بسم الله الرحمن الرحیم

نظریه زبان‌ها و ماشین‌ها

جلسه ۱۰

مجتبی خلیلی
دانشکده برق و کامپیوتر
دانشگاه صنعتی اصفهان

اثبات (طرف دوم)

LEMMA 1.60

If a language is regular, then it is described by a regular expression.

- اثبات:

زبان منظم A → عبارت منظم R

$$L(R) = A$$

اثبات (طرف دوم)

LEMMA 1.60 ....

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زبان منظم A → DFA M → GNFA N → عبارت منظم R

$L(M) = A$ $\quad$ $L(N) = A$ $\quad$ $L(R) = A$

اثبات (طرف دوم)

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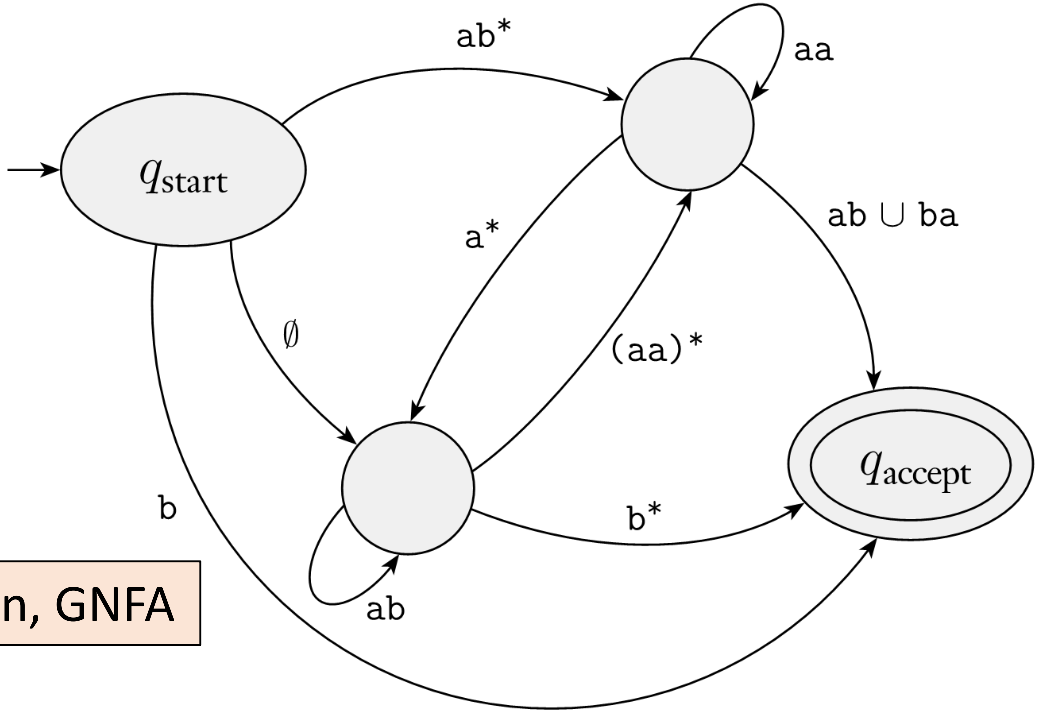
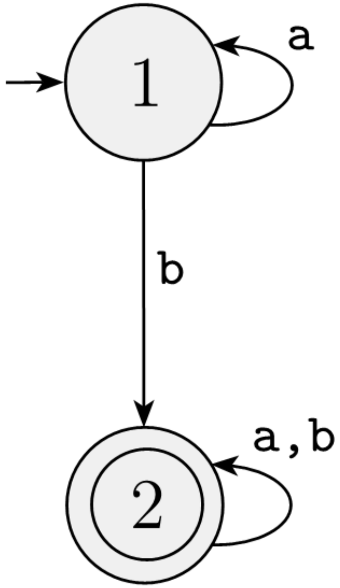


generalized nondeterministic finite automaton, GNFA

اثبات (طرف دوم)

- تبدیل DFA به GNFA:



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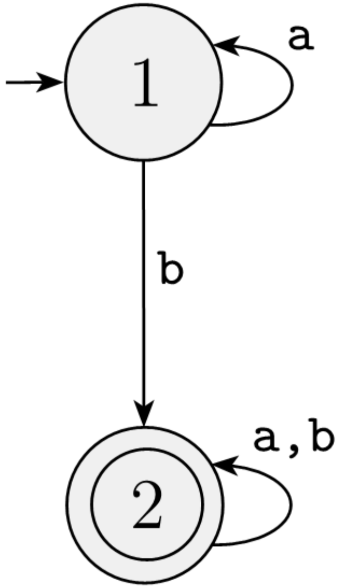

