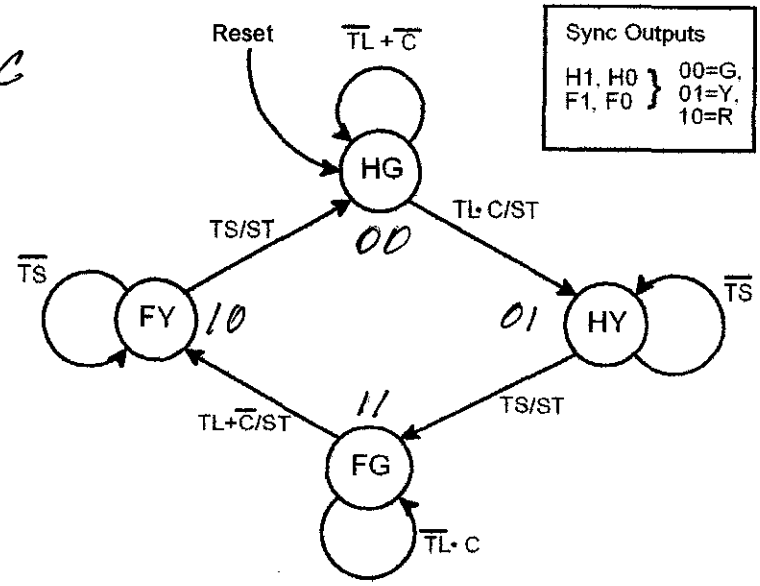
TLC



Sequential (Gray) Encoding

- represent states with 2 state bits $[Q_1, Q_0]$

Encoding $HG = 00 = \overline{Q_1} \cdot \overline{Q_0}$; $HY = \overline{Q_1} \cdot Q_0$; $FG = Q_1 \cdot Q_0$; $FY = Q_1 \cdot \overline{Q_0}$

$$Q_1^+ = TS \cdot HY + C \cdot \overline{TL} \cdot FG + (\overline{C} + TL) \cdot FG + \overline{TS} \cdot FY$$
$$= TS \cdot HY + FG + \overline{TS} \cdot FY$$

$$Q_0^+ = C \cdot TL \cdot HG + \overline{TS} \cdot HY + TS \cdot HY + C \cdot \overline{TL} \cdot FG$$
$$= C \cdot TL \cdot HG + HY + C \cdot \overline{TL} \cdot FG$$

$$\text{output } ST = C \cdot TL \cdot HG + TS \cdot HY + (\overline{C} + TL) \cdot FG + TS \cdot FY$$

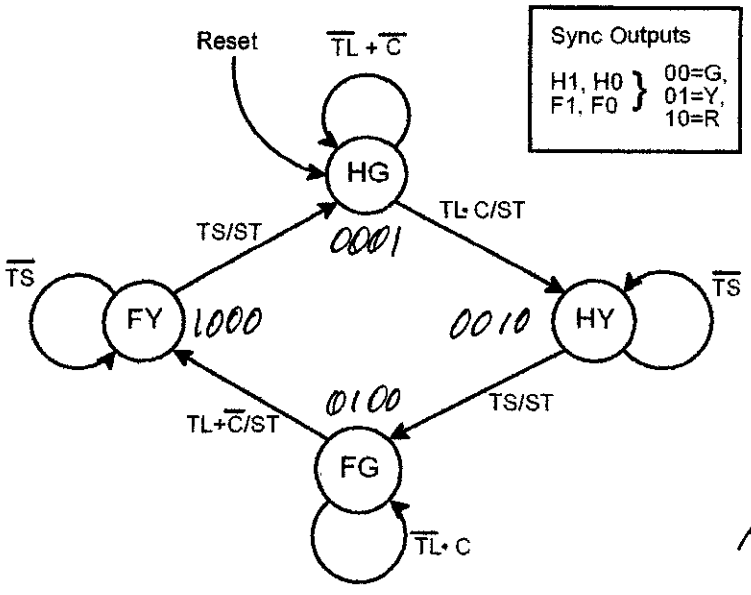
In terms of $[Q_1, Q_0]$

$$Q_1^+ = TS \cdot \overline{Q_1} \cdot Q_0 + Q_1 \cdot Q_0 + \overline{TS} \cdot Q_1 \cdot \overline{Q_0}$$

$$Q_0^+ = C \cdot TL \cdot \overline{Q_1} \cdot \overline{Q_0} + \overline{Q_1} \cdot Q_0 + C \cdot \overline{TL} \cdot Q_1 Q_0$$

$$ST = C \cdot TL \cdot \overline{Q_1} \cdot \overline{Q_0} + \overline{Q_1} \cdot Q_0 + C \cdot Q_1 \cdot Q_0 + \overline{C} \cdot Q_1 \cdot Q_0 + TL \cdot Q_1 \cdot Q_0 + TS \cdot Q_1 \cdot \overline{Q_0}$$

