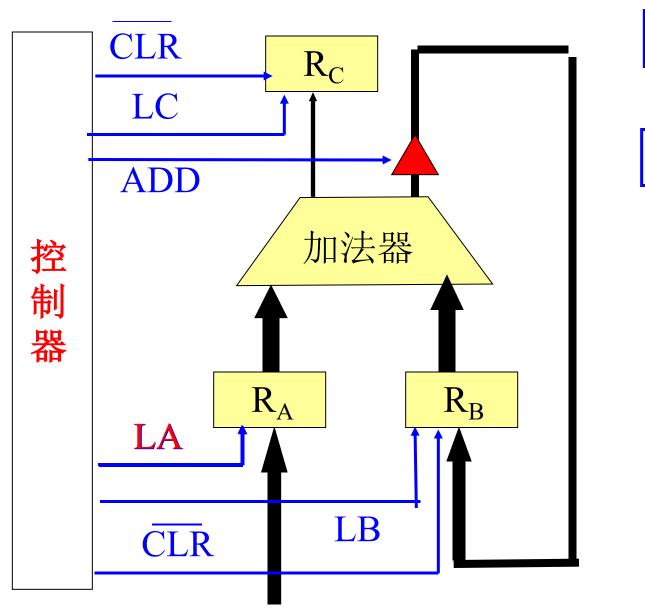
例:设计计数型8位累加器的控制器。

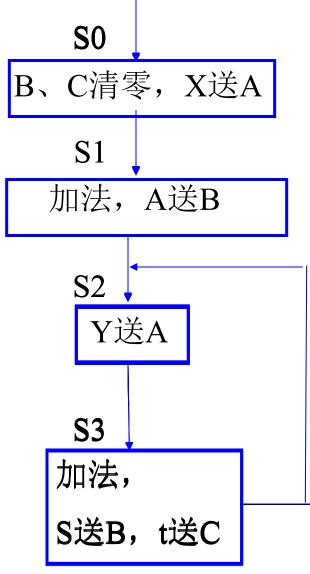
1) 逻辑划分

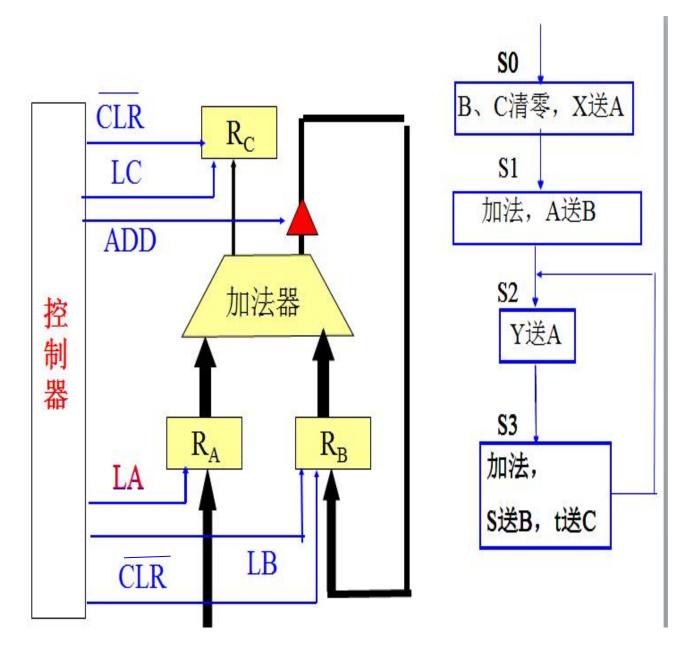
控制器、寄存器、加法器。

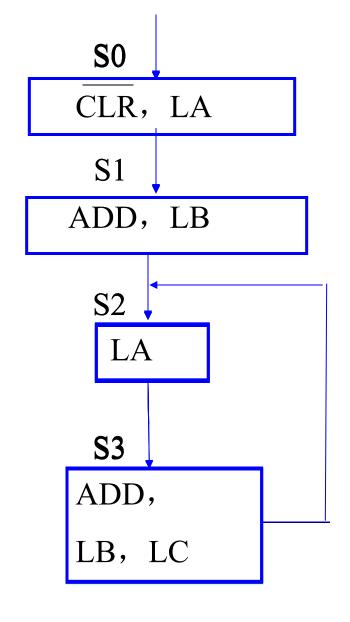
- · 2个八位寄存器: A(加数), B(加数、和);
- 1个一位寄存器: C (进位)
- 八位加法器:
- 一个控制器。