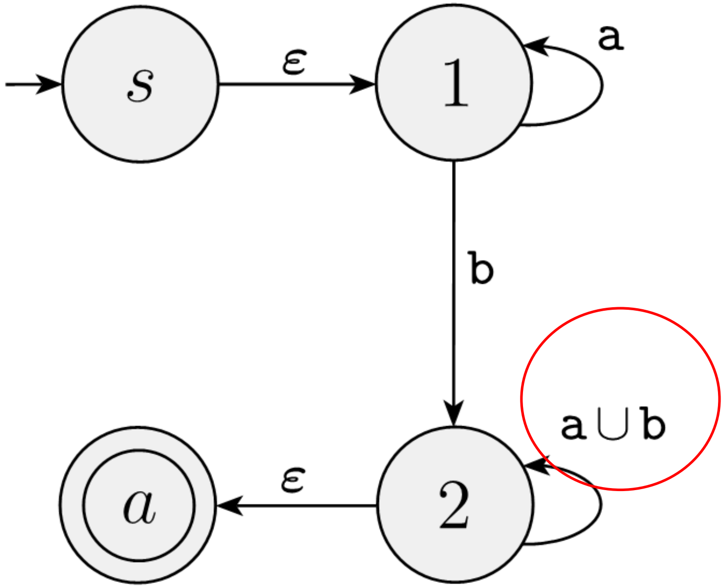

اثبات (طرف دوم)

- تبدیل DFA به GNFA:

- The start state has transition arrows going to every other state but no arrows coming in from any other state.
- There is only a single accept state, and it has arrows coming in from every other state but no arrows going to any other state. Furthermore, the accept state is not the same as the start state.
- Except for the start and accept states, one arrow goes from every state to every other state and also from each state to itself.

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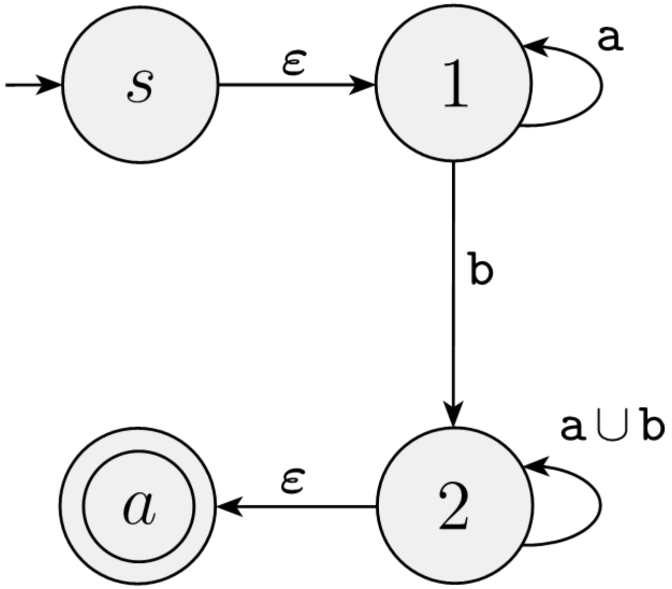

