4/16/2010

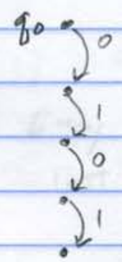
Deterministic F. A.

$q_i \xrightarrow{a} q_j$

$\delta(q_i, a) = q_j$

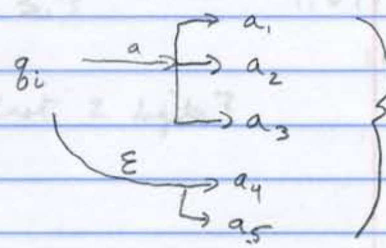
SERIAL COMPUTATION

0101




ACC / REJ

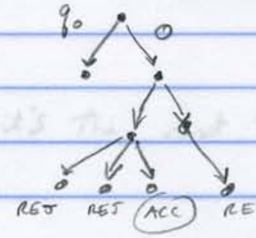
NON-DET. F.A.




Goes to all of these states simultaneously

$\delta(q_i, \ a \text{ or } \varepsilon) = \{q_1, q_2, \ldots\}$

PARRALEL or "MULTITHREADED" COMPUTATION




ACCEPT IF ANY OF THE FINAL STATES ACCEPTS

At every level of the tree, the machine is simultaneously in all states

$\Sigma = (0, 1)$

Accepts:
011010
110111
11
} examples

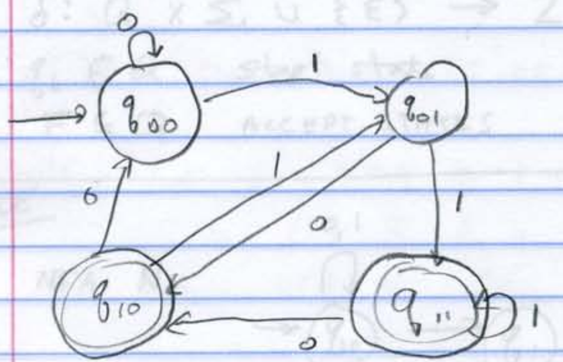
$L = \{ w \mid \text{second to last digit is } 1 \}$
$= \{ w \mid w = x1a,\ x \in \Sigma^*,\ a \in \Sigma_1 \}$

DFA

What are the possible combinations for last 2 digits?

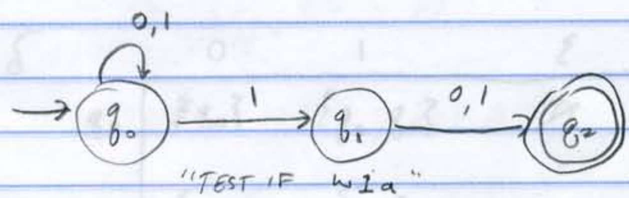
00, 01, 10, 11

Make states for each possibility



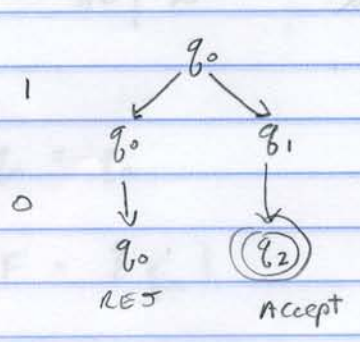

NFA

Every time you get a 1, "guess" that it's the next to last digit.



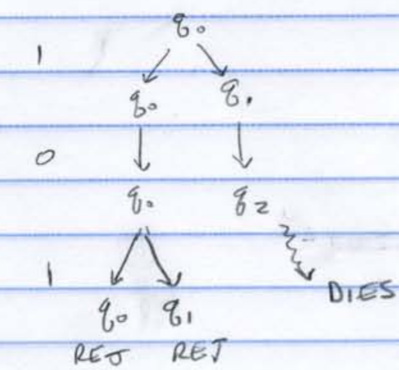

$q_2$ has no transitions out means on any input it goes to the empty set. (it "dies")

EXAMPLE $w = 10$




We accept 10

Example $w = 101$




WE REJECT 101

## Formal Definition of NFA:

NFA $N = (Q, \Sigma, \delta, q_0, F)$

$Q$ = Finite Set of States

$\Sigma$ = Finite ALPHABET

$\delta: Q \times \Sigma_\varepsilon \cup \{\varepsilon\} \rightarrow 2^Q$ (output is some subset of $Q$)

$q_0 \in Q$ start state

$F \subseteq Q$ ACCEPT STATES

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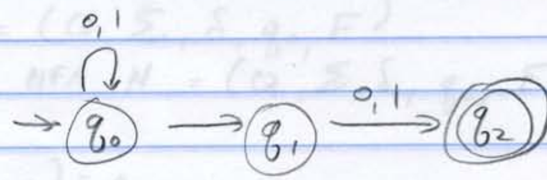
EXAMPLE

NFA $N_1$




$Q = \{q_0, q_1, q_2\}$

$\Sigma = \{0, 1\}$

| $\delta$ | 0 | 1 | $\varepsilon$ |
|---|---|---|---|
| $q_0$ | $\{q_0\}$ | $\{q_0, q_1\}$ | $\emptyset$ |
| $q_1$ | $\{q_2\}$ | $\{q_2\}$ | $\emptyset$ |
| $q_2$ | $\emptyset$ | $\emptyset$ | $\emptyset$ |

$q_0 = q_0$

$F = \{q_2\}$

Class-DFA = $\{L \mid L = L(M)$ for some DFA $M\}$

Class-NFA = $\{L \mid L = L(N)$ for some NFA $N\}$

Question: CLASS-DFA $\subseteq$ CLASS-NFA

i.e. can you rewrite any DFA as an NFA?

THM: CLASS-DFA $\subseteq$ CLASS-NFA

Pf let $L \in$ DFA $\Rightarrow L = L(M)$ for some DFA $M$

$M = (Q, \Sigma, \delta, q_0, F)$

Define NFA $N = (Q, \Sigma, \delta, q_0, F)$

If $\delta(q_i, a) = q_j$

Define

$\delta'(q_i, a) = \{q_j\}$

$\delta'(q_j, \varepsilon) = \emptyset$

QUESTION: NFA $\subseteq$ DFA ?

i.e. can you rewrite any NFA as a DFA?

If you can turn each level of tree into states of DFA, then yes.

Ponder this.