

NON-REGULAR

$$B = \{0^i 1^i \mid i \geq 0\}$$

$$C = \{w \mid w \text{ has } = \text{ #'s of } 1\text{'s}\}$$

$s \leftarrow$  this can't be pumped!

$$s = 0110101000011$$

Diagram showing the string  $s = 0110101000011$  with brackets under the first three '0's labeled  $x$ , the next three '1's labeled  $y$ , and the remaining '0's labeled  $z$ .

$$011 \quad 0101 \quad 0101$$

Diagram showing the string  $01101010101$  with brackets under the first three '0's labeled  $x$ , the next three '1's labeled  $y$ , and the remaining '0's labeled  $z$ .

$$\exists x, y, z \Rightarrow xy^2z = s$$

$$|y| \geq 1, |xy| \leq p,$$

$$\Rightarrow \forall i, xy^i z \in A$$

also not-regular

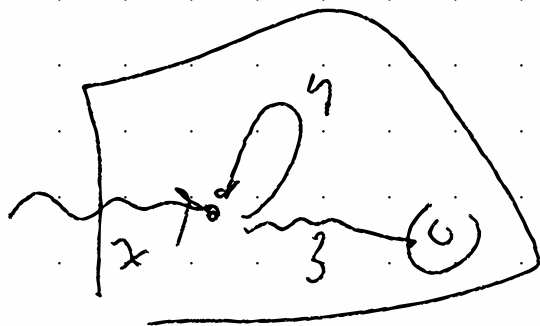
$$B = \{ s \in \{0,1\}^* \mid \# \text{ of } 0's = \# \text{ of } 1's \}$$

this is also non-regular

$$\begin{array}{cccccccc} & & & .4 & & & & \\ & & & \boxed{1} & 0 & 1 & 1 & 0 & 0 & 1 & 1 \\ \hline & 0 & 1 & 0 & 0 & & & & & & \\ & \underbrace{\hspace{1.5cm}} & & & & & & \underbrace{\hspace{1.5cm}} & & & \\ & \gamma & & & & & & \gamma & & & \end{array}$$

$$|xy| \leq p$$

$s \Rightarrow xy/3$  ← part loop  
 find

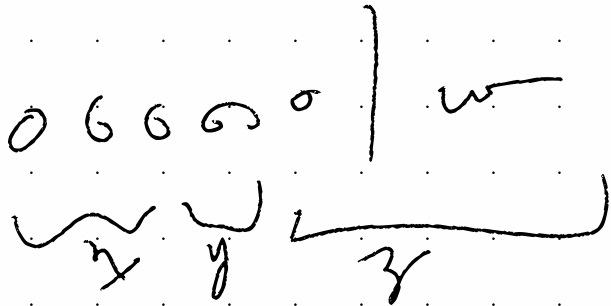


$$S = OPw$$

$$OPw \in \mathcal{C}$$

$$\begin{array}{r} s \\ \hline xy/3 \end{array}$$

$$w \in \{0,1\}^*$$



Another way

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

$$C \cap 0^* 1^* = \beta$$

Suppose  $C$  is Regular

$\implies$

$\beta$

regular by

~~$\beta$~~

$\implies$

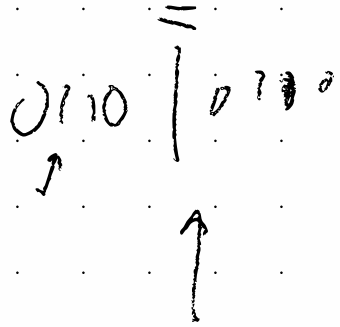
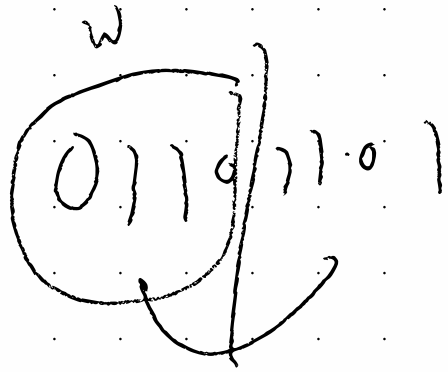
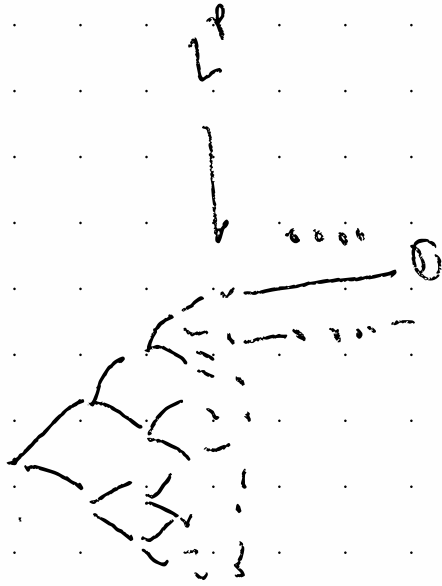
$C$  is not regular

