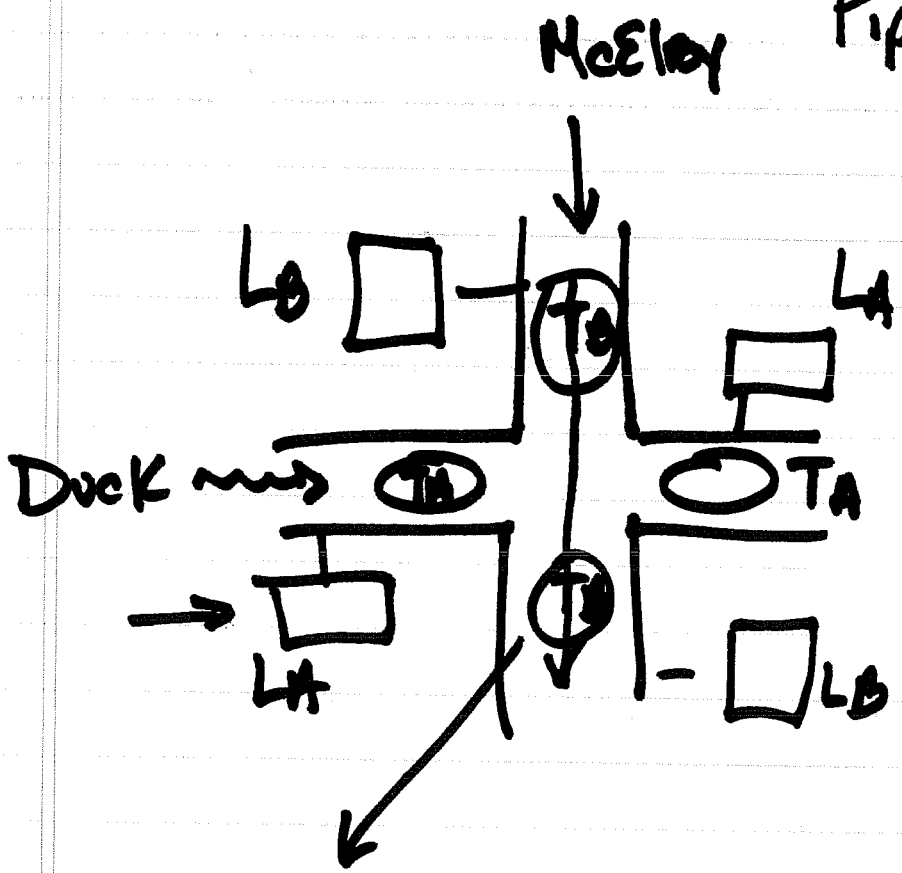
Midterm1 3/3/09

Sequential Circuits: Finite State Machines

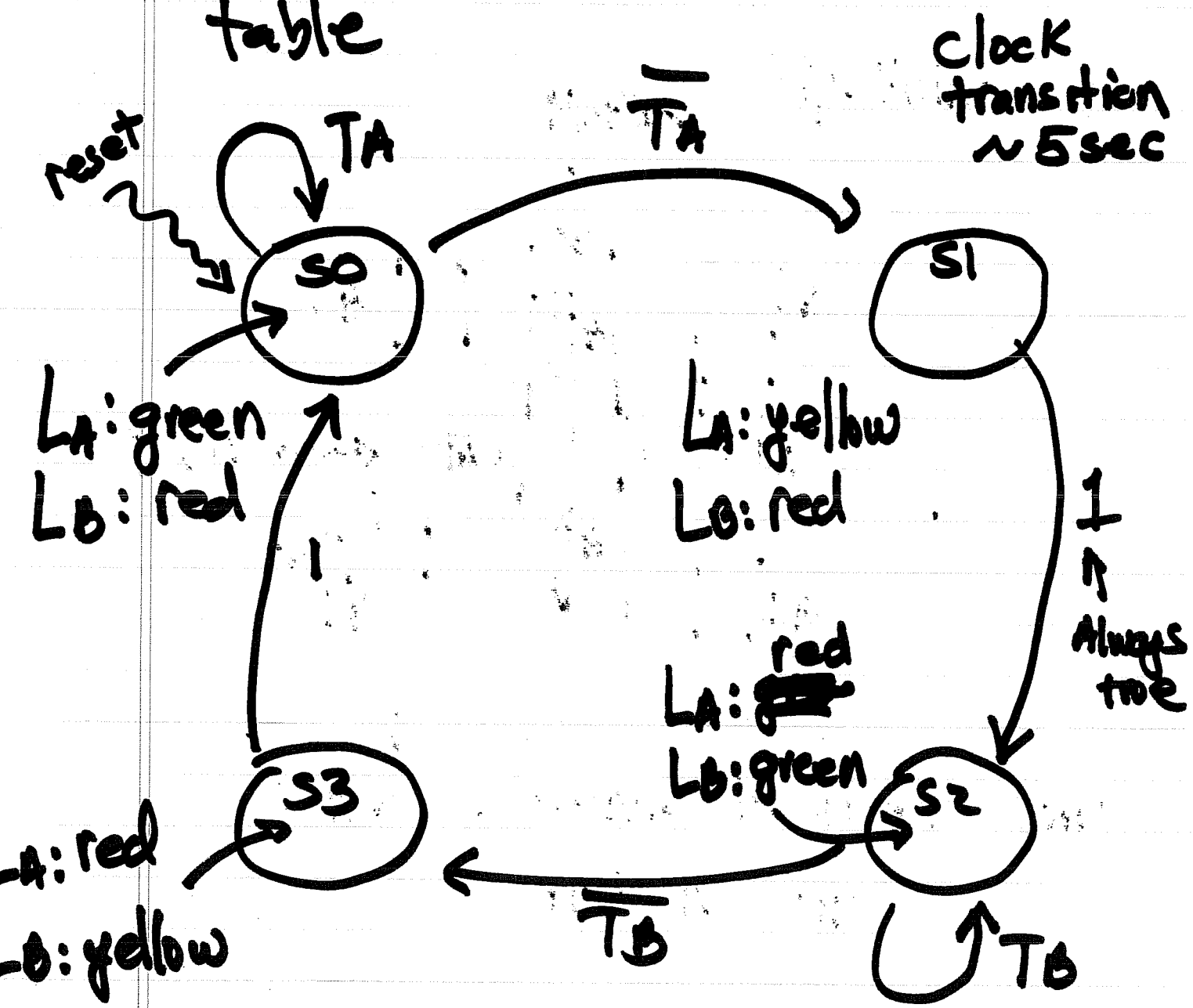
Pipelining



Sensor = sense between cars and no cars

FSM Methodology

1.) Create state diagram and/or state transition table



State Transition Table

Current State	Inputs T_A	Inputs T_B	Next state	Outputs L_A	Outputs L_B
S0	1	X	S0	G	R
S0	0	X	S1	G	R
S1	X	X	S2	Y	R
S2	X	1	S2	R	G
S2	X	0	S3	R	G
S3	X	X	S0	R	Y

encoding $\triangleq$ mapping from one element to another

OSU $\longrightarrow$ Awesome!

N inputs $\longrightarrow$ 2^N outputs

2 inputs

4 outputs

A_1	A_0	Y_3	Y_2	Y_1	Y_0
0	0	0	0	0	1
0	1	0	0	1	0
1	0	0	1	0	0
1	1	1	0	0	0

Binary encoding

one-hot encoding

2) Encode state transition table with all inputs and all outputs

State	Encoding
S0	0 0
S1	0 1
S2	1 0
S3	1 1

← Binary Encoding

bits = $\log_2$(# states)