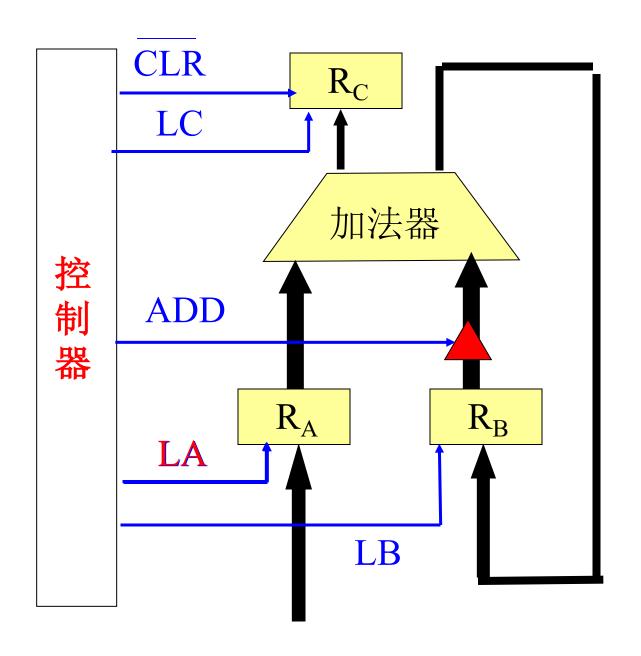
2) 数据通路

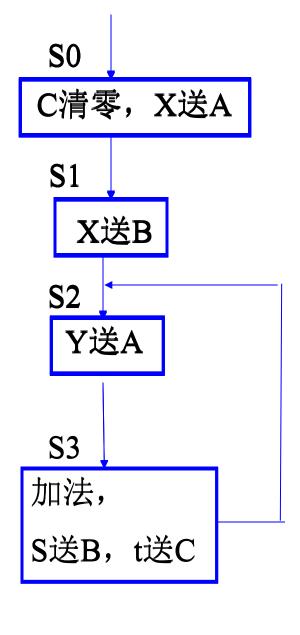












3) 控制器的ASM图

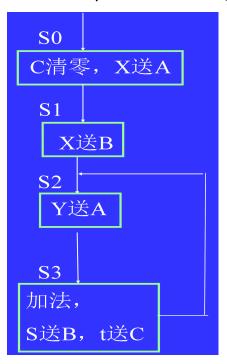
 S_0 : 打入命令 LA (脉冲) , 清零 CLR (电位) ;

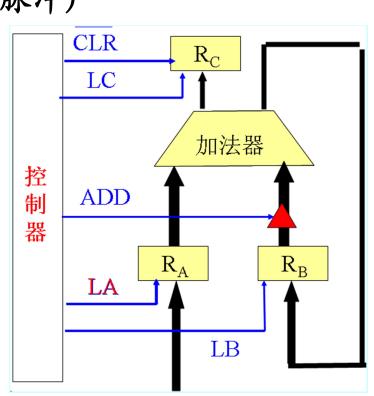
S₁: 打入命令 LB (脉冲);

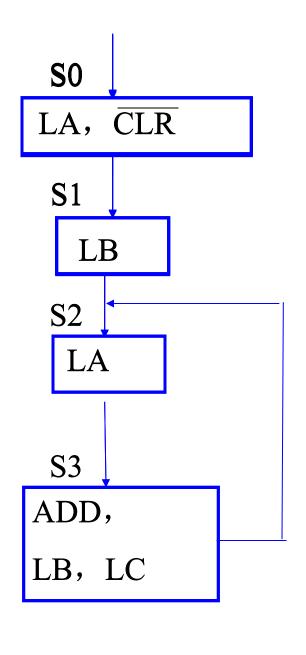
 S_2 : 打入命令 LA (脉冲);