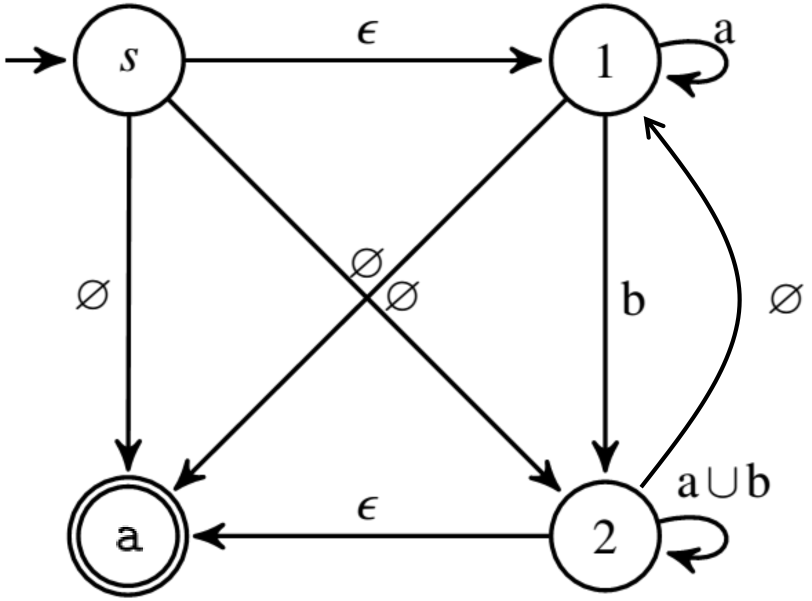

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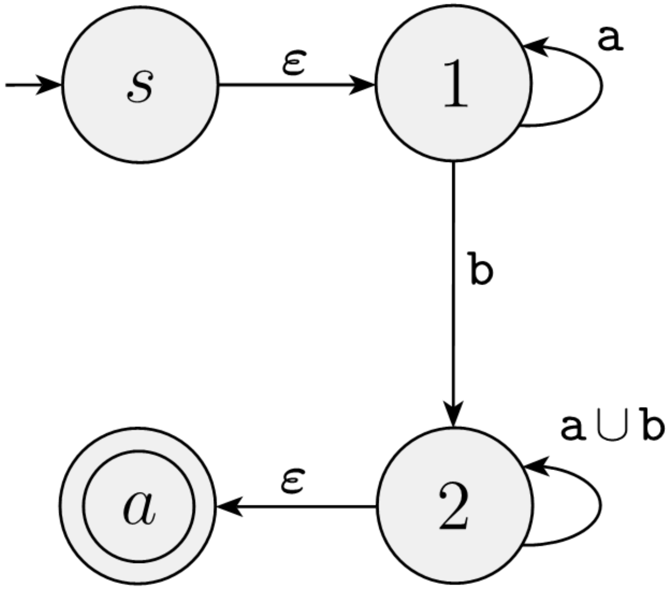
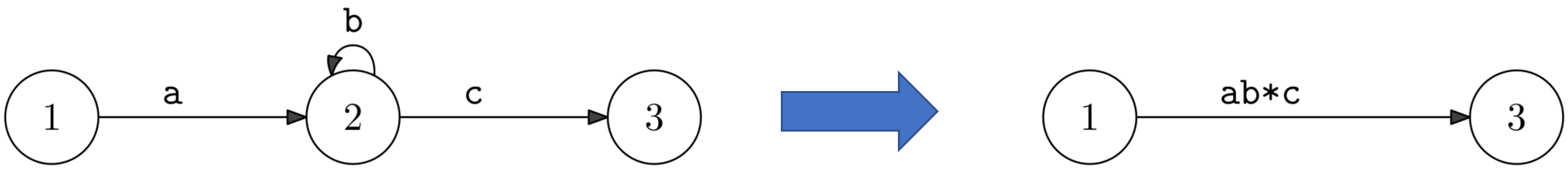


اثبات (طرف دوم)

- کاهش حالات GNFA:



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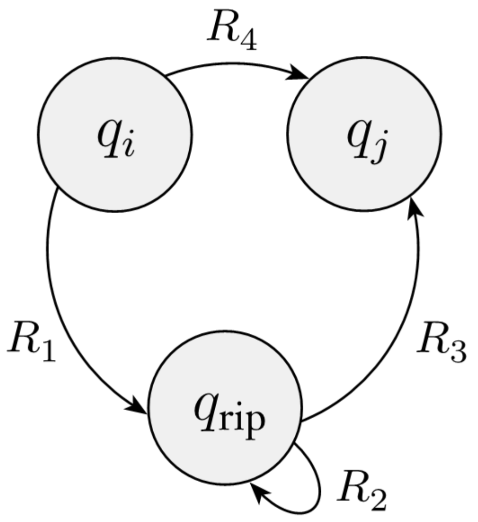

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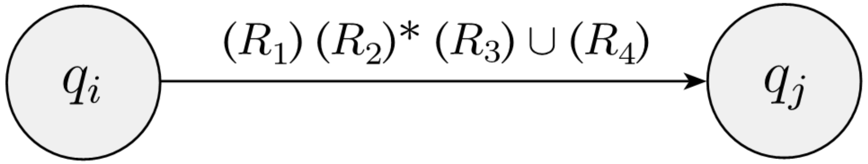