Worst case (ST) 15 literals, 5 terms, 4-input gates



4 State bits

$[Q_3, Q_2, Q_1, Q_0]$

$HG = 0001 = Q_0$; $HY = Q_1$

$FG = Q_2$; $FY = Q_3$

One Hot Encoding

$$Q_3^+ = \overline{TS}\cdot FY + (\overline{C}+TL)\cdot FG \; ; \; Q_2^+ = C\cdot\overline{TL}\cdot FG + TS\cdot HY$$

$$Q_1^+ = \overline{TS}\cdot HY + C\cdot TL\cdot HG \; ; \; Q_0^+ = (\overline{C}+\overline{TL})\cdot HG + TS\cdot FY$$

$$ST = C\cdot TL\cdot HG + TS\cdot HY + (\overline{C}+TL)\cdot FG + TS\cdot FY$$

In terms of $Q_3 \cdots Q_0$

$$Q_3^+ = \overline{TS}\cdot Q_3 + \overline{C}\cdot Q_2 + TL\cdot Q_2$$

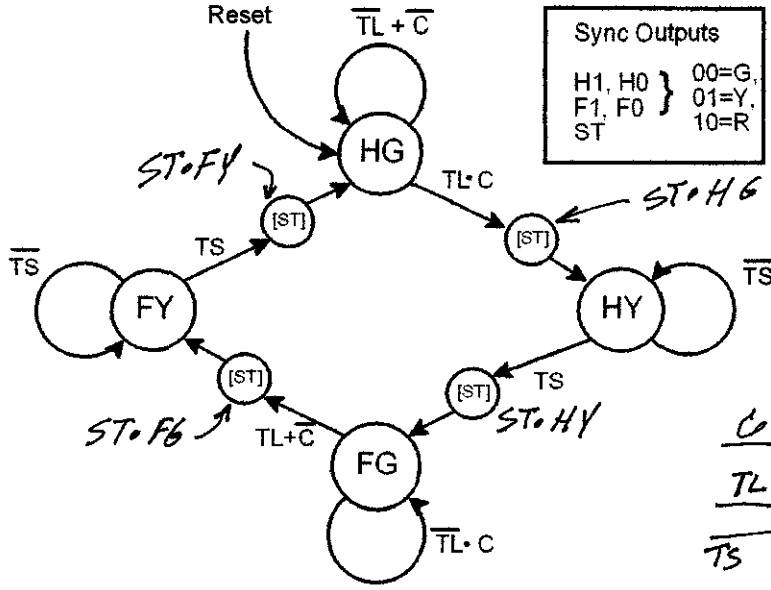
$$Q_2^+ = C\cdot\overline{TL}\cdot Q_2 + TS\cdot Q_1$$

$$Q_1^+ = \overline{TS}\cdot Q_1 + C\cdot TL\cdot Q_0$$

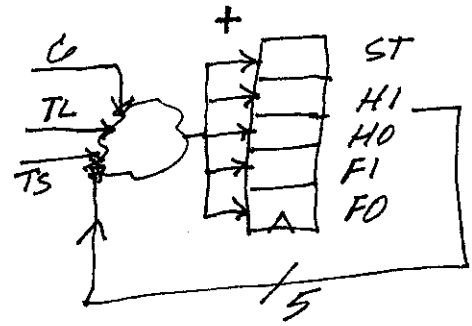
$$Q_0^+ = \overline{C}\cdot Q_0 + \overline{TL}\cdot Q_0 + TS\cdot Q_3$$

$$ST = C\cdot TL\cdot Q_0 + TS\cdot Q_1 + \overline{C}\cdot Q_2 + TL\cdot Q_2 + TS\cdot Q_3$$

Worst Case (ST) 11 literals, 5 terms, 3-input gates



State bits
[ST, H1, H0, F1, F0]