S₃: 加法命令 ADD (电位),

打入命令LB (脉冲),LC (脉冲)







4) 设计控制器

- 给ASM图的状态框编码 (Q_2Q_1)
- · 由ASM 图得控制信号表达式:

$$LA = (\overline{Q_2}^n \overline{Q_1}^n + Q_2^n Q_1^n) T_2 = (Q_1^n \oplus \overline{Q_2}^n) T_2$$

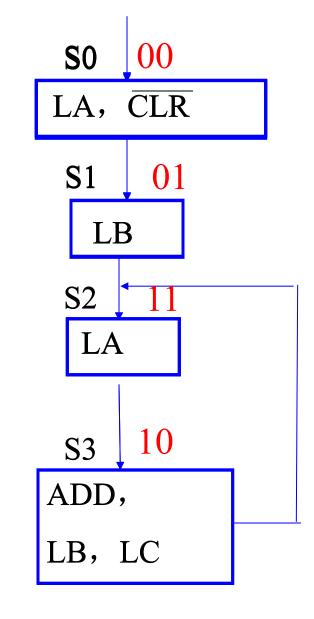
$$LB = (\overline{Q_2}^n Q_1^n + Q_2^n \overline{Q_1}^n) T_2$$

$$= (Q_1^n \oplus Q_2^n) T_2$$

$$LC = Q_2^n \overline{Q_1^n} T_2$$

$$\overline{CLR} = \overline{Q_2^n Q_1^n} CLR = Q_2^n + Q_1^n$$

$$ADD = Q_2^n \overline{Q_1^n}$$



• 控制器的状态转移表:

Q_2^n Q_1^n	$Q_2^{n+1} Q_1^{n+1}$	转移条件
0 0	0 1	
0 1	1 1	
1 1	1 0	
1 0	1 1	

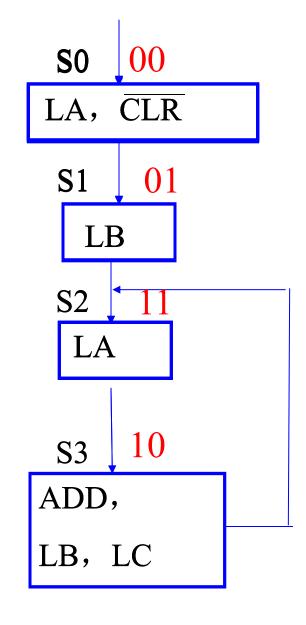
• 触发器驱动方程:

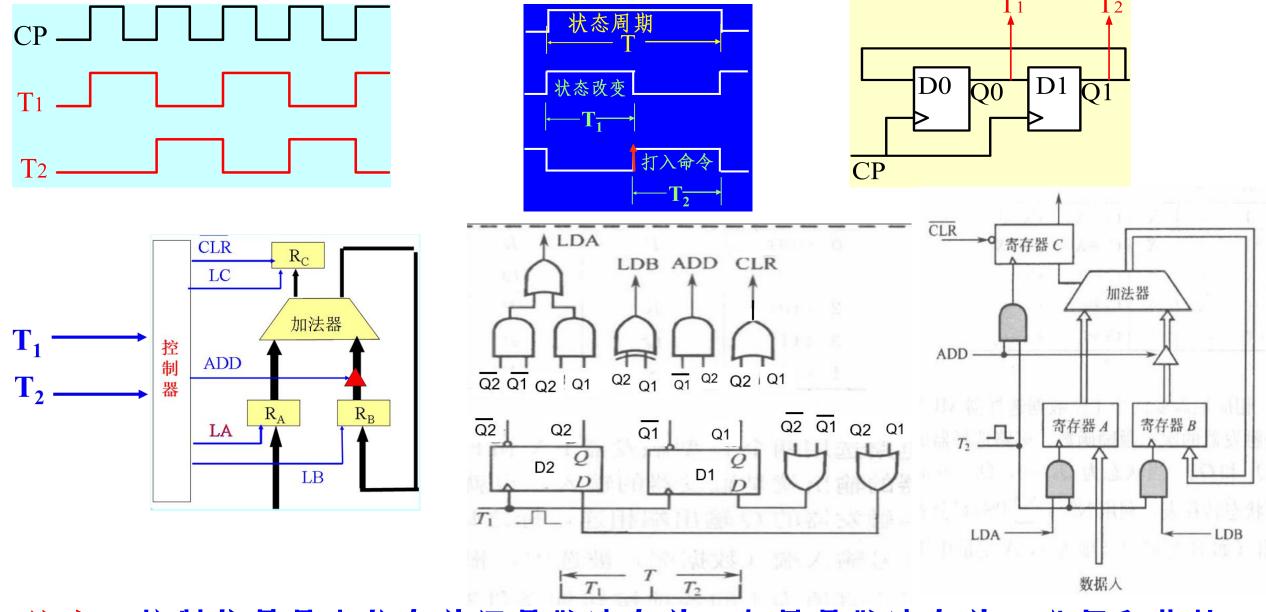
$$Q_{2}^{n+1} = \overline{Q_{2}^{n}} Q_{1}^{n} + Q_{2}^{n} Q_{1}^{n} + Q_{2}^{n} \overline{Q_{1}^{n}} = Q_{2}^{n} + Q_{1}^{n}$$

$$J_{2} = Q_{1}^{n} ; K_{2} = 0$$

$$Q_{1}^{n} = \overline{Q_{2}^{n}} \overline{Q_{1}^{n}} + \overline{Q_{2}^{n}} Q_{1}^{n} + Q_{2}^{n} \overline{Q_{1}^{n}} = \overline{Q_{2}^{n}} + \overline{Q_{1}^{n}}$$

$$J_{2} = 1 ; K_{2} = Q_{2}^{n}$$





注意: 控制信号是电位有效还是脉冲有效, 如果是脉冲有效, 必须和节拍脉冲T₂相"与"。

2. 定序型控制器

适用于状态数少的控制器。n个控制状态需n个触发器 每一个控制状态分配给一个触发器。

- 1) 给ASM图的状态框分配触发器:
- 2) 由 ASM 图得控制信号表达式:
- 3)控制器的MDS表:
- 4) 触发器的次态方程、激励函数:

特点:控制命令译码电路简单

1)分配触发器:

2)控制信号:
$$C_1 = Q_1^n$$

3)MDS表:
$$C_2 = Q_1^n \overline{X}$$

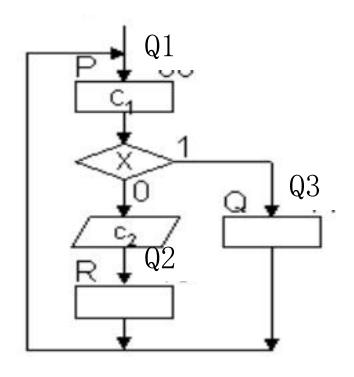
现态	次态 n+1	转移条件
Q1	Q2	\overline{X}
Q1	Q3	X
Q2	Q1	
Q3	Q1	