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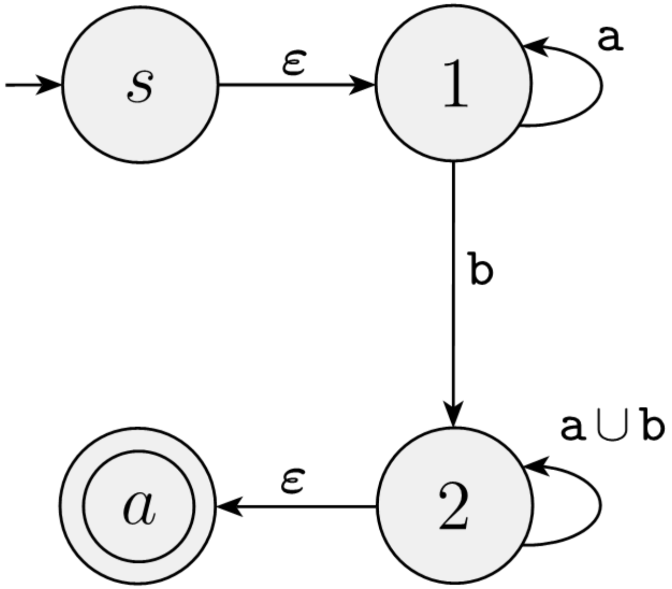

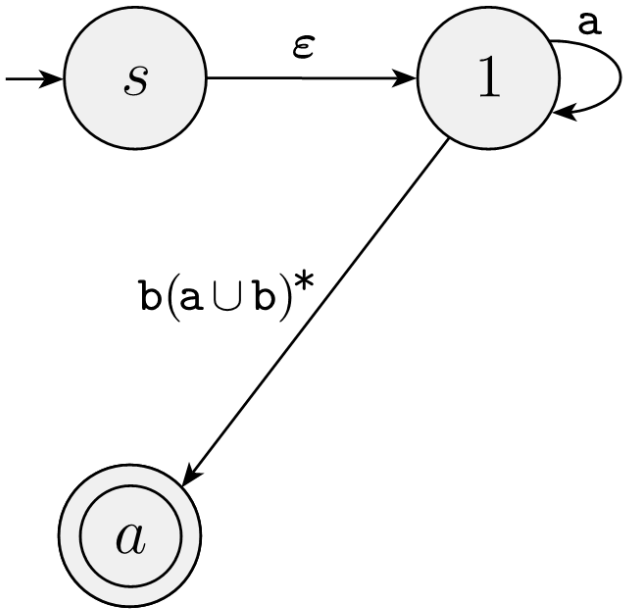

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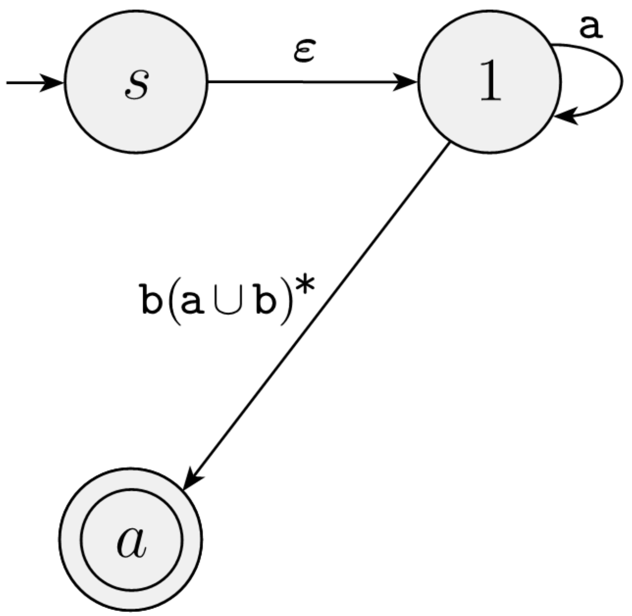
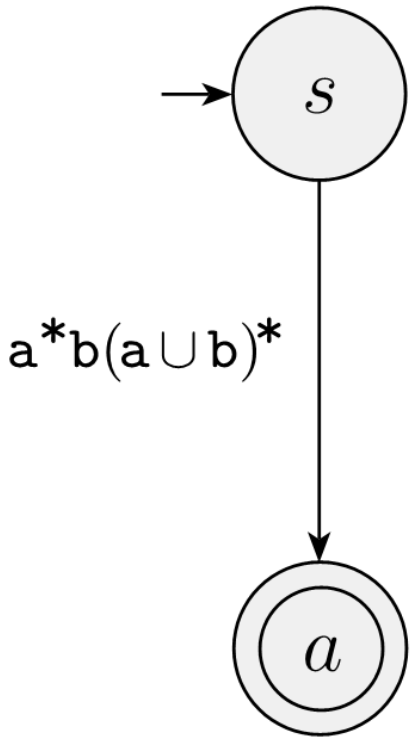
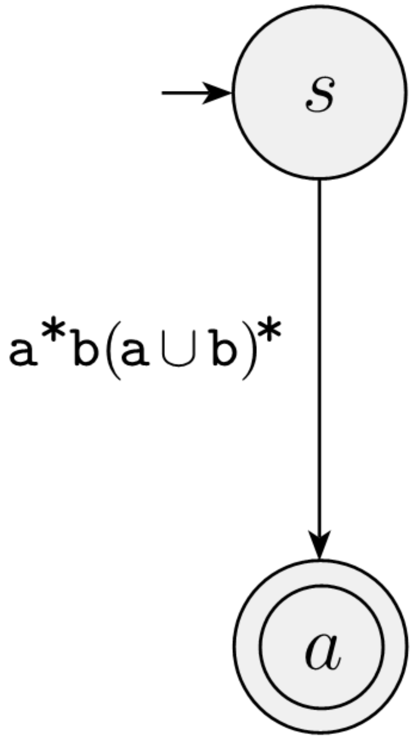




