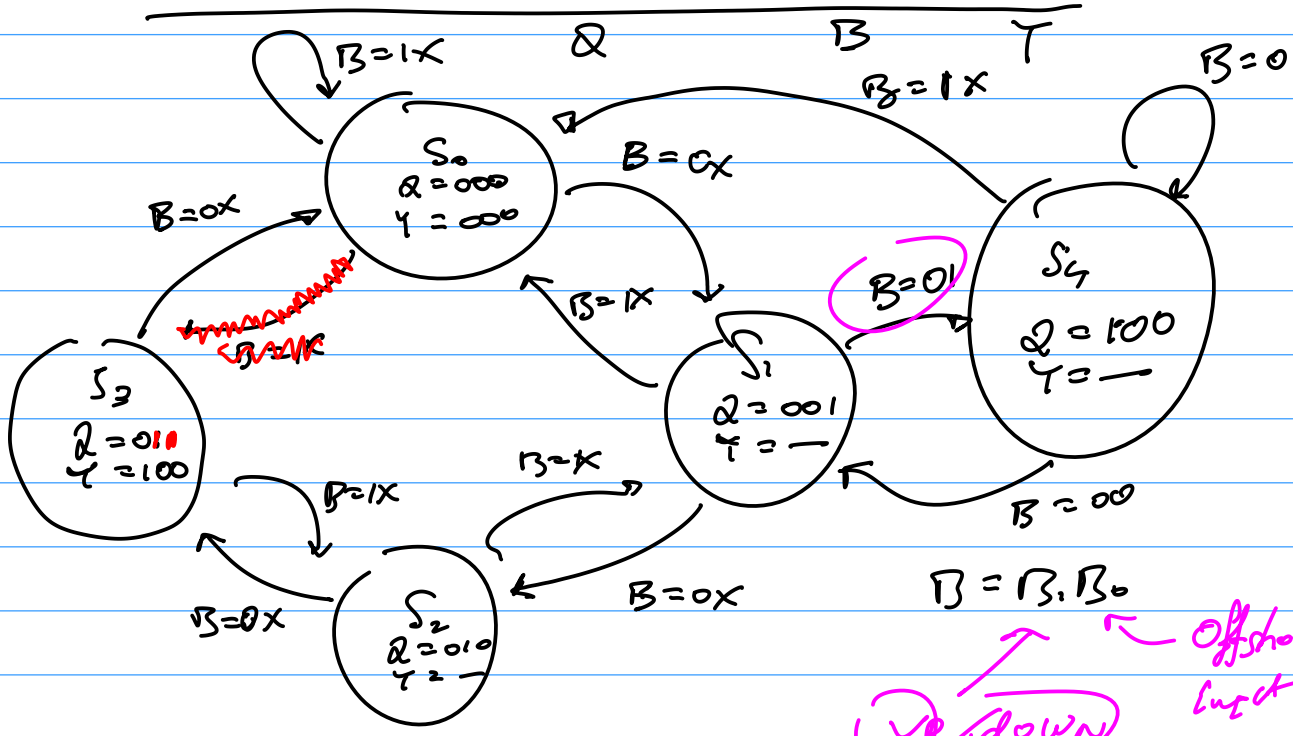
1. Logisim Demos
2. FSM Review

Steps to FSM:

1) Word Description of our Machine/Controller ✓
2) State Transition Diagram ✓

States, State variables, inputs, outputs

Q B T



States 5, 6, 7 are unaccounted for !

$B = B_1 B_0$ ← offshoot logic

$B_1 = 0$ UP $B_1 = 1$ DOWN

3) State Transition Table ✓
   a) Translate state transition diagram to table
   b) Determine/Fill missing columns for our Control Variables (implementation specific)
      D, JK
   c) Determine Boolean Expressions for Control Variables & Output Variables

Ex

t_n					t_{n+1}	
State #	Input Var	State var	Output var	Control Vars	State Var	State #
S	$B_1 B_0$	$Q_2 Q_1 Q_0$	$Y_2 Y_1 Y_0$	$D_2 D_1 D_0$	$Q_2 Q_1 Q_0$	S
S_0	0X	000	000	001	001	S_1

