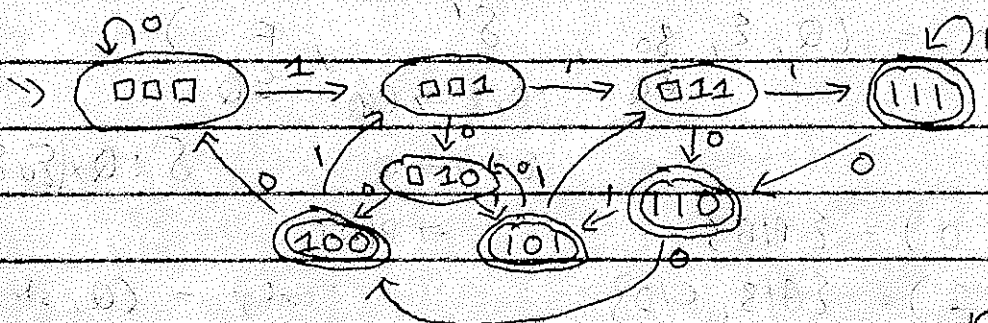


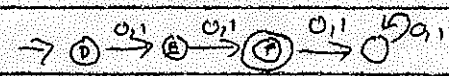
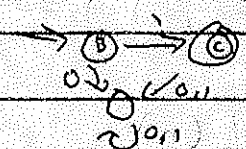
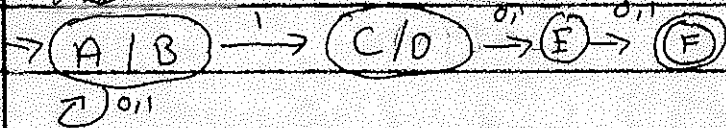
1-1)

A = "Strings where third to last letter is 1"  
 = "Anything" 0 "1" 0 "Two letters"



1100 ✓

011000 X



Old (DFA)



edges labels from

X were unique  
 "deterministic"

new (Non-deterministic Finite Automata

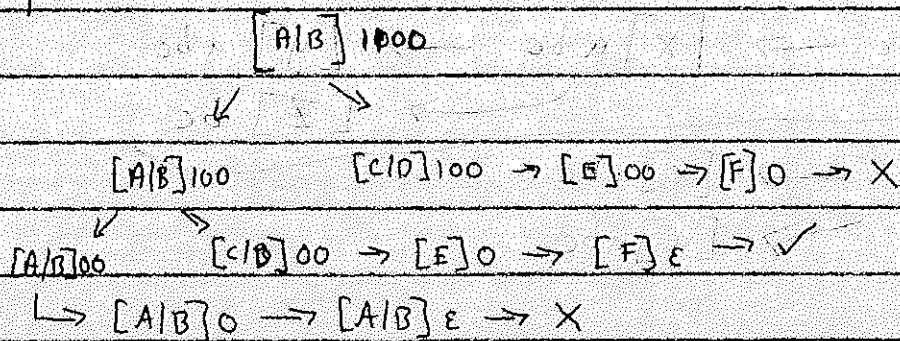


edges labels NOT  
 unique "non-deterministic"

= NFA)

NFAs have 4 interpretations

- Oracle — "knows" the accepting path & chooses it
- Fools (Back-tracking) — when we fail, we try again
- Parallelism — Take every choice (and close self)
- Mystery



4-2/

DFA  $d = (Q, \Sigma, q_0, \delta, F) \subseteq Q$   
 $\epsilon Q : Q \times \Sigma \rightarrow Q$

NFA  $n = (Q, \Sigma, q_0, \delta', F) \subseteq Q$   
 $\epsilon Q : Q \times \Sigma \rightarrow \mathcal{P}(Q)$

$\delta' : Q \times (\Sigma \cup \{\epsilon\}) \rightarrow \mathcal{P}(Q)$

$\delta'(A|B, 0) = \{A|B\} \rightarrow \mathcal{P}(Q)$

$\delta'(A|B, 1) = \{A|B, C|D\}$

$\delta'(F, 0) = \emptyset$

$\delta'(F, 1) = \{ \}$

"config" =  $(Q, \text{str } \Sigma)$   
 $\Rightarrow^* : (Q, \text{str } \Sigma, Q, \text{str } \Sigma)$   
 $\Rightarrow^* : \text{config} \times \text{config}$

$[q_0]w \Rightarrow^* [q_f] \epsilon \quad q_f \in F$

$w \in L(n)$

$w \in L(n)$

$[q_i]w \Rightarrow^* [q_i]w$  (refl)       $[q_i]w \Rightarrow^* [q_j]w' \Rightarrow^* [q_k]w''$  (trans)  
 $[q_i]w \Rightarrow^* [q_k]w''$  (ASO) 310

