Exercises

For these questions remember to consult to the ARMv8-M Architecture Reference Manual when in doubt.

1. How does the word 0xdec0ded1 appear in memory in a little-endian memory system and a big-endian memory system.

|  |  |  |
| --- | --- | --- |
| Address | Little-endian | Big-endian |
| n | 0xd1 | 0xde |
| n+1 | 0xde | 0xc0 |
| n+2 | 0xc0 | 0xde |
| n+3 | 0xde | 0xd1 |

1. Does the stack grow toward larger or smaller addresses?

Smaller addresses.

1. Assuming that SP is 0x0000\_2220 initially, what is its value after executing the instruction PUSH {r0,r2}?

2 registers \* 4 bytes each = 8 bytes (0x08)

SP=0x0000\_2220 – 0x08 = 0x0000\_2218

1. Assuming that SP is 0x0000\_2010 initially, what is its value after executing the instruction POP {r0-r7,PC}?

9 registers \* 4 bytes each = 36 bytes (0x24)

SP=0x0000\_2220 + 0x24 = 0x0000\_2244

1. Write the Thumb code to add five to the contents of register r6.

ADDS r6, #5

1. Write the Thumb code to subtract 1000 from the contents of register r6, using r3 as a temporary register.

LDR r3,=1000

SUBS r6, r3

1. Write the Thumb code to multiply the two 32-bit in memory at addresses 0x1234\_5678 and 0x7894\_5612, storing the result in address 0x2000\_0010.

LDR r0, =0x12345678

LDR r1, [r0]

LDR r0,=0x78945612

LDR r2, [r0]

MULS r2, r1, r2

LDR r0,=0x20000010

STR r2, [r0]

1. Write the Thumb code to load register r0 with the letter ‘E’ if the number in r12 is even, or else the letter ‘O’ if it is odd.

MOV r12, r7

LDR r0, =1

ANDS r0, r7

BNE Odd

LDR r0,=’E’

B Done

Odd

LDR r0,=’O’

Done

… next instruction

1. Why would you use a BLX instruction rather than a BX instruction?

The BLX instruction saves the return (link) address, so it is used as a subroutine call. The BX instruction doesn’t save the return address, so it is used as a subroutine return or computed jump instead.

1. Why would you use a BL instruction rather than a BLX instruction?

Both instructions can be used to call subroutines. BLX requires the target address to already be stored in a register. BL uses an address which is computed as the current PC address plus an offset which is stored in the instruction.

1. Write the Thumb code to call a subroutine at address 0x6555\_8888. Where is the return address located?

LDR r0,=0x65558888

BLX r0

The return address is stored in the link register (lr, r14).