Synchronous Sequential Circuit

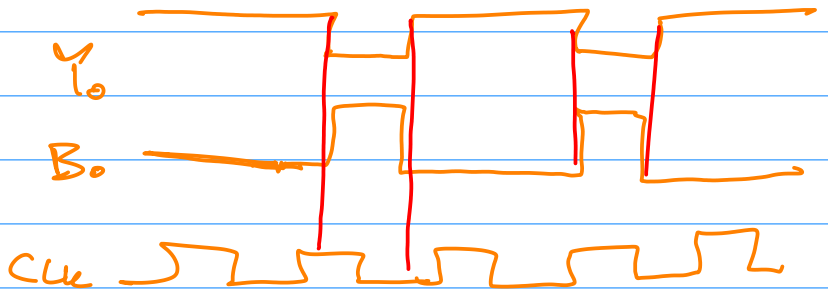
Make Asynch !

Moore Machine : $Y = Y(Q)$ Example : $Y = Q$

Mealy Machine : $Y = Y(Q, B)$

Combinatorial Circuit $Y = Y(B)$ ← Not an FSM

$Q = 000$ $\quad Y_0 = Q_2 Q_1 Q_0 + \bar{B}_0$



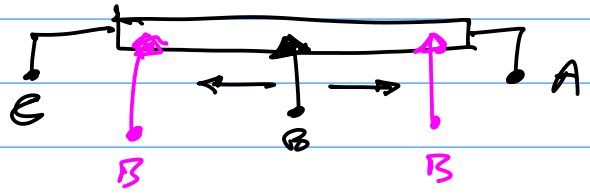
Plan: 1) FSM Block Diagram 2) ADL Extended Example.

Potentiometer

R_A, R_B

$D = \dfrac{R_B}{R_A + 2R_B}$

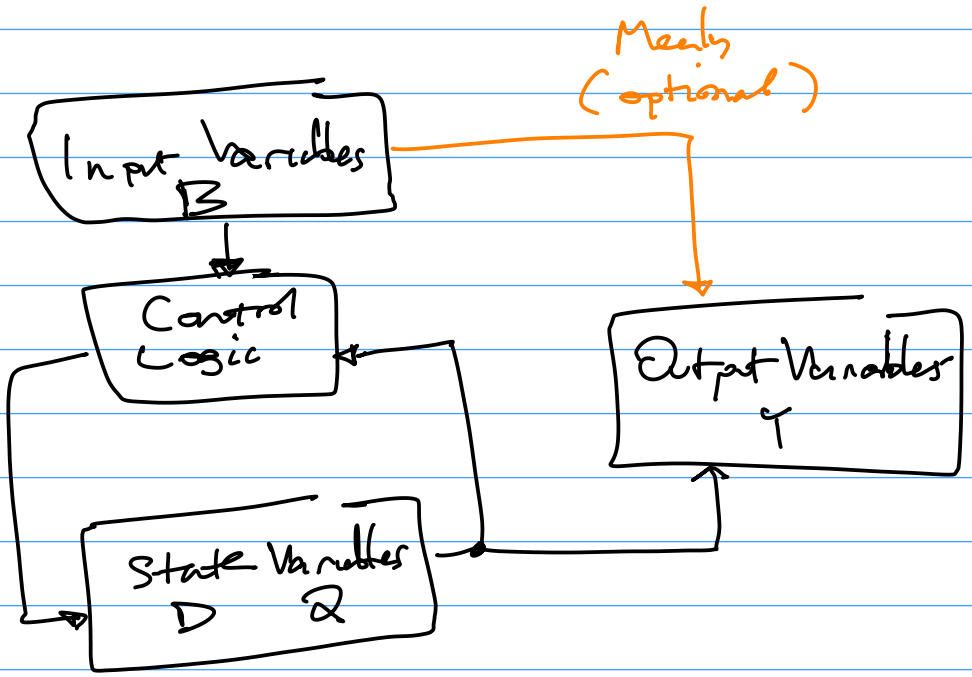
$f = \dfrac{1}{\log 2\, C (R_A + 2R_B)}$



