CPE 221 Classwork 12: Machine Code in ARM

Student Name (as in Canvas): _____

A Number: _____

Points: 20

1 Identify Shift Amount (10 Points)

Determine the shift amount used in the instruction whose machine code is `0xE0443205`

Solution

Shift amount is 4.

Explanation

- In Binary: 1110 0000 0100 0100 0011 0010 0000 0101
- By looking at bits 11:7, we see that shift amount is 0010 0 which is 4 in decimal.

The instruction is `SUB R3, R4, R5, LSL #4`.

2 Encode MOV Instruction (5 Points)

Encode the assembly instruction `MOV FP, SP` into machine code.

Solution

`0xE1A0B00D`
(If followed from the CPULator)
or
`0xE3A0B00D` (If followed the rules mentioned in the slide)

Explanation

`0xE3A0B00D` (If followed the rules mentioned in the slide, sets I = 1)

31:28 (cond)	27:26 (op)	25:20 (I, cmd, S)	19:16 (Rn)	15:12 (Rd)	11:0 (Src2)
1110	00	1 1101 0	0000	1011	Src2
4 bits	2 bits	6 bits	4 bits	4 bits	12 bits

Src2:

Bits 11:7 (shamt5)	Bits 6:5 (sh)	Bit 4	Bits 3:0 (Rm)
00000	00	0	1101

`0xE1A0B00D` (If followed the rules mentioned in the slide, sets I = 0)
Note that this is the correct interpretation.

31:28 (cond)	27:26 (op)	25:20 (I, cmd, S)	19:16 (Rn)	15:12 (Rd)	11:0 (Src2)
1110	00	0 1101 0	0000	1011	Src2
4 bits	2 bits	6 bits	4 bits	4 bits	12 bits

Src2:

Bits 11:7 (shamt5)	Bits 6:5 (sh)	Bit 4	Bits 3:0 (Rm)
00000	00	0	1101

3 Encode ROR Instruction (5 Points)

Encode the assembly instruction `ROR R0, R5, R7` into machine code.

Solution

`E1A00775`

Explanation

31:28 (cond)	27:26 (op)	25:20 (I, cmd, S)	19:16 (Rn)	15:12 (Rd)	11:0 (Src2)
1110	00	0 1101 0	0000	0000	Src2
4 bits	2 bits	6 bits	4 bits	4 bits	12 bits

Src2:

Bits 11:8 (Rs)	Bit 7	Bits 6:5 (sh)	Bit 4	Bits 3:0 (Rm)
0111	0	11	1	0101