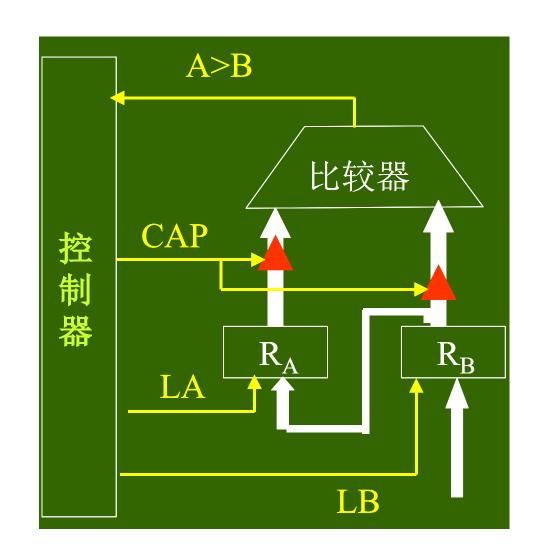
$$Q_1^{n+1} = Q_2^n + Q_3^n$$

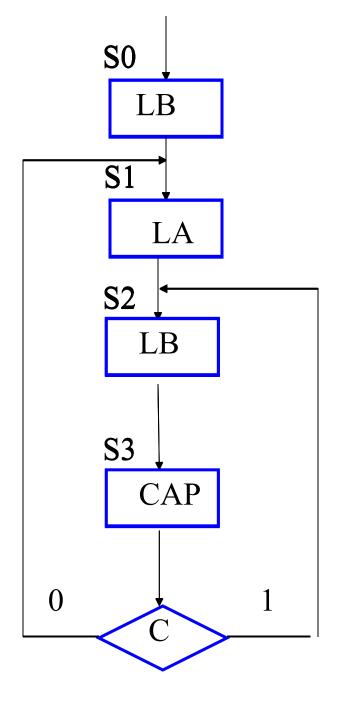
$$Q_2^{n+1} = Q_1^n \ \overline{X}$$

$$Q_3^{n+1} = Q_1^n X$$



教材第三章最 后一节 例:将四位二进制数X,Y分别存入寄存器A和B中,然后比较两数大小,使大数存入寄存器A,设计定序型控制器。





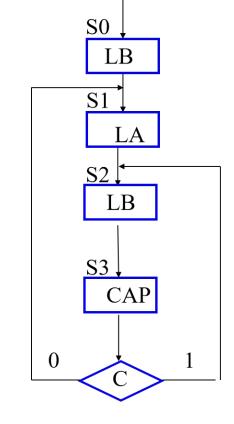
• 控制信号:
$$LB = (Q_0^n + Q_2^n)T_2$$

$$LA = Q_1^n T_2$$

$$CAP = Q_3^n$$

• MDS表:

现态	次态	转移条件
Q0	Q1	
Q1	Q2	
Q2	Q3	
Q3	Q1 Q2	$\overline{\mathbf{C}}$



• 次态方程:

$$Q_{1}^{n+1} = Q_{0}^{n} + Q_{3}^{n} \overline{C}$$

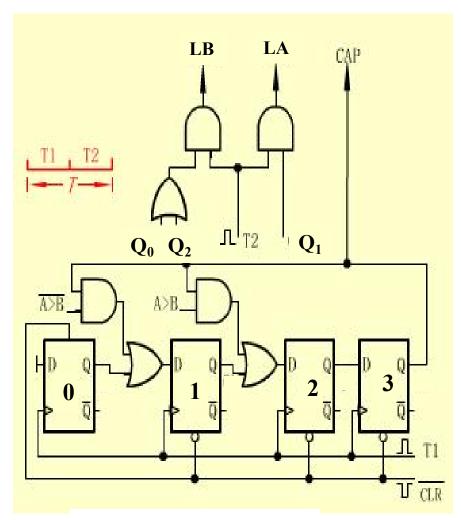
$$Q_{2}^{n+1} = Q_{1}^{n} + Q_{3}^{n} C$$

$$Q_{3}^{n+1} = Q_{2}^{n}$$

$$Q_{0}^{n+1} = 0$$

现态	次态	转移条件
Q0	Q1	
Q1	Q2	
Q2	Q3	
Q3	Q1 Q2	$\overline{\frac{\mathbf{C}}{\mathbf{C}}}$