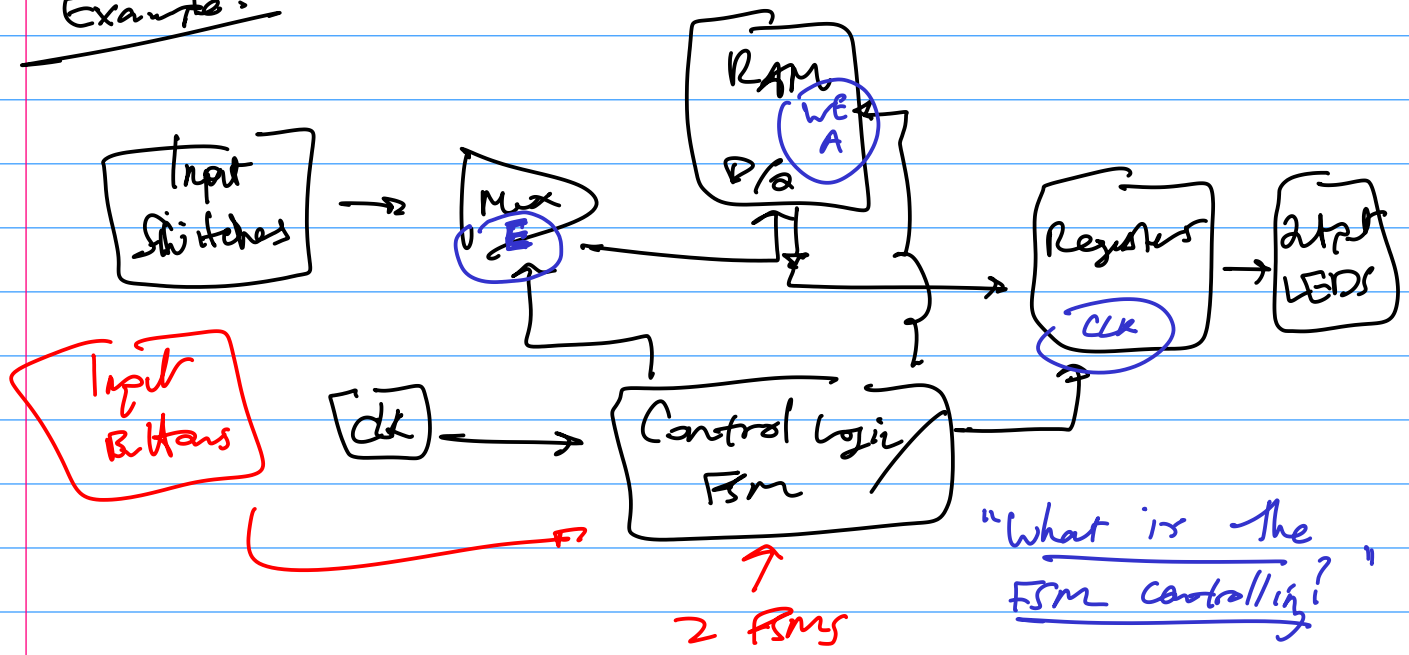
R_{BA} High $\qquad$ R_{BA} Low

Functional Block Diagram of FSMs

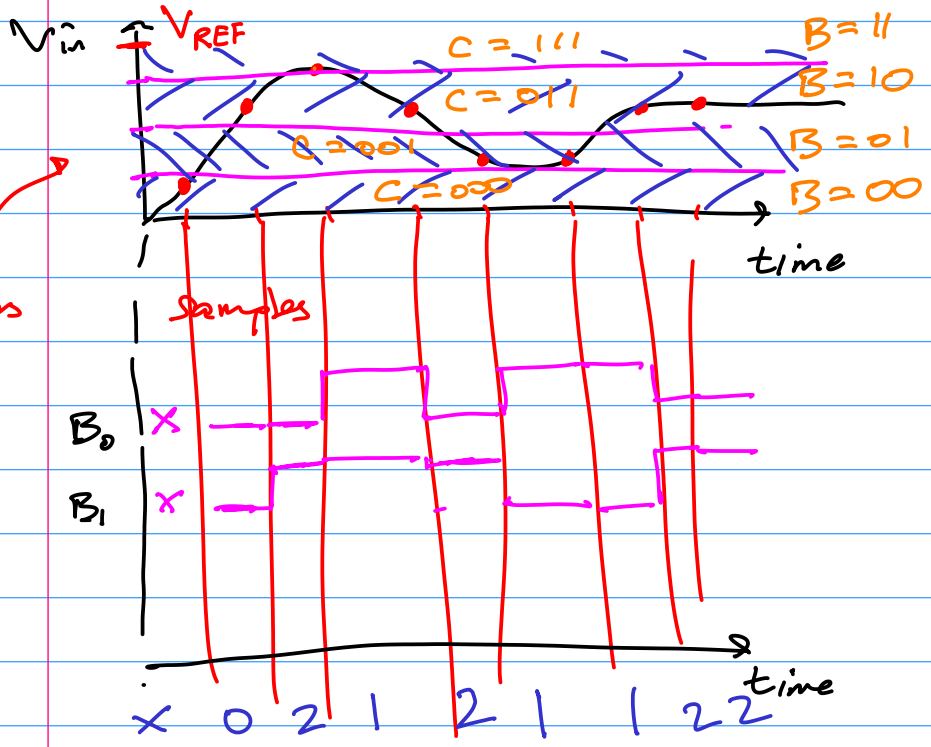
(FBD)



