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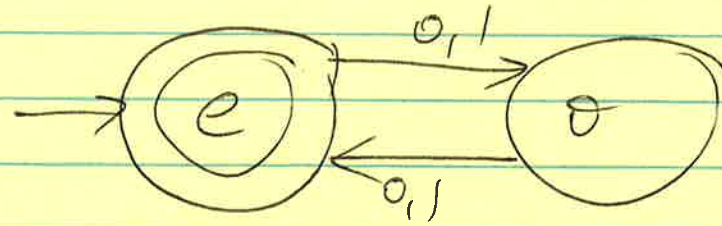
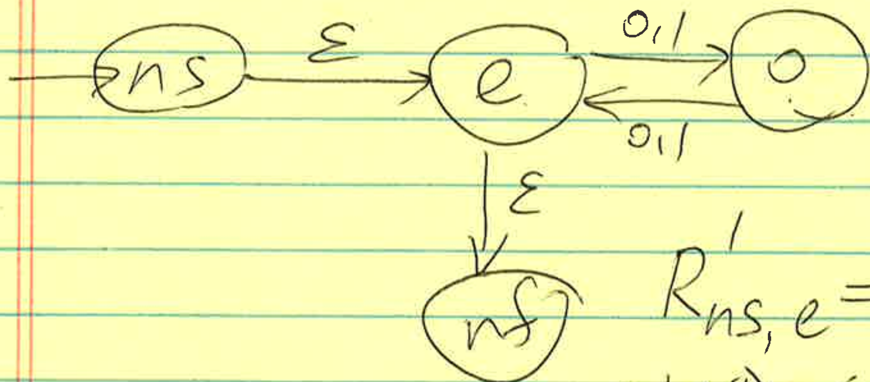
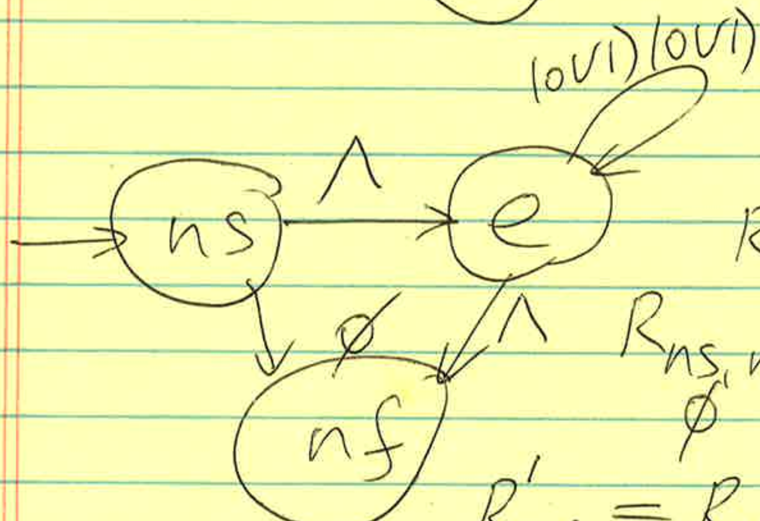
$$R'_{ij} = R_{ij} \cup (R_{ik} R_{kk}^{*} R_{kj})$$





$$R'_{ns,e} = \overset{\Lambda}{R_{ns,e}} \cup (\underset{\emptyset}{R_{ns,o}} R_{o,o}^{*} R_{o,e})$$



$$R'_{ns,nf} = \underset{\emptyset}{R_{ns,nf}} \cup (\underset{\emptyset}{R_{ns,o}} R_{o,o}^{*} R_{o,e})$$

$$R'_{e,e} = \underset{\emptyset}{R_{e,e}} \cup (\underset{(0\cup 1)}{R_{e,o}} \underset{\emptyset^{*}}{R_{o,o}^{*}} \underset{(0\cup 1)}{R_{o,e}})$$

Λ

$$R'_{e,nf} = \underset{\Lambda}{R_{e,nf}} \cup (\underline{R_{e,o} R_{o,o}^{*}} \underset{\emptyset}{R_{o,nf}})$$