• 电路实现:



$$Q_1^{n+1} = Q_0^n + Q_3^n \overline{C}$$

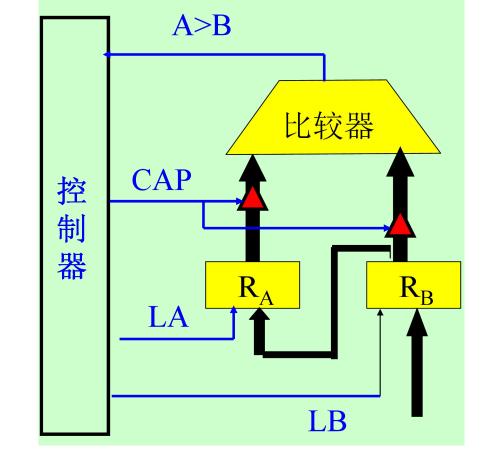
$$Q_2^{n+1} = Q_1^n + Q_3^n C$$

$$Q_3^{n+1} = Q_3^n C$$

$$Q_3^{n+1} = Q_2^n$$

$$Q_0^{n+1} = Q_0^n$$

$$Q_0^{n+1} = Q_0^n$$



$$LB = (Q_0^n + Q_2^n)T_2$$

$$LA = Q_1^n T_2$$

$$CAP = Q_3^n$$

3. 多路选择器 (MUX) 型控制器

适应于状态数较多, N 个触发器可构成 2ⁿ 个控制状态。 n 个触发器需 n 个数据选择器

- 1) 给ASM图的状态框编码:
- 2) 由 ASM 图得控制信号表达式:
- 3) 控制器的状态转移表:
- 4) 数据选择器的数据端: $D_1 = Q_2^n Q_1^n X + Q_2^n Q_1^n$

数据选择器: 输出F (n) → D触发器D (n);

地址输入(共用) ← D触发器(Q)

确定: 数据端 ← 转移条件

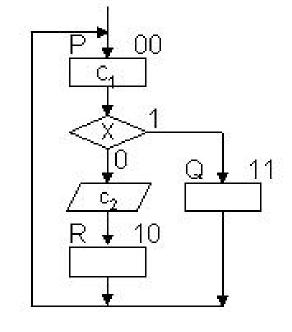
- 1) 给ASM图的状态框编码:
- 2) 由 ASM 图得控制信号表达式:

$$C_{1} = \overline{Q_{1}^{n}} \overline{Q_{0}^{n}}$$

$$C_{2} = \overline{Q_{1}^{n}} \overline{Q_{0}^{n}} \overline{X}$$

3) 控制器的状态真值表:

Q_1^n	Q_0^n	Q_1^{n+}	$^{1} Q_{0}^{n+1}$	转移条件
0	0	1	0	X
		1	1	X
1	0	0	0	
1	1	0	0	
0	1	0	0	



$$D_{1} = \overline{Q_{1}^{n}} \overline{Q_{0}^{n}} (X + \overline{X}) = \overline{Q_{1}^{n}} \overline{Q_{0}^{n}}$$

$$D_{0} = \overline{Q_{1}^{n}} \overline{Q_{0}^{n}} X$$

4) 数据选择器的数据端:

2个四选一的选择器

$\mathbf{A_1}\mathbf{A_0} = \mathbf{Q_1}^{\mathbf{n}} \ \mathbf{Q_0}^{\mathbf{n}}$

MUX1 -- D1

MUX0 - D0

$$MUX1 (d0) = \overline{X} + X = 1;$$

MUX1 (d1) = 0;

MUX1 (d2) = 0;

MUX1 (d3) = 0;

Q_1^n	Q_0^n	Q_1^{n-1}	$+1$ Q_0^{n+1}	转移条件
0	0	1	0	X
		1	1	X
0	1	0	0	
1	0	0	0	
1	1	0	0	