Example:

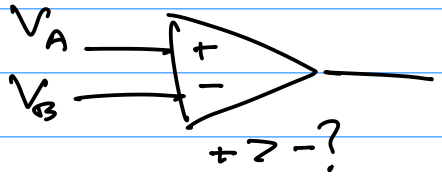


Analog to Digital Conversion

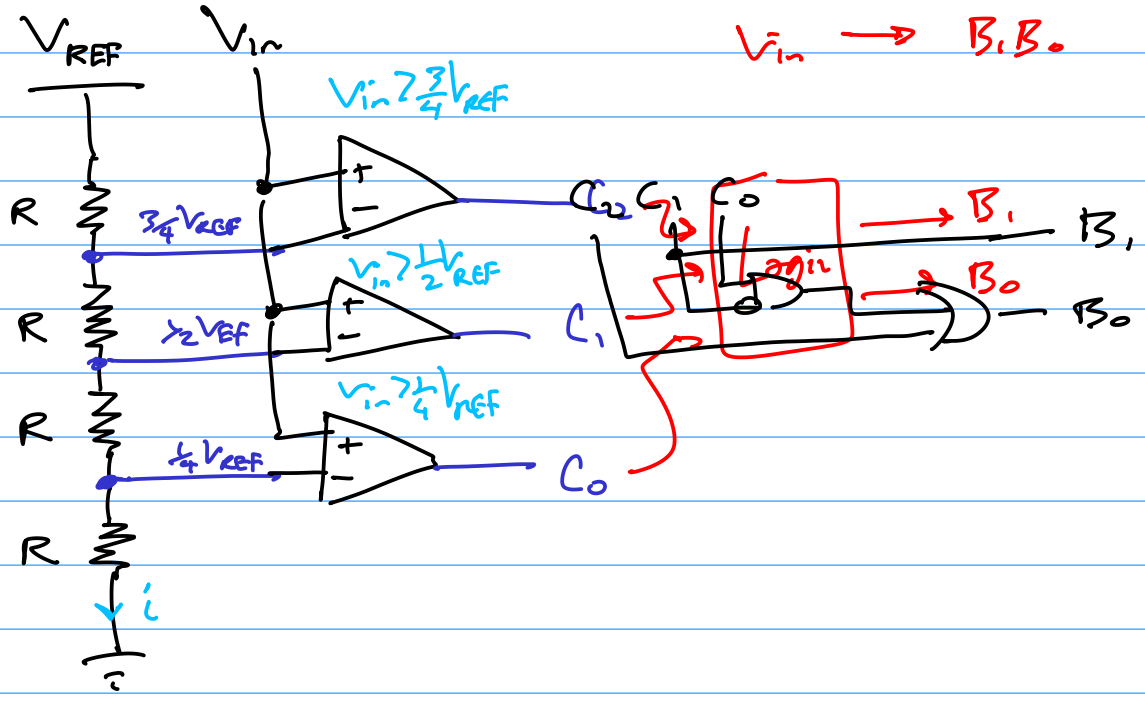


2 Bit ADC
↳ 4 possible voltage values

Comparator



$$Z = \begin{cases} 1 & V_A > V_B \\ 0 & V_A \le V_B \end{cases}$$



$V_{in} \rightarrow B_1 B_0$

$V = iR = \frac{1}{4}V_{REF}$

$$V_{REF} = i(R+R+R+R)$$

$$i = \frac{V_{REF}}{4R}$$

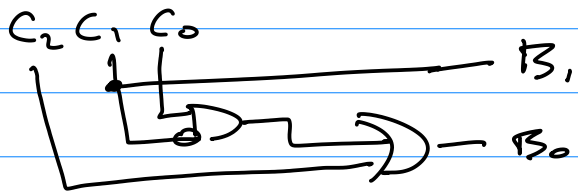
$C_2C_1C_0$	B_1B_0
000	00
001	01
010	xx
011	10
100	xx
101	xx
110	xx
111	11

