"I pledge my honor that I have abided
by the Stevens Honor System" *Julia Nelson*

Problem 1

$$L = \{0^{2^i} : i \geq 0\} \quad \text{generates} \quad \{0, 00, 0000, 000000 \cdots\}$$

There exists an int n such that $w \in L$
with $|w| > n$
x, y, z
$\in \Sigma^*$
such that
$w = xyz$
$|xy| \leq n$
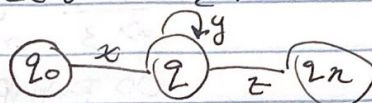$|x| \geq 1$
For all $i \geq 0$
$w_i = xy^i z \in L$

$w = 0^{2^i}$

if $w = xyz$ then $y = a^k$

$w_i = xy^i z$

$w_0 = 0^{2^i - k}$

w_0 is Not in L

Problem 2

Prove Lang $B = \{0^i 1^j : i \neq j\}$ is not Regular
Consider how B is related to Non-reg lang

$B = |0^i 1^j| \quad i \neq j$

$\{0^i 1^j : i \geq 0\}$

lets assume B is Reg lang
and gen. strings # of 0's not equal to # of $\frac{1}{2}$ 1's.
Complement of B is

$$\overline{B} = \{0^i 1^j | i = j\} \quad \text{generates string}$$

with equal # i's and j's

if B is regular, so is $\overline{B}$ (closed prop)
since $\overline{B} \{\text{of } B \text{ (not-reg)}\}$
$\overline{B} = \{0^i 1^j | i = j\}$ then
$$B = \{0^i 1^j | i \neq j\} \text{ is Not Regular}$$

Problem 3

whats min pumping length æ for the following languages

P^1 any string of long
$P \rightarrow$ pump length
$P^1 > P$

1. 0001^*

Min string length is 000
$\Rightarrow 3 \rightarrow P^1 = 3$
So pumping length can be
$P = 2$

$P^1 > P$
$3 > 2$

2. $0^* 1^* = \{ \epsilon, 00, 11, 01, 001, \dots \}$

min length $P^1 = \epsilon$
so cant be pumped $P = 0$

3. $0^* 1^* 0^* 1^* \cup 10^* 1 = \{ \epsilon, 01010i, \dots \}$

Min string $= \epsilon$
So cannot be pumped $\quad P = 0$

4. $(01)^* = \{ \epsilon, 01, 0101, 01010, \dots \}$

Min $P^1 = \epsilon$
Cannot be pumped $\quad P = 0$

5. $1^* 0 1^* 0 1^* = \{ 00, 1001, 0101, \dots \}$

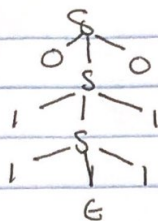Min string length $P^1 = 2$
P can $= 1$
$P^1 > P \quad 2 > 1$

Problem 4

alphabet $\{0,1\}$

1. $\{w : w = w^R\}$ lang of pelindromes

$$S \to 0S0 \mid 1S1 \mid \epsilon$$
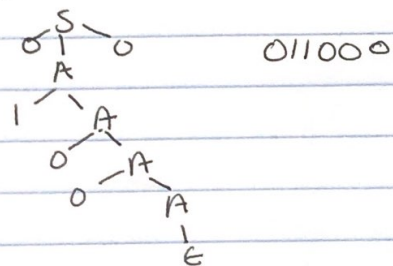
take string $\underbrace{01}_{W} \underbrace{110}_{W^R}$

2. $S \to 0A0 \mid 1A1$ $\{w : w \text{ starts + ends } w/ \text{ same symbol}\}$

$A \to 0A0 \mid 1A1 \mid 0A1 \mid 1A0 \mid 0A \mid 1A \mid \epsilon$

$\{_u \to 011000$

     011000

3. $\{w : w \text{ contains more 0's than 1's}\}$

$S \to AS \mid 0A \mid 0S$

$A \to AA \mid 0A1 \mid 1A0 \mid \epsilon$

take string 01010