IIT PALAKKAD

Indian Institute of Technology Palakkad
भारतीय प्रौद्योगिकी संस्थान पालक्काड
Under Ministry of Human Resource Development, Govt. of India
मानव संसाधन विकास मंत्रालय के अधीन, भारत सरकार

# CS-5009: Lab 1 – Worksheet

**Roll No: 111601032** **Date: 09-08-2019**
**Name: Himanshu Rai**

## Part 1: Memory access and moving data

<table>
<tr><th>Instruction</th><th colspan="8">Value after execution of instruction</th></tr>
<tr><td>LDR R1, const_val</td><td colspan="8">R1 = 0xDEADBEEF</td></tr>
<tr><td rowspan="3">LDR R0, =const_val</td><td colspan="8">R0 = 0x00000208</td></tr>
<tr><td colspan="8">First 8 bytes of memory starting at address in R0</td></tr>
<tr><td>EF</td><td>BE</td><td>AD</td><td>DE</td><td>08</td><td>02</td><td>00</td><td>00</td></tr>
<tr><td>LDR R1, [R0]</td><td colspan="8">R1 = 0xDEADBEEF</td></tr>
<tr><td>LDRH R1, [R0]</td><td colspan="8">R1 = 0x0000BEEF</td></tr>
<tr><td>LDRB R1, [R0]</td><td colspan="8">R1 = 0x000000EF</td></tr>
<tr><td>LDR R0, =equate_val</td><td colspan="8">R0 = 0x8BADF00D</td></tr>
<tr><td>LDR R1, =const_val</td><td colspan="8">R1 = 0x00000208</td></tr>
<tr><td>MOV R2, R0</td><td colspan="4">R0 = 0x8BADF00D</td><td colspan="4">R2 = 0x8BADF00D</td></tr>
<tr><td>MOVS R2, #0</td><td colspan="8">R2 = 0x00000000</td></tr>
</table>

**Question:** ***LDR R0, =const_val*** **has different behavior than** ***LDRR0, =equate_val*****.**
ANSWER – Because of the way they are declared – one using EQU and other using DCD.

Department of Computer Science and Engineering,
Indian Institute of Technology Palakkad,
Ahalia Integrated Campus,
Kozhippara P. O, Palakkad, Kerala, Pin: 678557

## Part 2: Arithmetic and logic operations

| Instruction | Value after execution of instruction | | | |
|---|---|---|---|---|
| MSR APSR, R0 (first) | R1 = 0x00000032 | R2 = 0x0000007B | R3 = 0xFFFFFFF0 | |
| | N = 0 | Z = 0 | C = 0 | V = 0 |
| ADDS R2, R1 | R1 = 0x00000032 | | R2 = 0x000000AD | |
| | N = 0 | Z = 0 | C = 0 | V = 0 |
| SUBS R2, R1 | R1 = 0x00000032 | | R2 = 0x0000007B | |
| | N = 0 | Z = 0 | C = 1 | V = 0 |
| ADDS R3, R1 | R1 = 0x00000032 | | R3 = 0x00000022 | |
| | N = 0 | Z = 0 | C = 1 | V = 0 |
| SUBS R3, R1 | R1 = 0x00000032 | | R3 = 0xFFFFFFF0 | |
| | N = 1 | Z = 0 | C = 0 | V = 0 |
| MSR APSR, R0 (second) | R1 = 0x00000032 | R2 = 0x0000007B | R3 = 0xFFFFFFF0 | |
| | N = 0 | Z = 0 | C = 0 | V = 0 |
| ADD R3, R1 | R1 = 0x00000032 | | R3 = 0x00000022 | |
| | N = 0 | Z = 0 | C = 0 | V = 0 |
| CMP R1, R2 | R1 = 0x00000032 | | R2 = 0x0000007B | |
| | N = 1 | Z = 0 | C = 0 | V = 0 |
| CMP R2, R1 | R1 = 0x00000032 | | R2 = 0x0000007B | |
| | N = 0 | Z = 0 | C = 1 | V = 0 |
| CMP R1, R1 | R1 = 0x00000032 | | | |
| | N = 0 | Z = 1 | C = 1 | V = 0 |
| CMP R1, #0x40 | R1 = 0x00000032 | | | |
| | N = 1 | Z = 0 | C = 0 | V = 0 |
| CMP R2, #0x40 | R1 = 0x00000032 | | | |
| | N = 0 | Z = 0 | C = 1 | V = 0 |

| | | | | |
|---|---|---|---|---|
| CMP R1, R3 | R1 = 0x00000032 | | R3 = 0x00000022 | |
| | N = 0 | Z = 0 | C = 1 | V = 0 |
| CMN R1, R3 | R1 = 0x00000032 | | R3 = 0x00000022 | |
| | N = 0 | Z = 0 | C = 0 | V = 0 |

