SYSC 3006 Lab 6 (Fall 2016) Version 2

Control FSM Output LO Table

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **3 1** | **3 0** | **2 9** | **2 8** | **2 7** | **2 6** | **2 5** | **2 4** | **2 3** | **2 2** | **2 1** | **2 0** | **1 9** | **1 8** | **1 7** | **1 6** | **1 5** | **1 4** | **1 3** | **1 2** | **1 1** | **1 0** | **9** | **8** | **7** | **6** | **5** | **4** | **3** | **2** | **1** | **0** |  |
| **State**  **Hex encoding** | **Unused (0)** | **AADD** | **IRCE** | **IBWrite** | **IBRead** | **MDRget** | **MDRput** | **MDROE** | **MDRCE** | **MAROE** | **MARCE** | **PCOE** | **C1OE** | **AOP** | **ANOP** | **DR** | **SXR** | **SYR** | **RegSEL** | **RegLD** | **T1CE** | **T1OE** | **T2CE** | **T2OE** | **NextState7** | **NextState6** | **NextState5** | **NextState4** | **NextState3** | **NextState2** | **NextState1** | **NextState0** | **Hex**  **Encoding** |
| **(F0)**  **00** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **1** | **1** | **0** | **0** | **1** | **0** | **0** | **0** | **1** | **1** | **1** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **1** | **0032 3801** |
| **(F1)**  **01** | **0** | **1** | **0** | **0** | **1** | **0** | **0** | **0** | **1** | **1** | **0** | **0** | **1** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **1** | **1** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **1** | **0** | **48C8 0602** |
| **(F2)**  **02** | **0** | **0** | **1** | **0** | **0** | **1** | **0** | **1** | **0** | **0** | **0** | **0** | **0** | **0** | **1** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **1** | **1** | **2502 0003** |
| **(D)**  **03** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **1** | **0** | **0** | **1** | **0** | **0** | **0** | **1** | **0** | **0** | **0** | **0** | **1** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0012 2100** |
| **(E0)**  **04** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **1** | **0** | **1** | **0** | **1** | **1** | **1** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **1** | **0** | **1** | **0002 B805** |
| **(E1)**  **05** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **1** | **0** | **0** | **0** | **1** | **1** | **1** | **0** | **1** | **1** | **0** | **0** | **0** | **0** | **0** | **0** | **1** | **1** | **0** | **0004 7606** |
| **(E2)**  **06** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **1** | **1** | **0** | **0** | **1** | **0** | **0** | **0** | **0** | **1** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0003 2100** |
| **(E3)**  **07** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **1** | **0** | **0** | **0** | **1** | **1** | **1** | **0** | **0** | **1** | **0** | **0** | **0** | **0** | **0** | **0** | **1** | **1** | **0** | **0004 7206** |
| **(E4)**  **08** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **1** | **0** | **1** | **0** | **1** | **1** | **1** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **1** | **0** | **0** | **1** | **0002 B809** |
| **(E5)**  **09** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **1** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **1** | **1** | **0** | **0** | **0** | **0** | **0** | **0** | **1** | **1** | **0** | **0004 0606** |
| **(E6)**  **0A** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **1** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **1** | **0** | **0** | **0** | **0** | **0** | **0** | **1** | **1** | **0** | **0004 0206** |
| **(E7)**  **0B** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **1** | **0** | **1** | **0** | **0** | **1** | **1** | **0** | **0** | **1** | **0** | **0** | **0** | **0** | **0** | **1** | **1** | **0** | **0** | **0005 320C** |
| **(E8)**  **0C** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **1** | **0** | **1** | **0** | **0** | **0** | **0** | **0** | **1** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **1** | **1** | **0** | **1** | **000A 080D** |

Control FSM Output LO Table (continued … if needed)