$$MUX0 (d0) = X$$

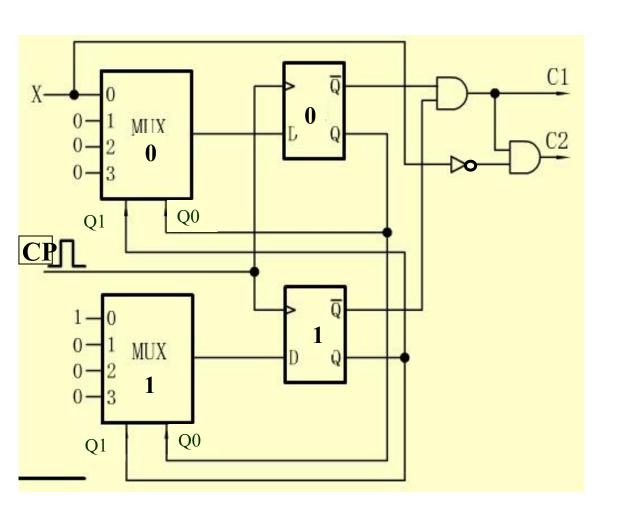
$$MUX0 (d1) = 0$$

$$MUX0 (d2) = 0$$

$$MUX0 (d3) = 0$$

$$D_{1} = Q_{1}^{n} Q_{0}^{n} (X + \overline{X}) = Q_{1}^{n} Q_{0}^{n}$$

$$D_0 = Q_1^n Q_0^n X$$



MUX1 (0) = 1; MUX0 (0) = X

MUX1 (1) = 0; MUX0 (1) = 0

MUX1 (2) = 0; NUX0 (2) = 0

MUX1 (3) = 0; MUX0 (3) = 0

$$C_{1} = \overline{Q_{1}^{n}} \overline{Q_{0}^{n}}$$

$$C_{2} = \overline{Q_{1}^{n}} \overline{Q_{0}^{n}} \overline{X}$$

$$D_{1} = \overline{Q_{1}^{n}} \overline{Q_{0}^{n}} (X + \overline{X}) = \overline{Q_{1}^{n}} \overline{Q_{0}^{n}}$$

$$D_{0} = \overline{Q_{1}^{n}} \overline{Q_{0}^{n}} X$$

1) 给ASM图的状态框编码 (Q_1Q_0) :

2) 由ASM 图得控制信号表达式:

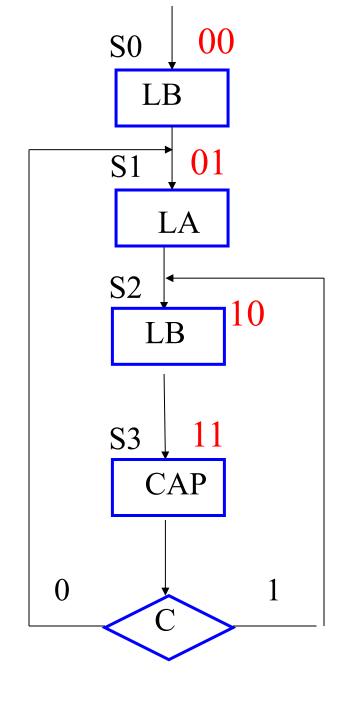
$$LB = (\overline{Q_1}^n \overline{Q_0}^n + Q_1^n \overline{Q_0}^n)T_2$$

$$LA = \overline{Q_1}^n Q_0^n T_2$$

$$CAP = Q_1^n Q_0^n$$

3) 控制器的状态真值表:

$Q_1^n Q_0^n$	Q_1^n	$+1 Q_0^{n+1}$	转移条件
0 0	0	1	
0 1	1	0	
1 0	1	1	
1 1	0	1	\overline{C}
	1	0	C



4) 数据选择器的数据端:

2个四选一的选择器

$$\mathbf{A_1}\mathbf{A_0} = \mathbf{Q_1}^{\mathbf{n}} \ \mathbf{Q_0}^{\mathbf{n}}$$

Mux1 (d0) = 0;

Mux1 (d1) = 1;

Mux1 (d2) = 1;

Mux1 (d3) = C;

Mux0 (d0) = 1

Mux0 (d1) = 0

Mux0 (d2) = 1

Mux0 (d3) = C

Q_1^n	Q_0^n	Q_1^{n+}	$-1 Q_0^{n+1}$	转移条	件
0	0	0	1		
0	1	1	0		
1	0	1	1		
1	1	0	1	\overline{C}	
		1	0	C	

祝同学们学业有成!