Sequential Circuits

Example

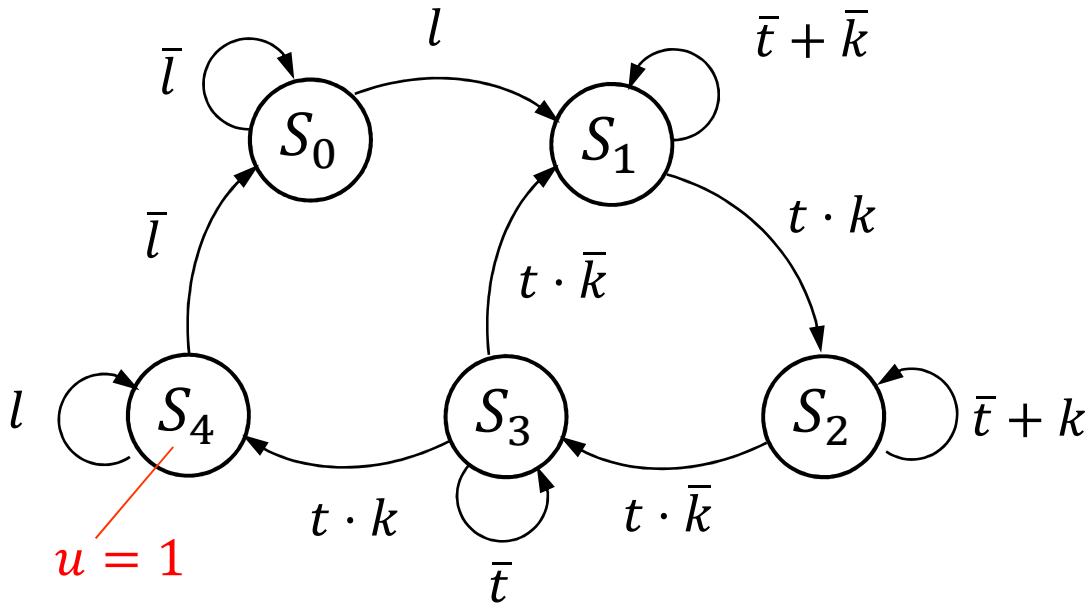
A safe unlocked when a correct code is entered on a keypad

The keypad has only two keys : 0 and 1
The correct key is : 101

l : locked
t : key touched
k : key
u : unlock

Sequential Circuits

- Example



Sequential Circuits

Representation of a sequential circuit ?

- State graph

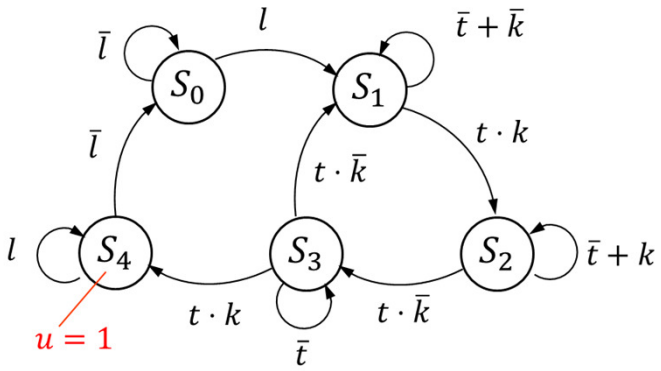
$$G = (X, Y, S, T, O)$$

define the number of memory elements required to represent $S : M$

represent each state s by a vector of M

Sequential Circuits

Example



	M
S_0	000
S_1	001
S_2	011
S_3	010
S_4	100

Logarithmic

	M
S_0	00001
S_1	00010
S_2	00100
S_3	01000
S_4	10000

Linear (one hot)

Sequential Circuits

Representation of a sequential circuit ?

- State graph

$$G = (X, Y, S, T, O)$$

define the *transition function* : m_k

m_k = sum of the Boolean function of the transitions that have as target a state where m_k=1

Sequential Circuits

- Example

$$M_0 = M_0 \cdot \bar{l} + M_4 \cdot \bar{l}$$

$$M_0 = M_0 \cdot \bar{l} + M_4 \cdot \bar{l}$$

$$M_1 = M_0 \cdot l + M_1 \cdot (\bar{t} + \bar{k}) + M_3 \cdot t\bar{k}$$

$$M_2 = M_2 \cdot (\bar{t} + k) + M_1 \cdot tk$$

$$M_3 = M_3 \cdot \bar{t} + M_2 \cdot t\bar{k}$$

$$M_4 = M_4 \cdot l + M_3 \cdot tk$$

Sequential Circuits

Representation of a sequential circuit ?

- State graph

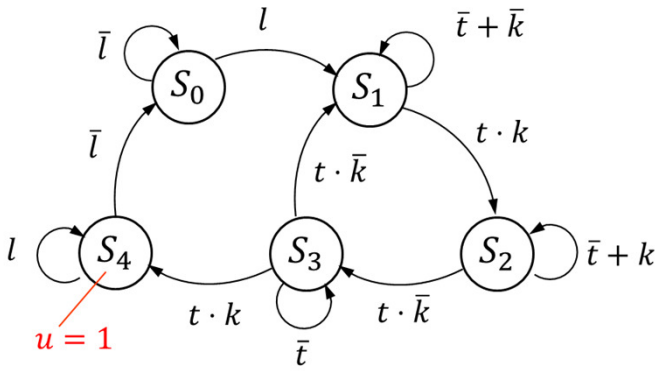
$$G = (X, Y, S, T, O)$$

define the *output function* : y_i

y_i = sum of the output conditions concerning y_i

Sequential Circuits

Example



$$M_0 = M_0 \cdot \bar{l} + M_4 \cdot \bar{l}$$

$$M_1 = M_0 \cdot l + M_1 \cdot (\bar{t} + \bar{k}) + M_3 \cdot t\bar{k}$$

$$M_2 = M_2 \cdot (\bar{t} + k) + M_1 \cdot tk$$

$$M_3 = M_3 \cdot \bar{t} + M_2 \cdot t\bar{k}$$

$$M_4 = M_4 \cdot l + M_3 \cdot tk$$

$$u = M_4$$