$q_j \in \delta(q_i, w_0)$

NFA-rule

$\delta(q_i, a) = q_j$

$a \in \Sigma$

$[q_i]w_0w_1 \Rightarrow^* [q_j]w_1$

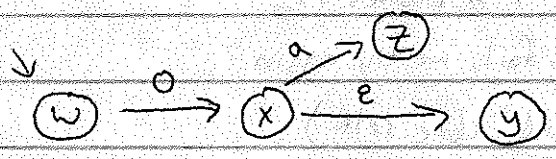
$[q_i]aw \Rightarrow^* [q_j]w$

$w \in \text{str } \Sigma$

$w_1 \in \text{str } \Sigma$

$w_0 \in \Sigma \cup \{\epsilon\}$

Sigma u Set (epsilon)



$[w]0abc \rightarrow [x]abc \rightarrow [y]abc$

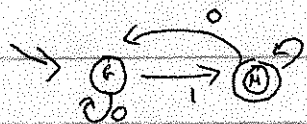
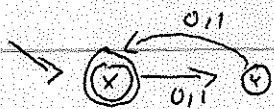
$[w]0abc \rightarrow [x]abc \rightarrow [z]bc$   
 $[w]0abc \rightarrow [y]abc$

4-3

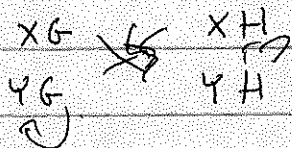
# NFAs closed under union

A = "Even-length"

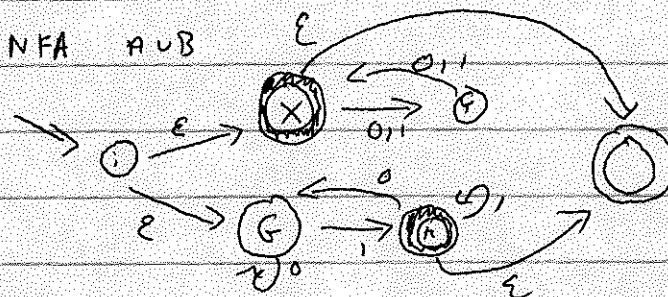
B = "is odd num"



DFA A ∪ B



NFA A ∪ B

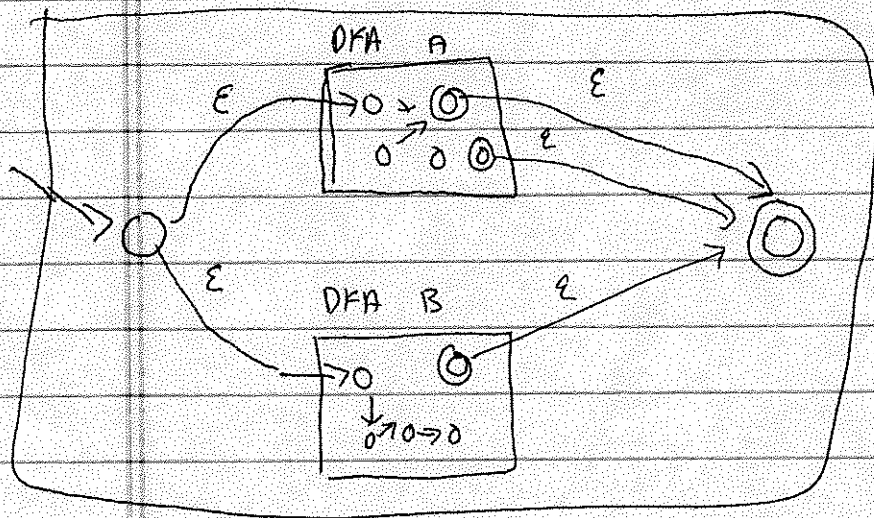


$[i] b_0 b_1 \dots b_n$

$[X] b_0 \dots b_n$

$[G] b_0 \dots b_n$

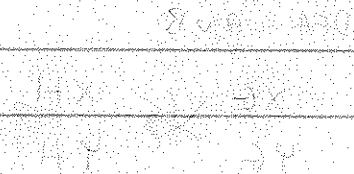
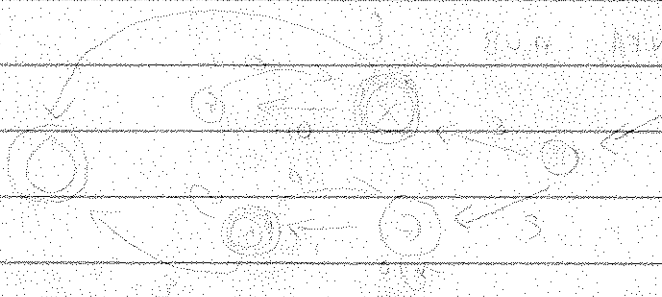
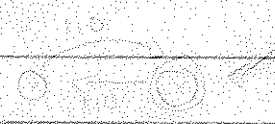
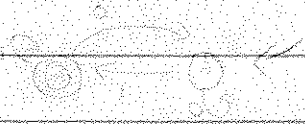
NFA A ∪ B



"proof" NFAs are closed under Union

NTA's chosen under

NTA's chosen under



NTA's chosen under

NTA's chosen under

NTA's chosen under

NTA's chosen under