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **3 1** | **3 0** | **2 9** | **2 8** | **2 7** | **2 6** | **2 5** | **2 4** | **2 3** | **2 2** | **2 1** | **2 0** | **1 9** | **1 8** | **1 7** | **1 6** | **1 5** | **1 4** | **1 3** | **1 2** | **1 1** | **1 0** | **9** | **8** | **7** | **6** | **5** | **4** | **3** | **2** | **1** | **0** |  |
| **State**  **Hex encoding** | **Unused (0)** | **AADD** | **IRCE** | **IBWrite** | **IBRead** | **MDRget** | **MDRput** | **MDROE** | **MDRCE** | **MAROE** | **MARCE** | **PCOE** | **C1OE** | **AOP** | **ANOP** | **DR** | **SXR** | **SYR** | **RegSEL** | **RegLD** | **T1CE** | **T1OE** | **T2CE** | **T2OE** | **NextState7** | **NextState6** | **NextState5** | **NextState4** | **NextState3** | **NextState2** | **NextState1** | **NextState0** | **Hex**  **Encoding** |
| **(E9)**  **0D** | **0** | **1** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **1** | **1** | **1** | **0** | **0** | **0** | **0** | **0** | **1** | **1** | **0** | **4000 0706** |
| **(E10)**  **0E** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **1** | **0** | **0** | **0** | **1** | **0** | **1** | **0** | **1** | **1** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **1** | **1** | **1** | **1** | **0022 B00F** |
| **(E11)**  **0F** | **0** | **0** | **0** | **0** | **1** | **0** | **0** | **0** | **1** | **1** | **0** | **0** | **0** | **0** | **1** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **1** | **0** | **0** | **0** | **0** | **08C2 0010** |
| **(E12)**  **10** | **0** | **0** | **0** | **0** | **0** | **1** | **0** | **1** | **0** | **0** | **0** | **0** | **0** | **0** | **1** | **1** | **0** | **0** | **1** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0503 2000** |
| **(E13)**  **11** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **1** | **0** | **0** | **0** | **1** | **0** | **1** | **0** | **1** | **1** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **1** | **0** | **0** | **1** | **0** | **0022 B012** |
| **(E14)**  **12** | **0** | **0** | **0** | **0** | **0** | **0** | **1** | **0** | **1** | **0** | **0** | **0** | **0** | **0** | **1** | **1** | **0** | **0** | **1** | **1** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **1** | **0** | **0** | **1** | **1** | **0283 3013** |
| **(E15)**  **13** | **0** | **0** | **0** | **1** | **0** | **0** | **0** | **1** | **0** | **1** | **0** | **0** | **0** | **0** | **1** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **1142 0000** |
| **(E16)**  **14** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **1** | **0** | **1** | **0** | **1** | **1** | **1** | **0** | **0** | **0** | **0** | **0** | **0** | **1** | **0** | **1** | **0** | **1** | **0002 B815** |
| **(E17)**  **15** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **1** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **1** | **1** | **0** | **0** | **0** | **0** | **1** | **0** | **1** | **1** | **0** | **0004 0616** |
| **(E18)**  **16** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **1** | **0** | **0** | **0** | **1** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **1** | **0** | **0** | **0** | **0** | **1** | **1** | **1** | **1** | **0022 010F** |
| **(E19)**  **17** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **1** | **0** | **1** | **0** | **1** | **1** | **1** | **0** | **0** | **0** | **0** | **0** | **0** | **1** | **1** | **0** | **0** | **0** | **0002 B818** |
| **(E20)**  **18** | **0** | **1** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **1** | **1** | **0** | **0** | **0** | **0** | **1** | **1** | **0** | **0** | **1** | **4000 0619** |
| **(E21)**  **19** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **1** | **0** | **0** | **0** | **1** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **1** | **0** | **0** | **0** | **1** | **0** | **0** | **1** | **0** | **0022 0112** |
| **1A** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** |
| **1B** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** |

Control FSM Output HI Table Control FSM Output HI Table (continued… if needed)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| bit : | 3 | 2 | 1 | 0 | Hex |
| (State)  hex | **IRS20** | **IRS16** | **IRU20** | **IRU16** |  |
| (F0)  00 | **0** | **0** | **0** | **0** | **0** |
| (F1)  01 | **0** | **0** | **0** | **0** | **0** |
| (F2)  02 | **0** | **0** | **0** | **0** | **0** |
| (D)  03 | **0** | **0** | **0** | **0** | **0** |
| (E0)  04 | **0** | **0** | **0** | **0** | **0** |
| (E1)  05 | **0** | **0** | **0** | **0** | **0** |
| (E2)  06 | **0** | **0** | **0** | **0** | **0** |
| (E3)  07 | **0** | **0** | **0** | **0** | **0** |
| (E4)  08 | **0** | **0** | **0** | **0** | **0** |
| (E5)  09 | **0** | **0** | **0** | **1** | **1** |
| (E6)  0A | **0** | **0** | **1** | **0** | **2** |
| (E7)  0B | **0** | **0** | **0** | **0** | **0** |
| (E8)  0C | **0** | **0** | **0** | **0** | **0** |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| bit : | 3 | 2 | 1 | 0 | Hex |
| (State)  hex | **IRS20** | **IRS16** | **IRU20** | **IRU16** |  |
| 1A |  |  |  |  | **0** |
| 1B |  |  |  |  | **0** |
| 1C |  |  |  |  | **0** |
| 1D |  |  |  |  | **0** |
| 1E |  |  |  |  | **0** |
| 1F |  |  |  |  | **0** |
| 20 |  |  |  |  | **0** |
| 21 |  |  |  |  | **0** |
| 22 |  |  |  |  | **0** |
| 23 |  |  |  |  | **0** |
| 24 |  |  |  |  | **0** |
| 25 |  |  |  |  | **0** |
| 26 |  |  |  |  | **0** |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| bit : | 3 | 2 | 1 | 0 | Hex |
| (State)  hex | **IRS20** | **IRS16** | **IRU20** | **IRU16** |  |
| (E9)  0D | **0** | **0** | **0** | **0** | **0** |
| (E10)  0E | **0** | **0** | **0** | **0** | **0** |
| (E11)  0F | **0** | **0** | **0** | **0** | **0** |
| (E12)  10 | **0** | **0** | **0** | **0** | **0** |
| (E13)  11 | **0** | **0** | **0** | **0** | **0** |
| (E14)  12 | **0** | **0** | **0** | **0** | **0** |
| (E15)  13 | **0** | **0** | **0** | **0** | **0** |
| (E16)  14 | **0** | **0** | **0** | **0** | **0** |
| (E17)  15 | **0** | **1** | **0** | **0** | **4** |
| (E18)  16 | **0** | **0** | **0** | **0** | **0** |
| (E19)  17 | **0** | **0** | **0** | **0** | **0** |
| (E20)  18 | **0** | **1** | **0** | **0** | **4** |
| (E21)  19 | **0** | **0** | **0** | **0** | **0** |