# Langmuir Function

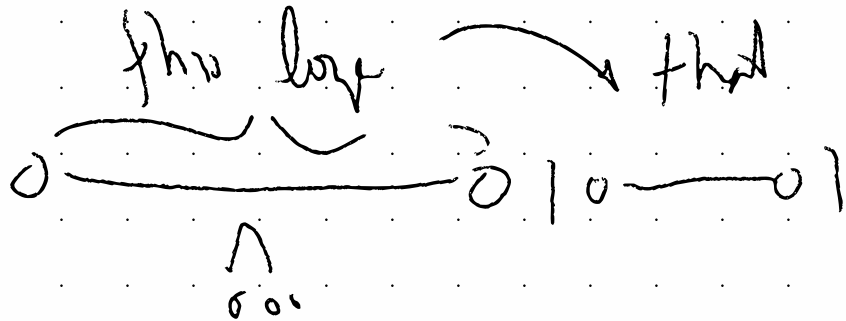
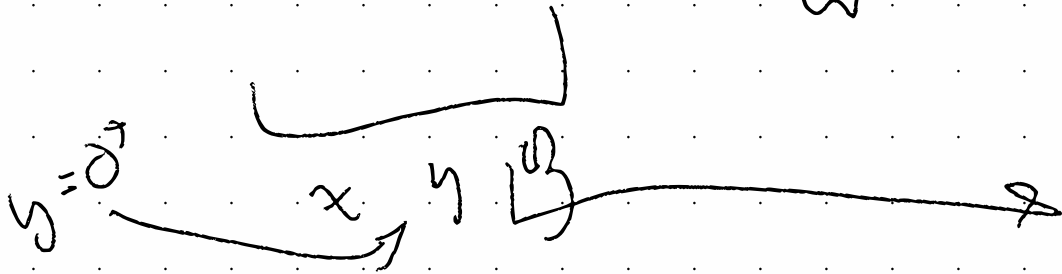
$$F = \frac{w}{1+w} \quad w \in \{0,1\}^k$$

$$\alpha \{ \alpha \}$$

$$\alpha \{ \alpha \}$$



$$S = \underbrace{000\dots01000\dots0}_{w} \in F$$



$S =$ 
502
0000
010060
01
← 102

┌  
0000  
└

Pump



0000
0000
0000
0060
01
← (06)

$\neq w$

$L_{\text{as}}$ 
 $y = 0^+$ 
,  $|y|$  is
} odd nope
} even nope

goal  $\left\{ \begin{array}{l} \exists s \in F \text{ st. } \forall x, y, z \text{ st.} \\ xy^p z = s, \quad |y| \geq 1, \quad |xy| \leq p \\ \exists i \text{ st } xy^i z \notin F. \end{array} \right.$

$s =$   $\underbrace{0000}_{x} \underbrace{0000}_{y} \underbrace{0000}_{z} \dots 01$   
 middle



✓  $y = 000$  ( $|y|$  odd)

$|xyz^2z|$  is odd

⇒ Pump out of F

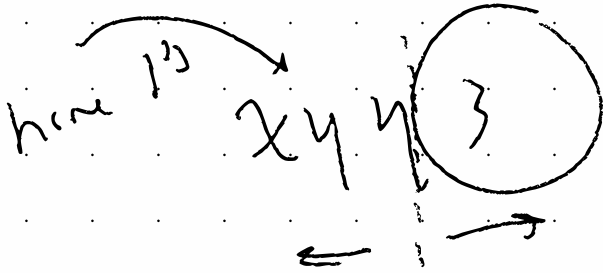
$|xyz|$  is even  $|y|$  is odd

$|xyyz| = |xyz| + |y|$   
odd even odd

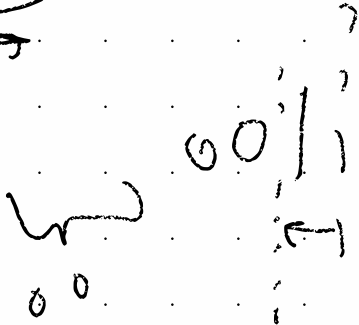
$y = 00$   $|y|$  is ~~odd~~ even

$xyyz \notin F$

$\Rightarrow$  also  
pump out  
 $\notin F$



2  $1^2$  are there



0000 10000  $\in \mathbb{F}$

00000 | 0000  
w  $\neq w$

length w /  $p=4$   
 $|s|=2$

$|s|=10$

$|x44z|=12$