press F2 exactly once to execute the RRX R1, R0 instruction at address 0000002C\(_{16}\).

What is in R1 and R0 after the RRX instruction at address 0000002C\(_{16}\)?