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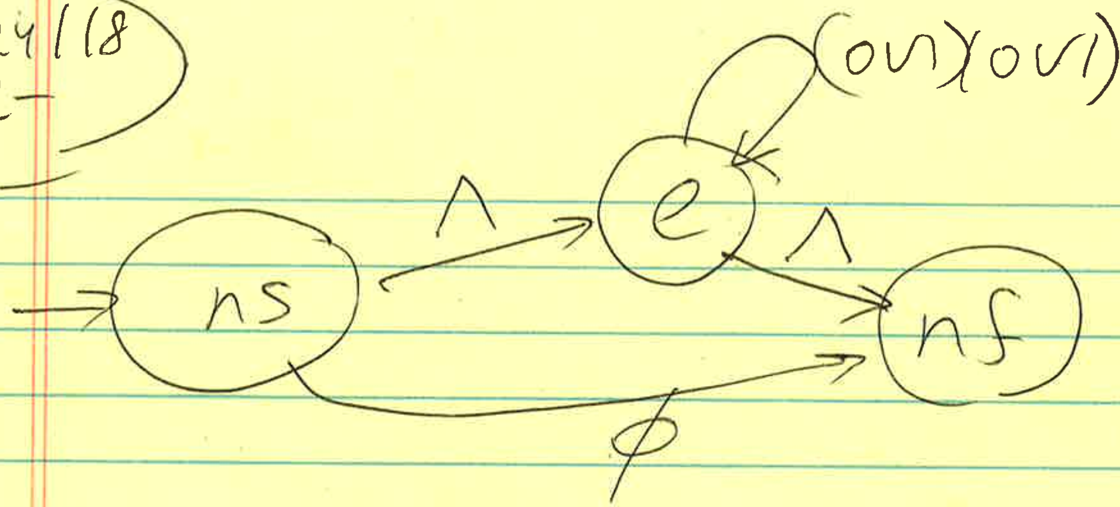
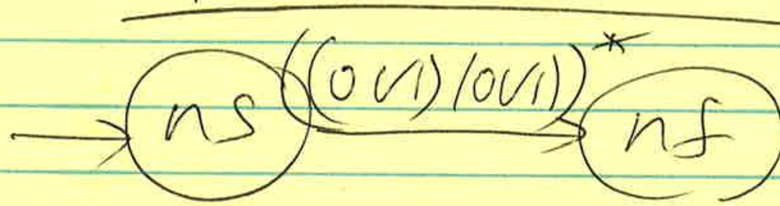


$$R'_{ns,nf} = \underset{\emptyset}{R_{ns,nf}} \cup \left(R_{ns,e}\, R_{e,e}^{*}\, R_{e,nf}\right)$$

$$\Lambda((0\cup 1)(0\cup 1))^{*}\Lambda$$

$$\boxed{((0\cup 1)(0\cup 1))^{*}}$$



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Pumping lemma.

$\forall \text{reg. } L\ \exists p\ \forall w \in L (\text{len}(w) \geq p \longrightarrow$
$\exists x, y, z (w = xyz\ \&\ \text{len}(y) > 0\ \&\ \text{len}(xy) \leq p$
$\&\ \forall i (xy^i p \in L)))$

For every regular language L there exists a natural number p such that every word w from L whose length is at least p can be represented as $w = xyz$, where y is non-empty, length of xy is smaller than or equal to p, and for every i, the word $x\underbrace{y \cdots y}_{i \text{ times}}z$ is in L.

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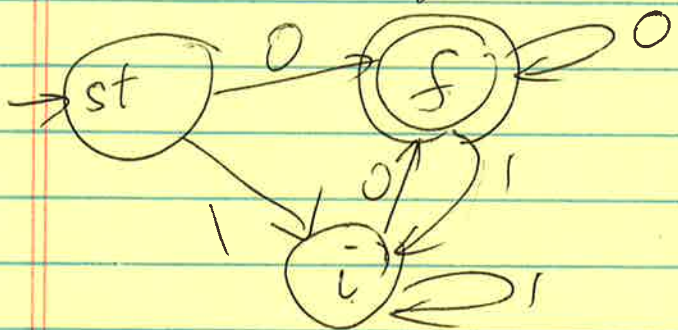
Proof: p = # of states in FA

