< Lecture 7 >

Recently we covered

- the definition of a NFA
- the equivalence between NFAs and DFAs

Let's remind where we were before:

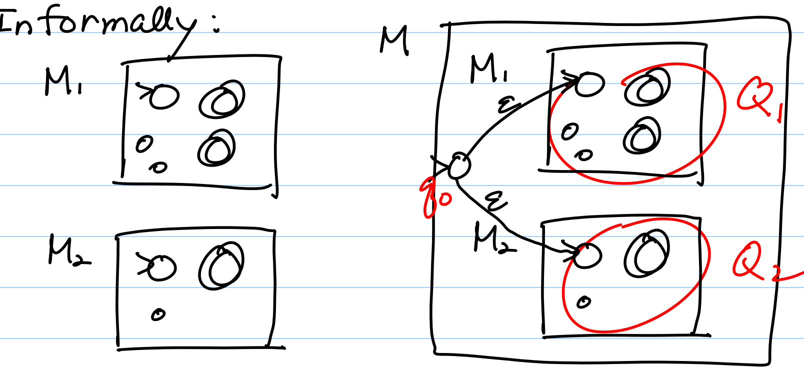
Thm: The set of regular languages is closed under regular operations.

Let's come back to

(1) Thm 1.25. For any regular languages A and B, $A \cup B$ is regular

Given NFA M_1 that recognizes A and NFA M_2 that recognizes B, Construct NFA M that recognizes $A \cup B$.

Informally:



Formally: Let $M_1 = (Q_1, \Sigma, \delta_1, q_1, F_1)$ NFA and NFA $M_2 = (Q_2, \Sigma, \delta_2, q_2, F_2)$.

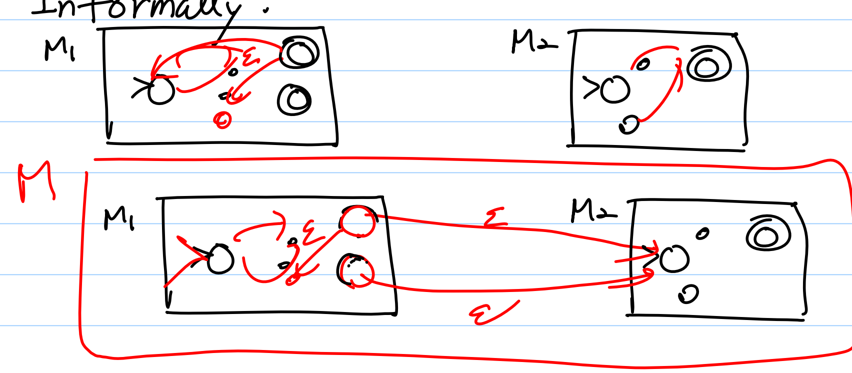
The following $M = (Q, \Sigma, \delta, q_0, F)$ recognizes $A \cup B$.

1. $Q = Q_1 \cup Q_2 \cup \{q_0\}$
2. q_0 is the new start state $\notin Q_1, \notin Q_2$
3. $F = F_1 \cup F_2$
4. $$\delta(q, \underset{\in \Sigma \cup \{\varepsilon\}}{a}) = \begin{cases} \delta_1(q, a) & q \in Q_1 \\ \delta_2(q, a) & q \in Q_2 \\ \{q_1, q_2\} & q = q_0,\ a = \varepsilon \\ \emptyset & q = q_0\ \ a \neq \varepsilon \end{cases}$$

(2) Thm 1.47. For any regular languages A and B, $A \circ B$ is regular.

Given NFA M_1 that recognizes A and NFA M_2 that recognizes B, Construct NFA M that recognizes $A \circ B$.

Informally:



Formally: Let $M_1=(Q_1, \Sigma, \delta_1, q_1, F_1)$ and
$M_2=(Q_2, \Sigma, \delta_2, q_2, F_2)$.

The following $M=(Q, \Sigma, \delta, q_1, F_2)$
recognizes $A \circ B$.

1. $Q = Q_1 \cup Q_2$
2. q_1 is the start state
3. F_2 is the set of accept states
4. For every $q \in Q$ and every $a \in \Sigma \cup \{\varepsilon\}$

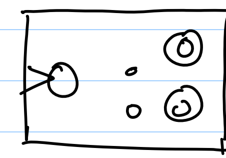
$$\delta(q,a) = \begin{cases} \delta_1(q,a) & q \in Q_1 \setminus F_1 \\ \delta_1(q,a) & q \in F_1,\ a \neq \varepsilon \\ \{q_2\} \cup \delta_1(q,a) & q \in F_1,\ a = \varepsilon \\ \delta_2(q,a) & q \in Q_2 \end{cases}$$

(3) Thm 1.47. For any regular language A,
A^* is regular.

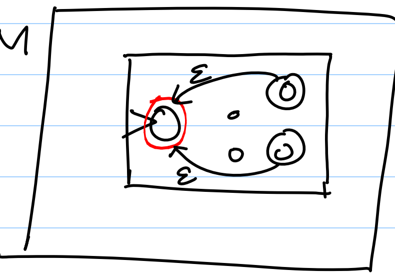
Given NFA M_1 that recognizes A and
construct NFA M that recognizes A^*.

Informally:

M_1



M



Why not work? (E 1.15)