What's not regular?

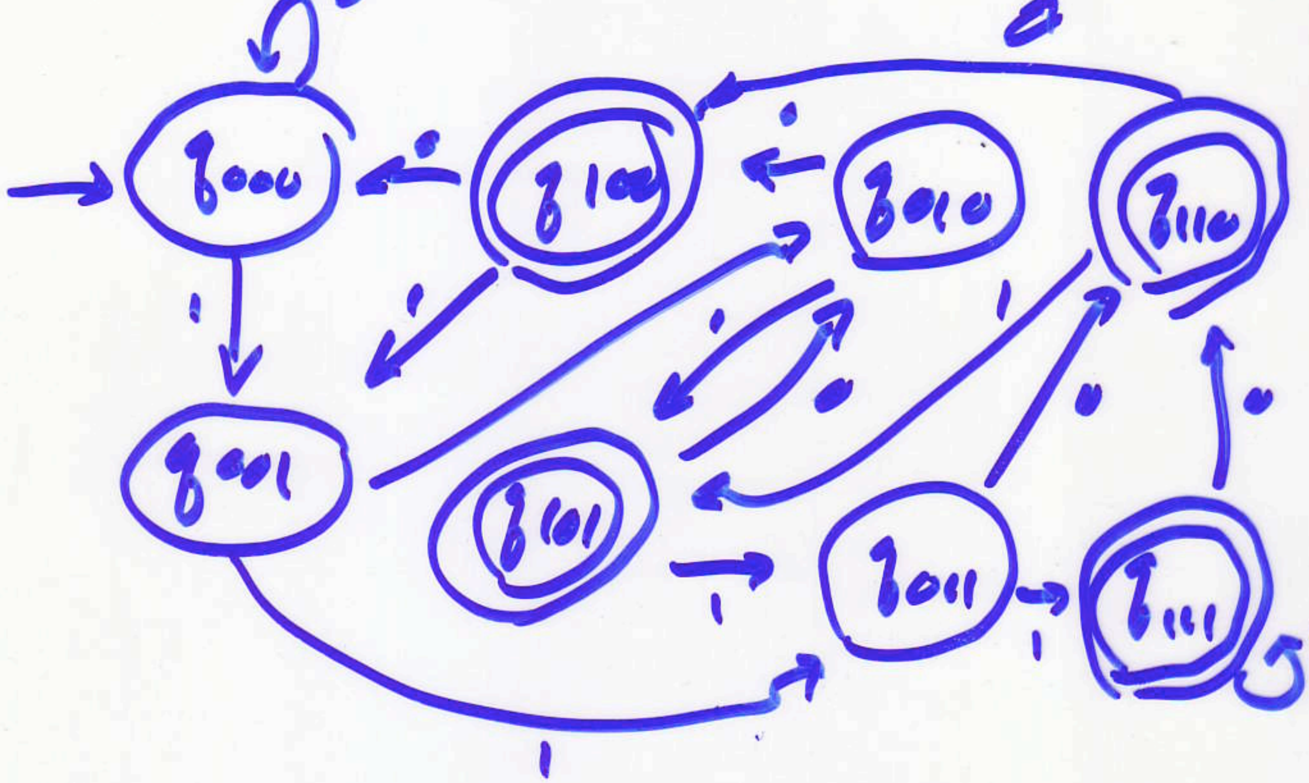
not reg. $\left[\begin{array}{l} \{0^n 1^n \mid n \geq 0\} \\ \{x \mid \#_0(x) = \#_1(x)\} \end{array}\right.$

is reg. $\left[\begin{array}{l} \{x \mid \#_{01}(x) = \#_{10}(x)\} \\ \end{array}\right.$

0101

$\underline{}\,1$

$\{x \mid 3^{\text{rd}} \text{ letter from right is } 1\}$



Suppose L ~~recognized~~ recognized by M with K < 8 states

Consider 8 inputs

if 00x 0 01x 0 ↑ ~~xx~~ 0 00 ~~xx~~ 1 00 ↑	000 001 010 011 100 101 110 111	By P.h.p. 2 inputs → same state q. if 0xx & 1xx go to same, then error q ∈ F or ∉.

$(^n \;)^n$

$$\{ 0^n 1^n \mid n \geq 0 \}$$

Take any M, DFA.

Suppose M has p states.

Let q_i = state M is in after reading 0^i

$0 \leq i \leq p$

p+1 values of i, so for some

$j < k$ $\quad 0 \leq j, k \leq p \quad q_j = q_k \quad j \neq k$

If M accepts $0^j 1^j$

then it also accepts

$0^k 1^j$.

$\therefore L(M) \neq \{0^n 1^n \mid n \geq 0\}$

$0^{j+(k-j)\cdot 5} 1^j$

$(^n \ )^n$

$\cancel{\{0^n 1^n \mid n \geq 0\}}$ $\{x \mid \#_0 x = \#_1 x\}$

Take any M, DFA.

Suppose M has p states.

Let q_i = state M is in after reading 0^i
$0 \leq i \leq p$

p+1 values of i, so for some

$j<k$ $0 \leq j, k \leq p$ $q_j = q_k$ $j \neq k$

If M accepts $0^j 1^j$

then it also accepts

$0^k 1^j$.

$\therefore L(M) \neq \cancel{\{0^n 1^n \mid n \geq 0\}}$

$0^{j+(k-j)}$ $\{x \mid \#_0 x = \#_1 x\}$

$L = \{ ww^R \mid w \in \Sigma^* \}$

$\underline{a\,a\,b\,a}\ \underline{a\,b\,a\,a}$

Suppose M w/ p states accepts L.

~~let~~ $w_1 \ldots w_{p+1}$ ~~be~~

~~p+1~~

let q_i be state M is in after reading a^i $0 \le i \le p$

$\therefore$ both ... $q_j = q_k$

$a^j bba^j$

$a^k bba^j$ etc.

$w_1 \ldots w_{p+1}$ all of same length, all different

$w_j w_j^R$ — $\in L$

$w_k w_j^R$ — $\notin L$

Pumping Lemma

If L is reg. $\exists\, p > 0$ st

$\forall s \in L$ $|s| \geq p$ $\exists\, x, y, z$

st $s = x \cdot y \cdot z$

$$|y| > 0$$

$$|xy| \leq p$$

$\forall i \geq 0$ $xy^iz \in L$