$B_1 = C_1$

B_0

C_2 \ C_1C_0	00	01	11	10
0	0	1	0	x
1	x	x	1	x

$B_0 = C_2 + \bar{C}_1 C_0$



ADC FSM

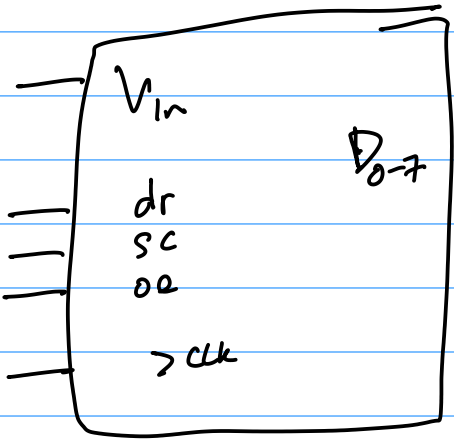
ADC Chip

time to convert

dr — Data Ready

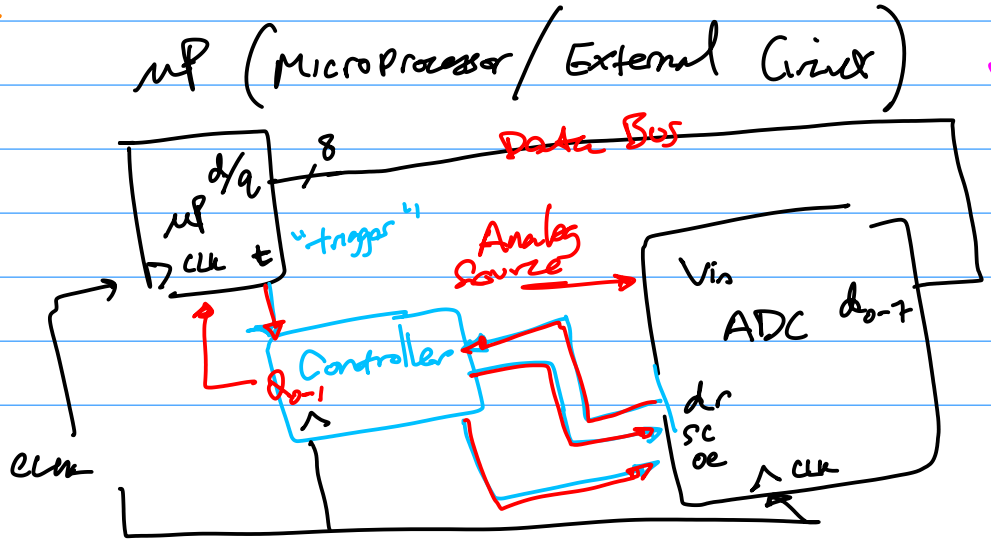
sc — Start Converting

oe — Otpt Enable



Connect to Data Bus

FBD

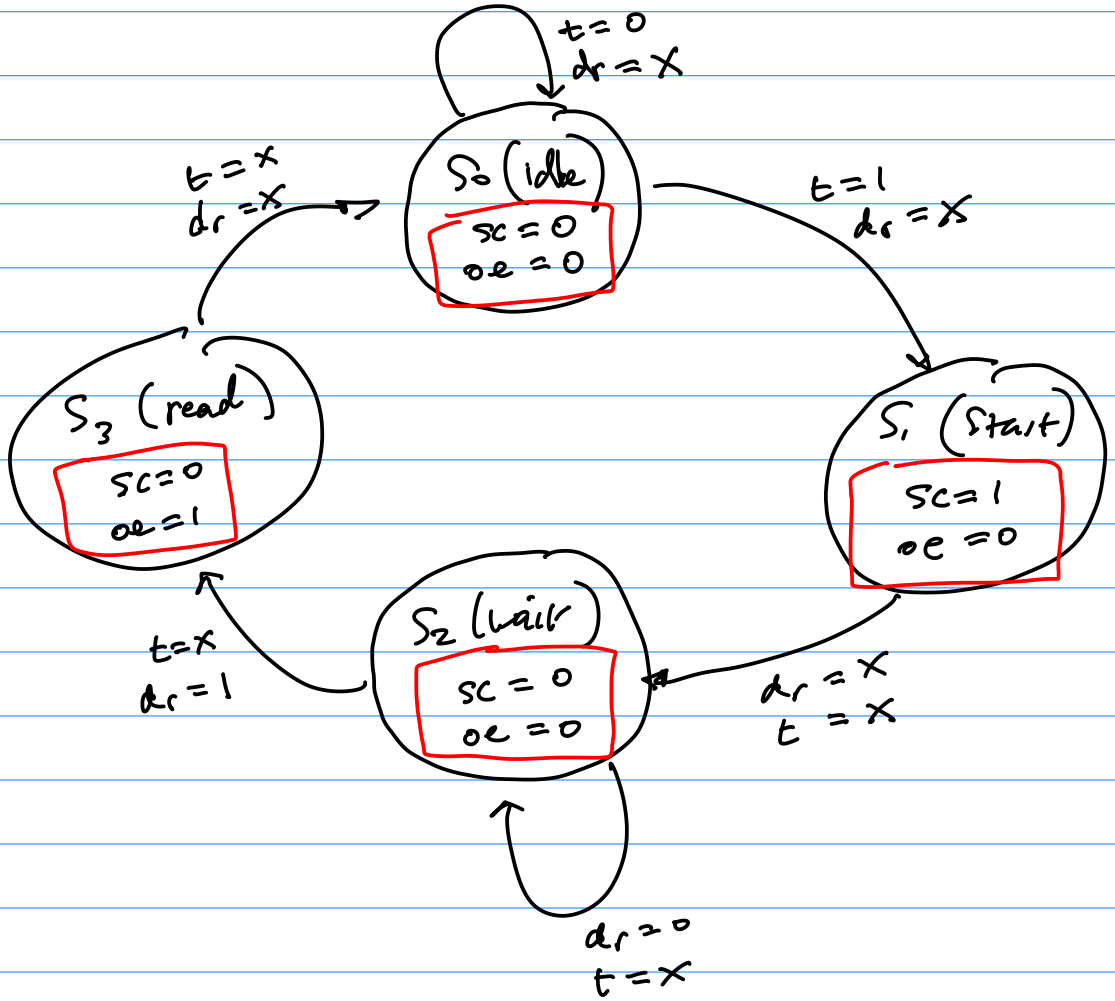


Other Circuits

Connected to Data bus

1) Tell the ADC to convert (upon trigger)
2) Wait until Data is ready
3) Enable ADC output
4) Read Data

State Transition Diagram:



State	Input t	Input dr	State Var Q1	State Var Q0	Output sc	Output oe	Control D1	Control D0	Next State Q1	Next State Q0	
S_0	0	X	0	0	0	0	0	0	0	0	S_0
S_0	1	X	0	0	0	0	0	1	0	1	S_1
S_1	X	X	0	1	1	0	1	0	1	0	S_2
S_2	X	0	1	0	0	0	1	0	1	0	S_2

S_2	x 1	10	∞	1 1	11	S_3
S_3	x x	11	01	0 0	00	S_0

$$[Sc = \bar{Q}_1 Q_0] \quad (\text{Start state})$$

$$[oe = Q_1 Q_0] \quad (\text{read state})$$

$$D_1 = \bar{Q}_1 Q_0 + \bar{t} r Q_1 \bar{Q}_0 + t r Q_1 \bar{Q}_0$$

$$= \bar{Q}_1 Q_0 + Q_1 \bar{Q}_0 \underbrace{(\bar{t} r + t r)}_{1}$$

$$[D_1 = Q_1 \oplus Q_0]$$

$$[D_0 = t \bar{Q}_1 \bar{Q}_0 + t r Q_1 \bar{Q}_0]$$