Output oriented Encoding

$$HG^+ = ST\cdot FY + \overline{ST}\cdot HG$$

$$HY^+ = ST\cdot HG + \overline{ST}\cdot HY$$

$$FG^+ = ST\cdot HY + \overline{ST}\cdot FG$$

$$FY^+ = ST\cdot FG + \overline{ST}\cdot FY$$

$$ST^+ = C\cdot TL\cdot HG + TS\cdot HY + (\overline{C}+TL)\cdot FG + TS\cdot FY$$

In terms of H1, H0, F1, F0:

$H1 = FG + FY$; $H1^+ = FG^+ + FY^+ = ST\cdot(HY+FG) + \overline{ST}\cdot(FY+FG)$

$$H1^+ = ST\cdot HY + \overline{ST}\cdot FY + FG$$

$$H1^+ = ST\cdot\overline{H1}\cdot H0 + \overline{ST}\cdot\overline{F1}\cdot F0 + \overline{F1}\cdot\overline{F0}$$

$$H0^+ = HY^+ = ST\cdot\overline{H1}\cdot\overline{H0} + \overline{ST}\cdot\overline{H1}\cdot H0$$

$$F1^+ = HG^+ + HY^+ = ST\cdot\overline{F1}\cdot F0 + \overline{ST}\cdot\overline{H1}\cdot H0 + \overline{H1}\cdot\overline{H0}$$

$$F0^+ = FY^+ = ST\cdot\overline{F1}\cdot\overline{F0} + \overline{ST}\cdot\overline{F1}\cdot F0$$

$$ST^+ = C\cdot TL\cdot\overline{H1}\cdot\overline{H0} + TS\cdot\overline{H1}\cdot H0 + \overline{C}\cdot\overline{F1}\cdot\overline{F0} + TL\cdot\overline{F1}\cdot\overline{F0} + TS\cdot\overline{F1}\cdot F0$$

Worst Case (ST^+) 16 literals, 5 terms, 4-input gates

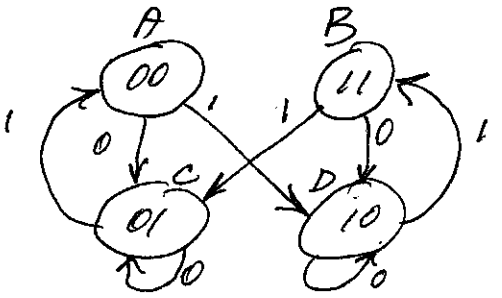
Heuristic State Assignment

Common Next State Association Example

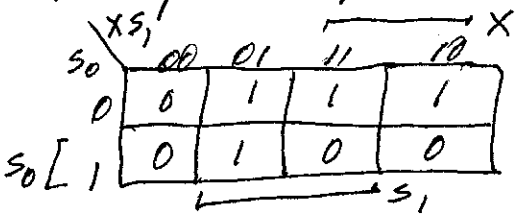
BAD Encoding

A=00, B=11

S	S^+ X=0	X=1
00	01	10
01	01	00
10	10	11
11	10	01



K-map for S_1^+

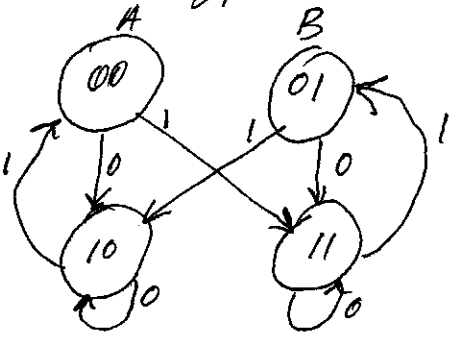


$S_1^+ = x \cdot \bar{S}_0 + \bar{x} \cdot S_1$

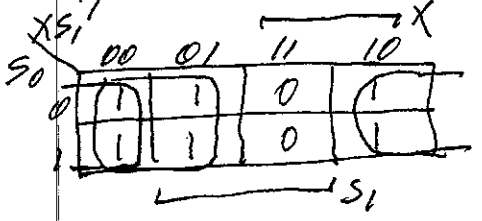
Encoding According to Rule (Good Encoding)

A=00, B=01

S	S^+ X=0	X=1
00	10	11
01	11	10
10	10	00
11	11	01



K-map for S_1^+



$S_1^+ = \bar{X} + \bar{S}_1$

Comparison: Bad encoding - 4 literals, 2 prod terms, 2-input gates

Good encoding - 2 literals, 2 "prod terms", 1-input gates