# CS-5009: Lab 1 – Worksheet

**Roll No: 111601032** **Date: 09-08-2019**

**Name: Himanshu Rai**

Part 1: Memory access and moving data

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Instruction** | **Value after execution of instruction** | | | | | | | |
| LDR R1, const\_val | R1 = 0xDEADBEEF | | | | | | | |
| LDR R0, =const\_val | R0 = 0x00000208 | | | | | | | |
| First 8 bytes of memory starting at address in R0 | | | | | | | |
| EF | BE | AD | DE | 08 | 02 | 00 | 00 |
| LDR R1, [R0] | R1 = 0xDEADBEEF | | | | | | | |
| LDRH R1, [R0] | R1 = 0x0000BEEF | | | | | | | |
| LDRB R1, [R0] | R1 = 0x000000EF | | | | | | | |
| LDR R0, =equate\_val | R0 = 0x8BADF00D | | | | | | | |
| LDR R1, =const\_val | R1 = 0x00000208 | | | | | | | |
| MOV R2, R0 | R0 = 0x8BADF00D | | | | R2 = 0x8BADF00D | | | |
| MOVS R2, #0 | R2 = 0x00000000 | | | | | | | |

Question: *LDR R0, =const\_val* has different behavior than *LDR R0, =equate\_val*.

ANSWER – Because of the way they are declared – one using EQU and other using DCD.

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 | | | |