## Part 3: Unconditional Branches

| Instruction | Value after execution of instruction |
|---|---|
| B spot3 | R15 (PC) = 0x000001F8 |
| B spot4 | R15 (PC) = 0x000001FA |
| B spot2 | R15 (PC) = 0x000001F6 |
| B spot1 | R15 (PC) = 0x000001F4 |

**Question:**

*What is the address of:*

spot1: 0x000001F4

spot2: 0x000001F6

spot3: 0x000001F8

spot4: 0x000001FA

## Part 4: Conditional Branches

***BNE Instruction***

| Loop | Instruction | Value after execution of instruction | | | |
|---|---|---|---|---|---|
| 1 | SUBS R0, #1 | R0 = 0x00000002 | | | |
| | | N = 0 | Z = 0 | C = 1 | V = 0 |
| | BNE dec_cnt | R15 (PC) = 0x000001F6 | | | |
| 2 | SUBS R0, #1 | R0 = 0x00000001 | | | |
| | | N = 0 | Z = 0 | C = 1 | V = 0 |
| | BNE dec_cnt | R15 (PC) = 0x000001F6 | | | |
| 3 | SUBS R0, #1 | R0 = 0x00000000 | | | |

| | | | | | |
|---|---|---|---|---|---|
| | | N = 0 | Z = 1 | C = 1 | V = 0 |
| | BNE dec_cnt | R15 (PC) = 0x000001FA | | | |
| 4 | SUBS R0, #1 | R0 = 0x00000002 | | | |
| | | N = 0 | Z = 0 | C = 1 | V = 0 |
| | BNE dec_cnt | R15 (PC) = 0x000001F6 | | | |

***BGE Instruction***

| Loop | Instruction | Value after execution of instruction | | | |
|---|---|---|---|---|---|
| 1 | SUBS R0, #1 | R0 = 0x00000002 | | | |
| | | N = 0 | Z = 0 | C = 1 | V = 0 |
| | BGE dec_cnt | R15 (PC) = 0x000001F6 | | | |
| 2 | SUBS R0, #1 | R0 = 0x00000001 | | | |
| | | N = 0 | Z = 0 | C = 1 | V = 0 |
| | BGE dec_cnt | R15 (PC) = 0x000001F6 | | | |
| 3 | SUBS R0, #1 | R0 = 0x00000000 | | | |
| | | N = 0 | Z = 1 | C = 1 | V = 0 |
| | BGE dec_cnt | R15 (PC) = 0x000001F6 | | | |
| 4 | SUBS R0, #1 | R0 = 0xFFFFFFFF | | | |
| | | N = 1 | Z = 0 | C = 0 | V = 0 |
| | BGE dec_cnt | R15 (PC) = 0x000001FA | | | |

## Part 5: Subroutines with Linked Branches

| Loop | Instruction | Value after execution of instruction |
|---|---|---|
| 1 | LDR R0, =value1 | R0 = 0x1FFFF000 |
| | | First 4 bytes of memory starting at address in R0 |
| | | 00 \| 00 \| 00 \| 00 |
| 1 | BL change_value | R14 (LR) = 0x00000217 |
| | | R15 (PC) = 0x0000021E |
| 1 | LDR R0, =value2 | R0 = 0x1FFFF004 |
| | | First 4 bytes of memory starting at address in R0 |
| | | 00 \| 00 \| 00 \| 00 |
| 1 | BL change_value | R14 (LR) = 0x0000021D |
| | | R15 (PC) = 0x0000021E |
| 2 | LDR R0, =value1 | R0 = 0x1FFFF000 |
| | | First 4 bytes of memory starting at address in R0 |
| | | 01 \| 00 \| 00 \| 00 |
| 2 | BL change_value | R14 (LR) = 0x00000217 |
| | | R15 (PC) = 0x0000021E |
| 2 | LDR R0, =value2 | R0 = 0x1FFFF004 |
| | | First 4 bytes of memory starting at address in R0 |
| | | 05 \| 00 \| 00 \| 00 |
| 2 | BL change_value | R14 (LR) = 0x0000021D |
| | | R15 (PC) = 0x0000021E |

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