State Diagram

Note: Transitions with no input written
is valid for all the inputs.

RST

S_3

S_{JLR} 1001

1000 S_{JAL}

1100

S_2

0010 S_{AN}

0000

0001 S_{ADI}

0011 S_{LHI}

0100 S_{LW}

0101 S_{SW}

0111 S_{BEQ}

0110 S_{SA} S_{LA}

S_{10}

S_6

S_7

S_8

1010 or 1011
or 1111 or
1010 or 1011

S_9

S_0

S_4

S_1

S_5

States in the ~~RISC~~ FSM.
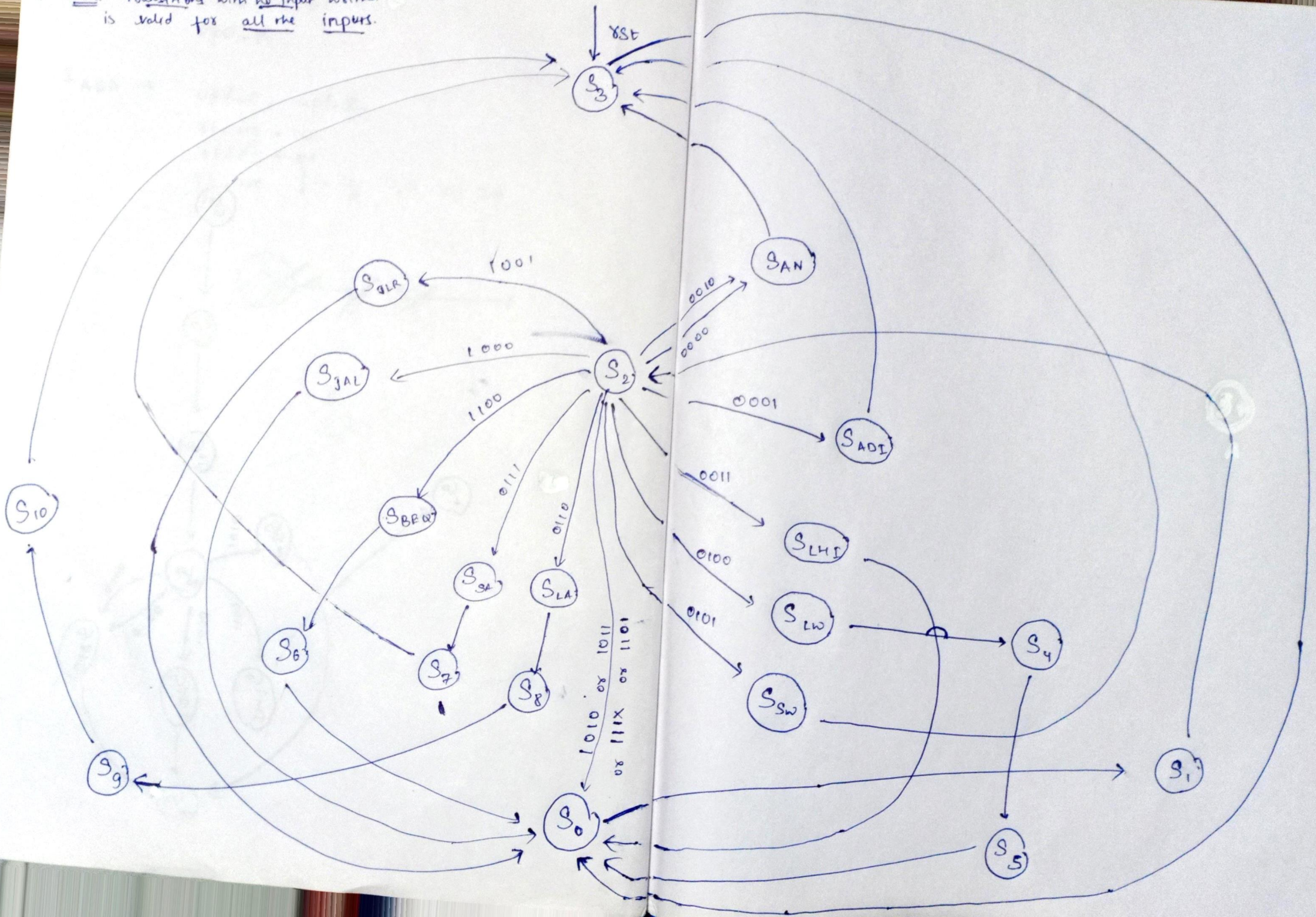
↱ ADD/ADC/ADZ

(S_{ADD}) ⇒ upd_c, upd_z   (0000)

rf_wc = 10   alu_op.

rf_dc = 01

rf_we   } if c & z are set.

↱ ADI

(S_{ADI}) ⇒ upd_c, upd_z   (0001)

rf_wc = 01

rf_dc = 01

rf_we

alu_bc = 10

(S_3) ⇒ alu_ac = 10

alu_bc = 01

upd_pc

NDV → (S_{ND}) ⇒ upd_z, rf_we   (0010)
NDC
NDZ   rf_wc = 10   alu_op

rf_dc = 01   rf_we.

LHI → (S_{LHI}) ⇒ rf_dc = 11   alu_ac = 10   (0011)

rf_we   alu_bc = 01

upd_pc.

LW → (S_{LW}) alu_ac = 01 $\longrightarrow (S_0)$

                  $\longmapsto$ (S_4) $\longrightarrow (S_5)$

                     m_rac   alu_ac = 10

       (0100) alu_bc = 01

                          upd_pc

                          rt_we

                          rf_we

SW → (S_{SW}) alu_ac = 01   alu_a = 10   alu_bc = 01

           m_wac   m_we   upd_pc

          (0101)

BEQ → (S_{BEQ}) alu_cin $\longrightarrow (S_6)$ $\longrightarrow (S_0)$

                    alu_ac = 10

         (1100) upd_pc

                 if z-imm = 0 → alu_bc = 01

                 else → alu_bc = 10

JAL → (S_{JAL}) →

      rf_dc = 10 ,   rt_we

      alu_ac = 10

      alu_bc = 11 (1000)

      upd_pc.

$SLR \rightarrow$ (S_{JLR}) $rd\_dc = 10$ rt_we

                         $pc - c$ upd_pc

                $(1\ 0\ 0\ 1)$

$LA \rightarrow$ (S_{LA}) $trc = 1$

               (0110)

$SA \rightarrow$ (S_{SA}) $trc = 1$

              (0111)

PS! $\rightarrow$ $\underline{S_{ADD}}$ is equivalent to $\underline{S_{ND}}$ so we can use $\underline{S_{AN}}$ as a common state.

$\rightarrow$ These states are the extra states added other than those already in the code.

(S4)   m_rac = 1

(S5)   rf_we = 1   upd-pc = 1
       zc = 1
       alu_ac = 10   ,
       alu_bc = 01

(S6)   alu-pc = 10   alu_bc = $\begin{cases} 10 & \text{if} \quad z\_imm = 1 \\ 01 & \text{els} \end{cases}$
       upd_pc = 1

(S7)   rf_rc = 1   alu_ac = 11
       m_we = 1   alu_bc = 01

(S8)   m_rac = 1
       alu_ac = 11
       alu_bc = 01

(S9)   m_rac = 1   rf_we = 1
       alu_ac = 11   rf_wc = 11
       alu_bc = 01

(S10) rf_we = 1
       rf_wc = 11