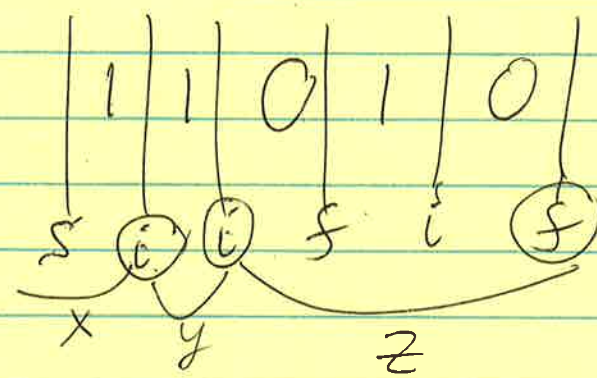
We look for first time when state is repeated

x – everything before the first repeating pair of states

y – everything between the first & second ~~state~~ repeating states

z – everything after

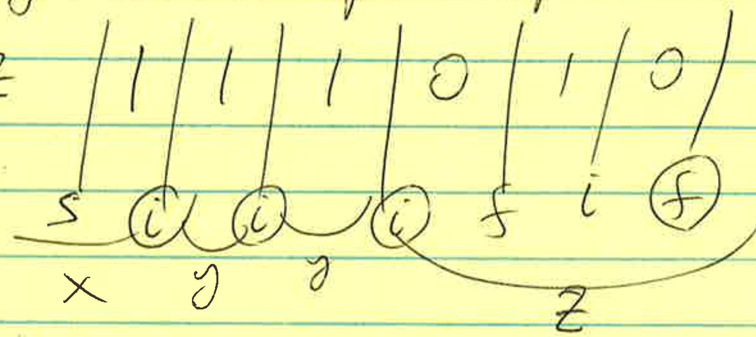




x=1
y=1
z=010

Pigeonhole principle

xyyz



xyz
xyyz

xyyyz
...

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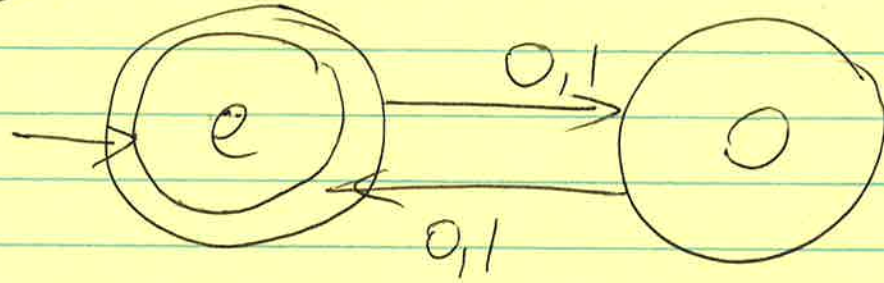

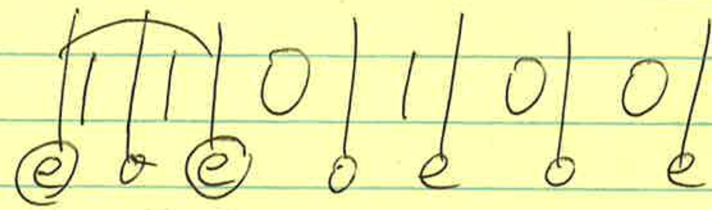

$x = \Lambda$

$y = 11$

$z = 0100$

1) find x, y, z

2) show that $xyyz$ is accepted by this automaton

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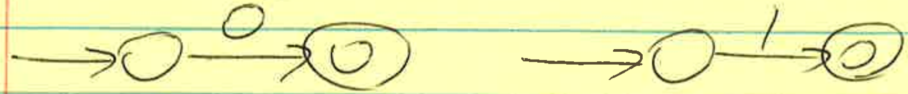
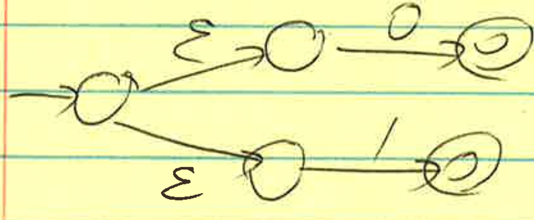
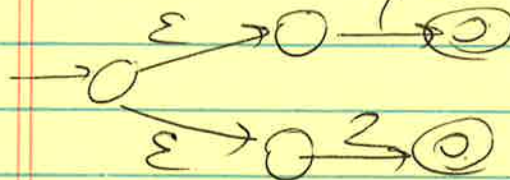
$(0 \cup 1)(1 \cup 2)^*$

