NON-REGULAR

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

$C = \{ w \mid w \text{ has } = 0\text{'s } \& \ 1\text{'s} \}$

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

$s = 011010100011$

$x \quad y$

$\exists x, y, z \Rightarrow xyz = s$

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

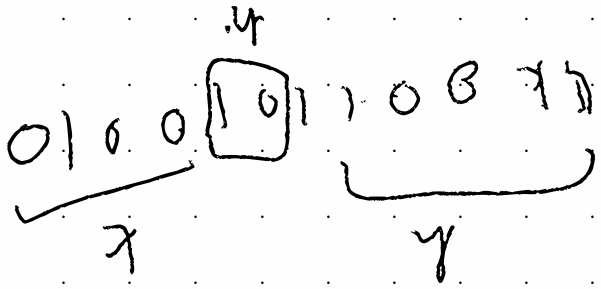
$\forall i, \ xy^i z \in A$

011 010 1 0001 1

also not-regular

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

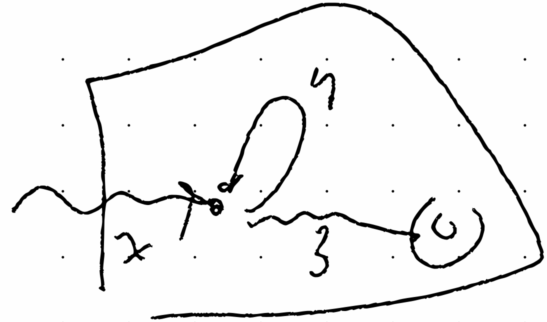
this is also non-regular



$$|xy| \leq p$$

$s = xy \mid z$ ← pump first

← find



$$s = 0^p w$$

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

$0^p w \in C$

$s \mid$

$xy \mid z$

$0\,0\,0\,0\,0 \mid w$

$\underbrace{\quad}_{x}\ \underbrace{\quad}_{y}\ \underbrace{\quad\quad}_{z}$

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

$C \cap 0^* 1^* = B$.

Suppose C is Reg Lang. $\Rightarrow$ B regular by

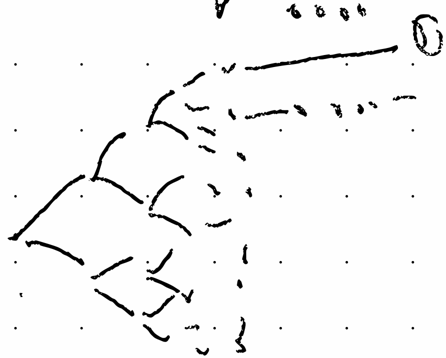
$\emptyset \Rightarrow$ C is not regular

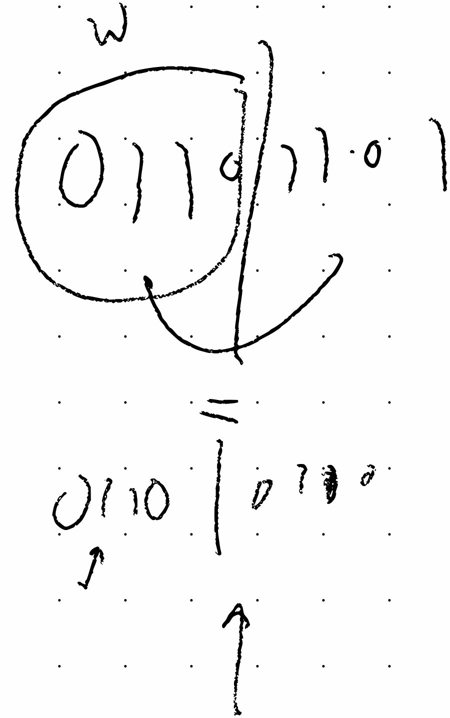
Language F not reg.

