Theory of Computation (CS F351)

Prof.R.Gururaj
CS&IS Dept.

BITS Pilani
Hyderabad Campus

BITS Pilani
Hyderabad Campus

Finite Automata and Regular Expression (Sec. 2.3 of T1)

Prof.R.Gururaj
CS&IS Dept.

Summary of our understanding about the FA/RE/RL

It is understood that the class of Languages accepted by FA remain same even with non-determinism.

The class of Languages accepted by FA has a sort of stability- meaning that the two different approaches (DFA and NDFA) end up with defining the same class.

Here in this section we have further proof about the stability.

The class of languages accepted by DFA & NDFA is same as the class of Regular Languages.

Regular Languages are those languages that can be described by Regular Expressions.

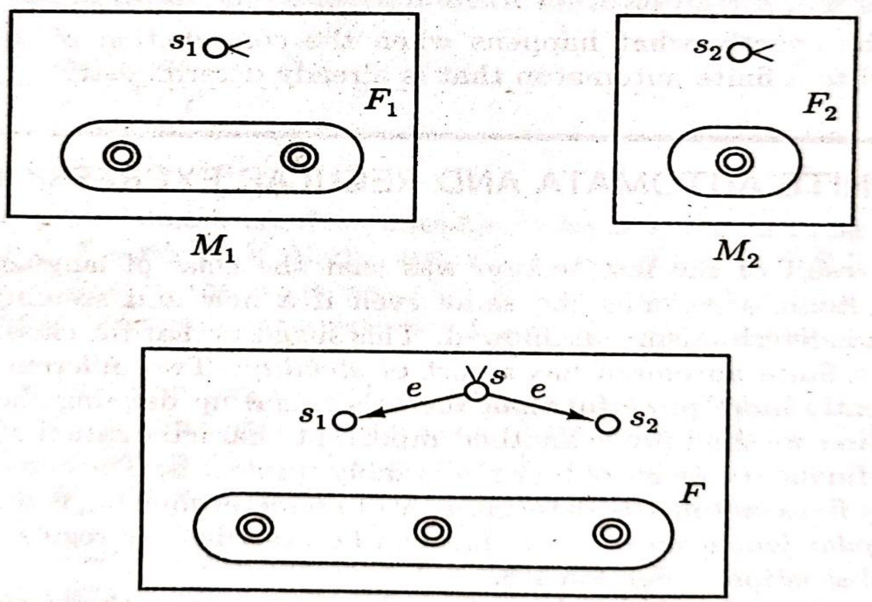
Properties of languages accepted by FA

The class of languages accepted by FA are closed under

- UNION
- CONCATENATION
- INTERSECTION
- KLEENE STAR
- COMPLEMENTATION

UNION:

Let $M_1 = (K_1, \Sigma, \Delta_1, s_1, F_1)$ and $M_2 = (K_2, \Sigma, \Delta_2, s_2, F_2)$ be nondeterministic finite automata; we shall construct a nondeterministic finite automaton M such that $L(M) = L(M_1) \cup L(M_2)$.