اثبات (طرف دوم)

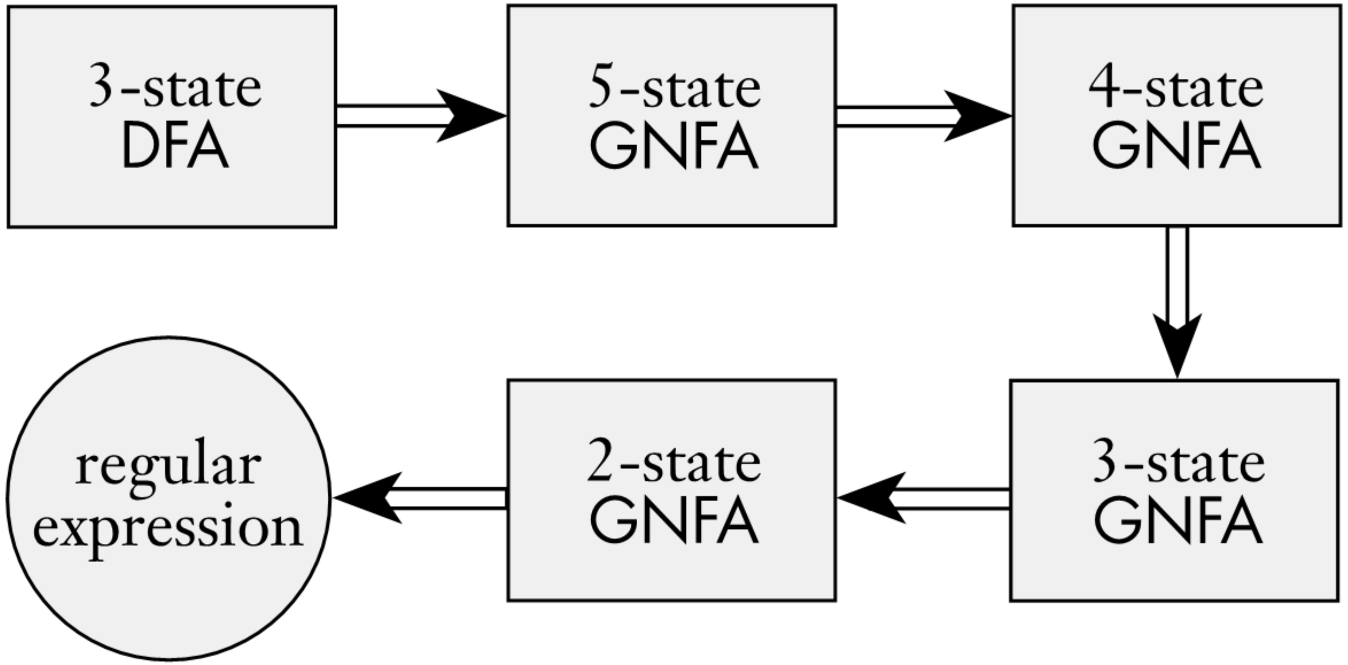
- یافتن عبارت منظم متناظر:



$$R = a^*b(a \cup b)^*$$

اثبات (طرف دوم)