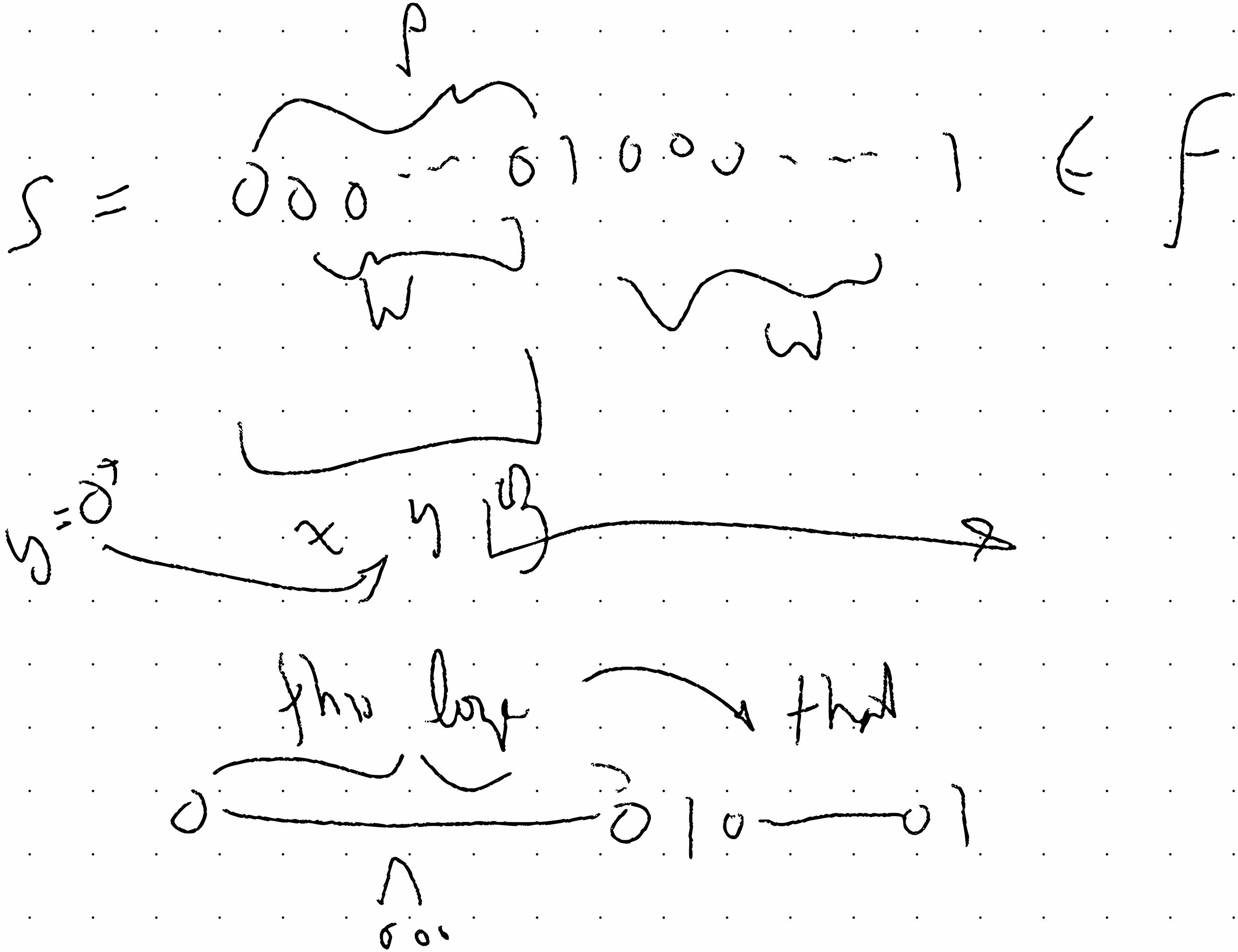
$F = \{ ww \mid w \in \{0,1\}^* \}$

$\underbrace{w}_{p} \; \underbrace{w}_{p}$

2^p







p
s = 000 ... 01000 ... 1 ∈ F
w
w
x
y
this loop
that
001

50↓   ↖ 102

$s = 0000 \text{—} 010000 \text{—} 01$

0000

k

pump

$0000 \text{—} 0000 \mid 0010000 \text{—} 001$ (10)

$\neq w$

w

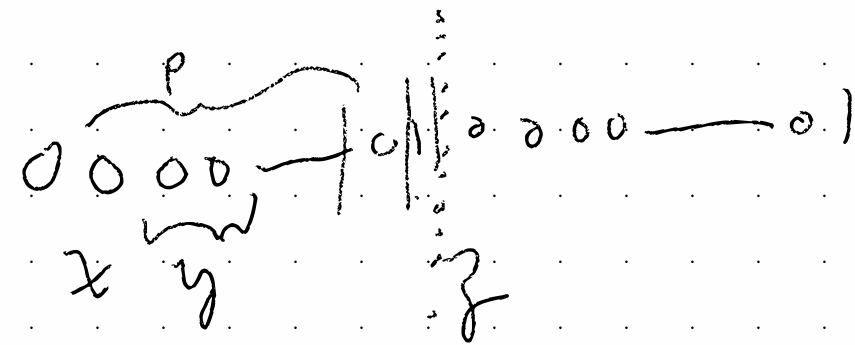
Lets $y = 0^t$, $|y|$ is
- odd nope
- even nope

Goal

$\exists s \in F$ s.t. $\forall x,y,z$ s.t.

$xyz = s$, $|y| \geq 1$, $|xy| \leq p$

$\exists i$ st $xy^i z \notin F$.

$s =$ 

✓ $y = 000$ $|y|$ odd

$|xy^2z|$ is odd

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

$|xyyz| = |xyz| + |y|$

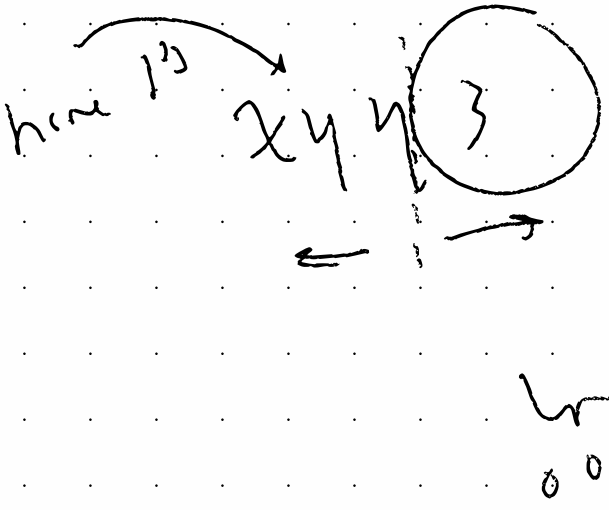
odd even odd

⇒ pump out of F

$y = 00$ $|y|$ is even

$\Rightarrow$ also pump out of L

$xyyz \notin L$



0 0 0 0 1 0 0 0 1 $\in F$

0 0 0 0 0 0 | 1 0 0 0 1

w | $\neq w$

example w/ $p = 4$

$|y| = 2$

$|s| = 10$

$|xyyz| = 12$