Inputs	Encoding
$\overline{T_A}$	0
T_A	1

↑ True

Outputs	Encoding
R	0 0
G	0 1
Y	1 0
X	1 1

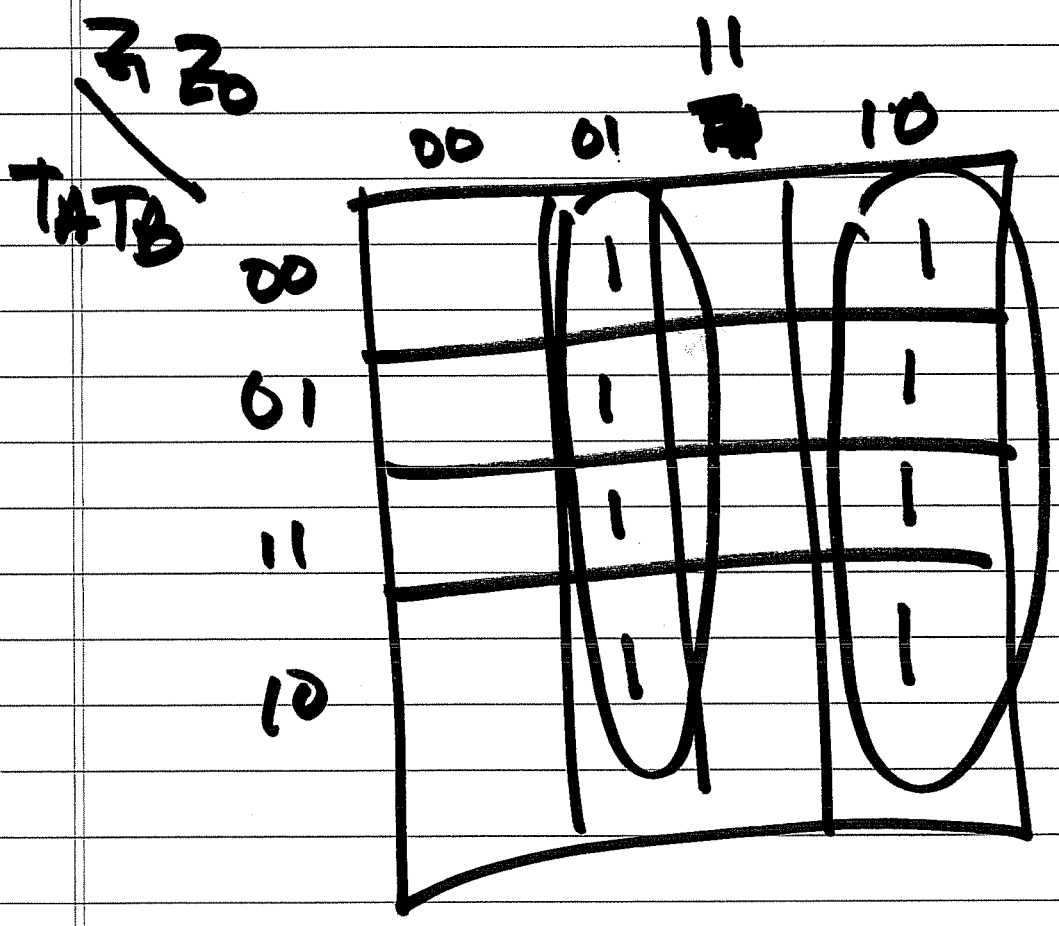
→ future enhancement

3.) Map encoding from #2 to the table in step #1

Current State z_1 z_0	Inputs T_A	Inputs T_B	Next State z_1^* z_0^*	Outputs L_{A1} L_{A0}	Outputs L_B
0 0	1	X	0 0	10	00
0 0	0	X	0 1	10	00
0 1	X	X	1 0	01	00
1 0	X	1	1 0	00	10
1 0	X	0	1 1	00	10
1 1	X	X	0 0	00	01

N.S.

4.) Simplify table from Step# 3 using a K-map or similar process



$$z_1^+ = \bar{z}_1 z_0 + z_1 \bar{z}_0$$

$$Z_0^* = \overline{Z_1}\,\overline{Z_0}\,\overline{T_A} + \overline{Z_1}\,\overline{Z_0}\,\overline{T_B}$$

$$L_{A1} = \overline{Z_1}$$

$$L_{A0} = Z_1 \cdot Z_0$$

$$L_{B1} = Z_1$$

$$L_{B0} = \overline{Z_1} \cdot Z_0$$

5.) Draw the implementation (schematic)