○ یک روند معمول (مثال):



اثبات (طرف دوم)

- اثبات فرمال:

اتوماتای متناهی نامعین بسط یافته

DEFINITION 1.64

A ***generalized nondeterministic finite automaton*** is a 5-tuple, $(Q, \Sigma, \delta, q_{\text{start}}, q_{\text{accept}})$, where

1. Q is the finite set of states,
2. Σ is the input alphabet,
3. $\delta\colon (Q - \{q_{\text{accept}}\}) \times (Q - \{q_{\text{start}}\}) \longrightarrow \mathcal{R}$ is the transition function,
4. q_{start} is the start state, and
5. q_{accept} is the accept state.

اتوماتای متناهی نامعین بسط یافته

A GNFA accepts a string w in Σ^* if $w = w_1 w_2 \cdots w_k$, where each w_i is in Σ^* and a sequence of states $q_0, q_1, \ldots, q_k$ exists such that

1. $q_0 = q_{\text{start}}$ is the start state,
2. $q_k = q_{\text{accept}}$ is the accept state, and
3. for each i, we have $w_i \in L(R_i)$, where $R_i = \delta(q_{i-1}, q_i)$; in other words, R_i is the expression on the arrow from q_{i-1} to q_i.

اثبات (طرف دوم)

- پس از تبدیل DFA M به GNFA G، روند Convert(G) اجرا و G را به یک عبارت منظم تبدیل میکند:

اثبات (طرف دوم)

CONVERT(G):

1. Let k be the number of states of G.

2. If $k = 2$, then G must consist of a start state, an accept state, and a single arrow connecting them and labeled with a regular expression R.
Return the expression R.

3. If $k > 2$, we select any state $q_{\text{rip}} \in Q$ different from q_{start} and q_{accept} and let G' be the GNFA $(Q', \Sigma, \delta', q_{\text{start}}, q_{\text{accept}})$, where

$$Q' = Q - \{q_{\text{rip}}\},$$

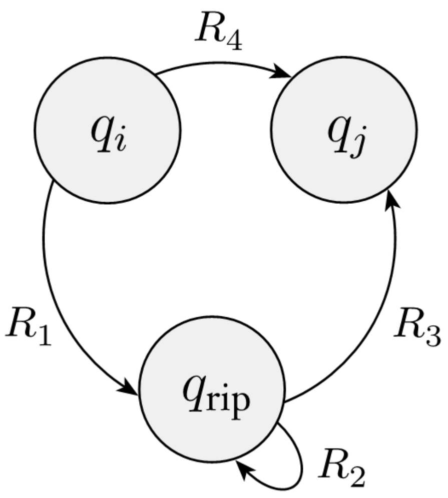
and for any $q_i \in Q' - \{q_{\text{accept}}\}$ and any $q_j \in Q' - \{q_{\text{start}}\}$, let

$$\delta'(q_i, q_j) = (R_1)(R_2)^*(R_3) \cup (R_4),$$

for $R_1 = \delta(q_i, q_{\text{rip}})$, $R_2 = \delta(q_{\text{rip}}, q_{\text{rip}})$, $R_3 = \delta(q_{\text{rip}}, q_j)$, and $R_4 = \delta(q_i, q_j)$.

4. Compute CONVERT(G') and return this value.

اثبات (طرف دوم)



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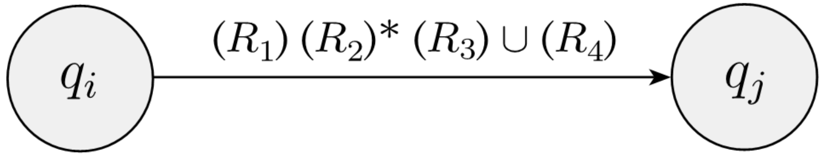

after

اثبات (طرف دوم)

CLAIM 1.65

For any GNFA G, CONVERT(G) is equivalent to G.

We prove this claim by induction on k, the number of states of the GNFA.