Decode ROM Table Main Memory (Test Program)

|  |  |  |
| --- | --- | --- |
| Instruction | Address  (hex) | Contents  (hex) |
| NOP (Form 3) | 00 | **00** |
| ADD (Form1) | 01 | **04** |
| SUB (Form 1) | 02 | **04** |
| MOV (Form 2) | 03 | **07** |
| AND (Form 1) | 04 | **04** |
| OR (Form 1) | 05 | **04** |
| XOR (Form 1) | 06 | **04** |
| NOT (Form 2) | 07 | **07** |
| ADD (Form 4) | 21 | **08** |
| SUB (Form 4) | 22 | **08** |
| MOV (Form 5) | 23 | **0A** |
| AND (Form 4) | 24 | **08** |
| OR (Form 4) | 25 | **08** |
| XOR (Form 4) | 26 | **08** |
| MVN (Form 5) | 27 | **0A** |
| LDR (Form 2) | 30 | **0E** |
| LDR (Form 4) | 31 | **14** |
| STR ( Form 2) | 34 | **11** |
| STR (Form 4) | 35 | **17­­­** |
| NEG | 17 | **0B** |

|  |  |  |  |
| --- | --- | --- | --- |
| Address  (hex) | Contents  (hex) | Instruction  (hex) | Result of Execution  Not marked! Only for practice. |
| 0 | **26FF0005** | **XOR R15, R15, #0x05** | R15 = 0x1001 |
| 1 | **------- Do not initialize ------** | **variable X** | - |
| 2 | **------- Do not initialize ------** | **variable Y** | - |
| 3 | **0x 07440F00** | **variable Z** | - |
| 4 | **23500001** | **MOV R5, #1** | R5 = 0x1 |
| 5 | **23600003** | **MOV R6, #3** | R6 = 0x3 |
| 6 | **01456000** | **ADD R4, R5, R6** | R4 = 0x4 |
| 7 | **34450000** | **STR R4, [ R5 ]** | MMem[ 0x1 ] = 0x4 |
| 8 | **27400007** | **MVN R4, #7** | R4 = 0xFFFFFFF8 |
| 9 | **3546FFFF** | **STR R4, [R6, #–1 ]** | MMem[ 0x2 ] = 0xFFFFFFF8 |
| ------- | **OPTIONAL FROM HERE ON !!** | **-------------------0----------** |  |
| A | **31650002** | **LDR R6, [ R5, #2 ]** | **R6 = 0x07440F00** |
| B | **22660F00** | **SUB R6, R6, 0x0F00** | **R6 = 0x07440000** |
| C | **3565000C** | **STR R6, [ R5, #0xC ]** | **MMem[ 0xD ] = 0x07440000** |
| D | **0x ABCD ABCD**  **Overwritten to:**  **07440000** | **mystery instruction**  **Ovewritten to:**  **NOT R4** | **R4 = 00000007** |
| E | **23F00000** | **MOV R15, #0** | **R15 = 00000000** |

Is this Instruction Set Architecture?

General Form 1 (3-operand):

~~E0: Load SY in T1~~

E0: Load SX in T1

E1: Load Op(SY,[T1]) in T2

E2: Load [T2] in DR

General Form 2 (2-operand):

~~E3: Load Op(SY) in T2~~

E3: Load Op(SX) in T2

E2: ‘’

General Form 3 (NOP):

* No states

General Form 4 (3-operand w/ imm16):

E4: Load SX in T1

E5: Load Op(IRU16, [T1]) in T2

E2: ‘’

General Form 5 (2-operand w/ imm20):

E6: Load Op(IRU20) in T2

E2: ‘’

UNIQUE: NEG (Op 0x17):

E7: Load NOT(DR) in T2

E8: Load C1 in T1

E9: Load [T1] + [T2] in T2

E2 : ‘’

REMEMBER :

* RegLD 1/0 is Read/Write

Mystery Instruction :

Opcode :   
 Prefix : A

Suffix : B (1011) -> ALU Operation :

A picture containing graphical user interface

Description automatically generated Graphical user interface, text, application

Description automatically generated Text

Description automatically generated with medium confidence Graphical user interface, text, application

Description automatically generated Text

Description automatically generated with medium confidence Graphical user interface, text, application

Description automatically generated