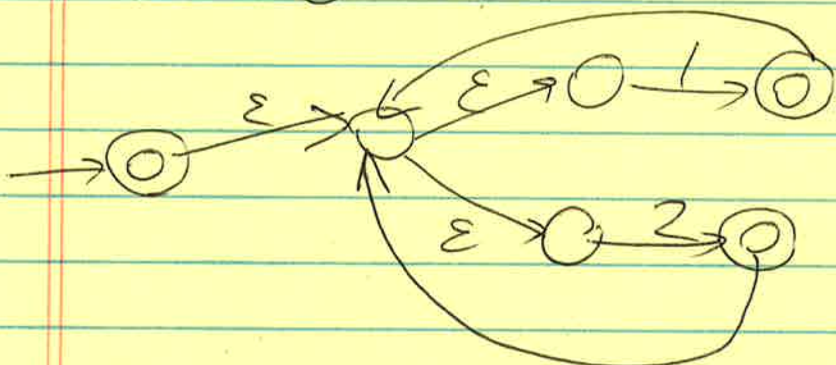




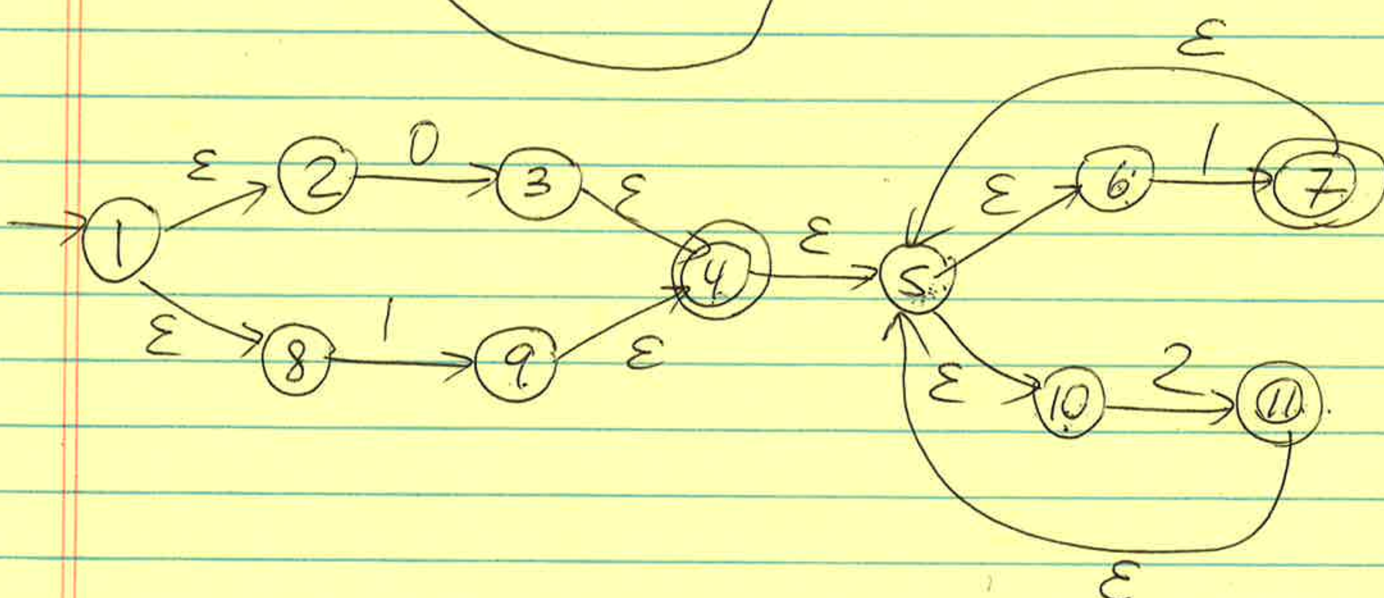
$0 \cup 1$



$1 \cup 2$



$(1 \cup 2)^*$



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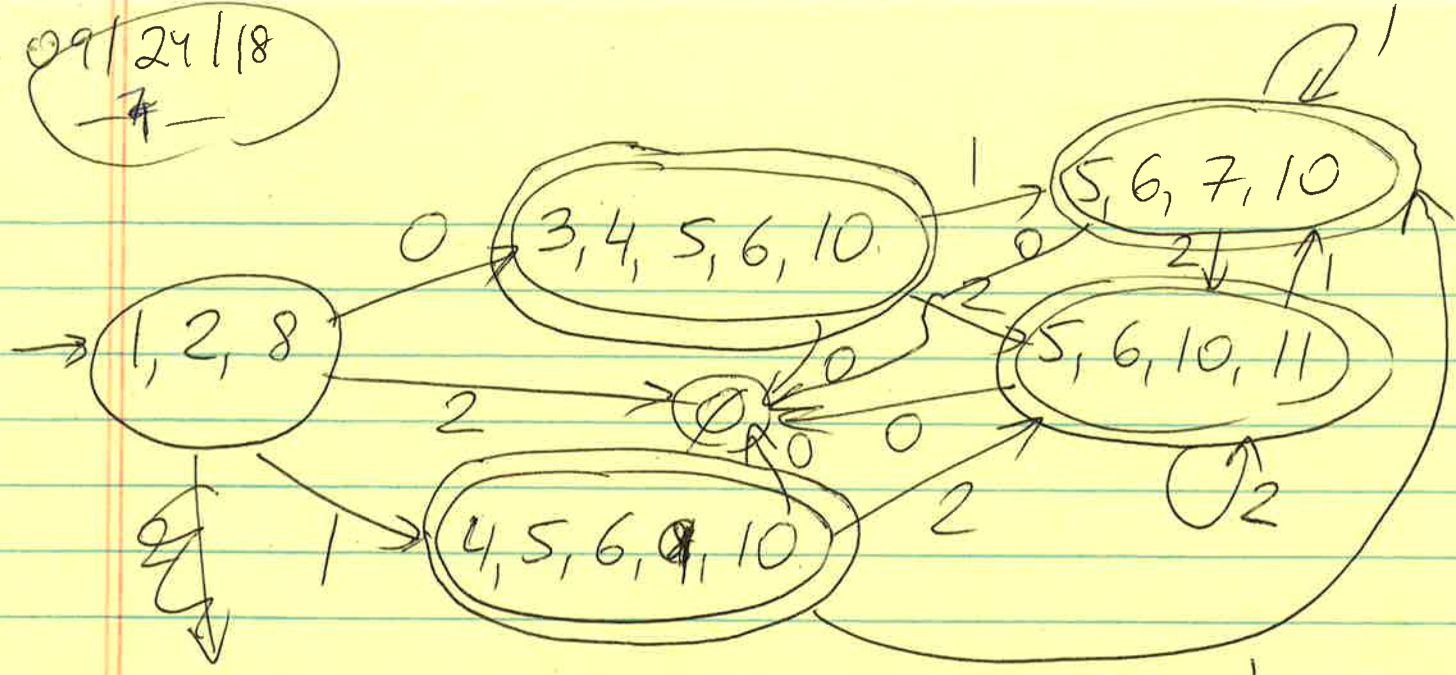

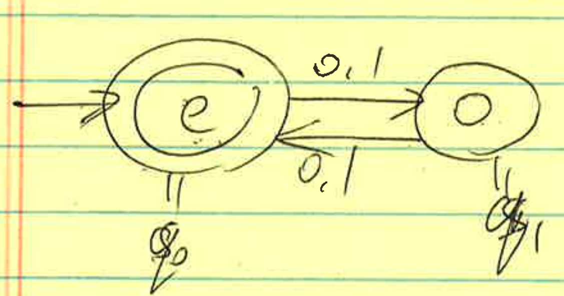

$N = 2, \quad q_0 = e, \quad q_1 = o$

$M = 2, \quad s_0 = 0, \quad s_1 = 1$

$\text{state}[q_0][s_0] = \text{state}[0][0] = 1$

$\text{state}[q_0][s_1] = \text{state}[0][1] = 1 \; (q_1)$

$\text{state}[q_1][s_0] = \text{state}[1][0] = 0$

$\text{state}[q_1][s_1] = \text{state}[1][1] = 0$

final[0] = true

final[1] = false