$M = (K, \Sigma, \Delta, s, F)$, where s is a new state not in K_1 or K_2,

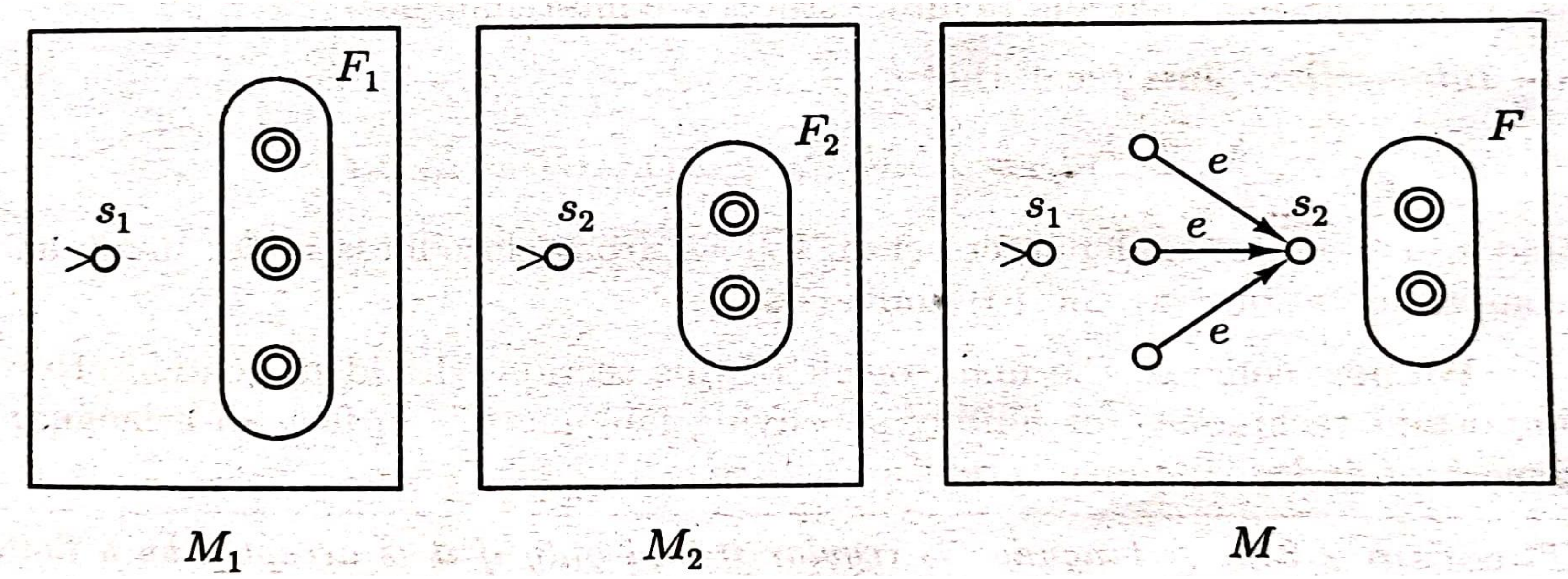
$$K = K_1 \cup K_2 \cup \{s\},$$

$$F = F_1 \cup F_2,$$

$$\Delta = \Delta_1 \cup \Delta_2 \cup \{(s, e, s_1), (s, e, s_2)\}.$$

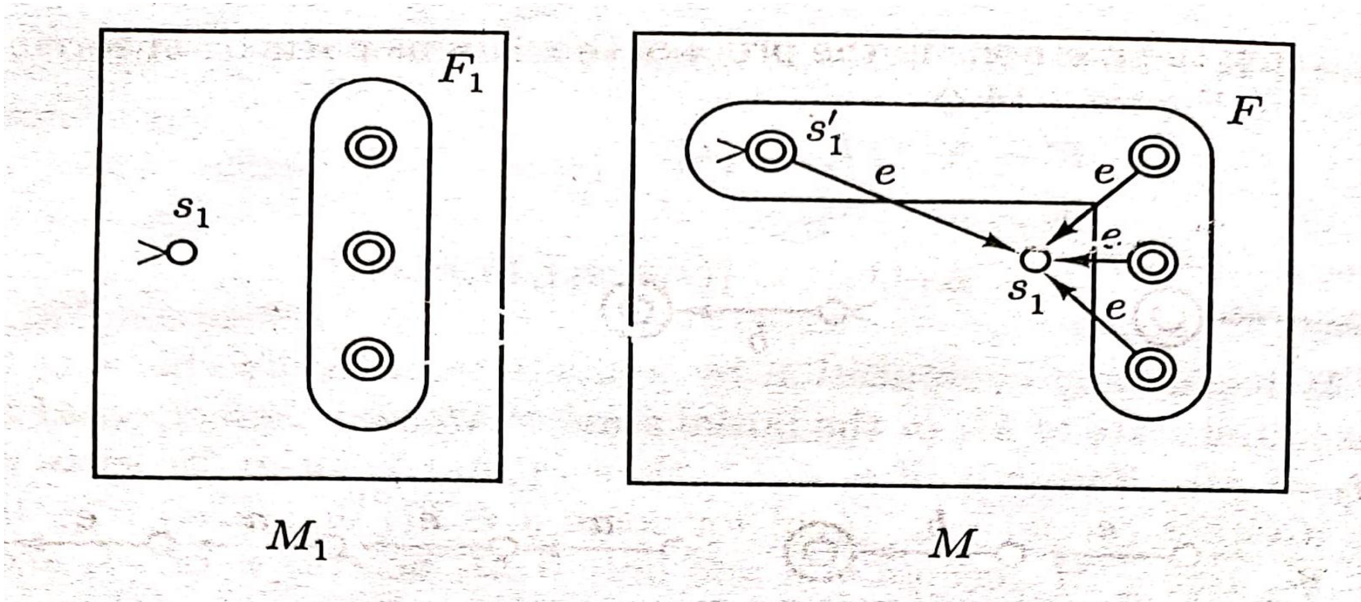
CONCATENATION:

Let $M_1 = (K_1, \Sigma, \Delta_1, s_1, F_1)$ and $M_2 = (K_2, \Sigma, \Delta_2, s_2, F_2)$ be nondeterministic finite automata; we shall construct a nondeterministic finite automaton M such that $L(M) = L(M_1) \circ L(M_2)$.



KLEENE STAR:

Let $M_1 = (K_1, \Sigma, \Delta_1, s_1, F_1)$ be nondeterministic finite automata; we shall construct a nondeterministic finite automaton M such that $L(M) = L(M_1)^*$.



(d) *Complementation.* Let $M = (K, \Sigma, \delta, s, F)$ be a *deterministic* finite automaton. Then the complementary language $\overline{L} = \Sigma^* - L(M)$ is accepted by the deterministic finite automaton $\overline{M} = (K, \Sigma, \delta, s, K - F)$. That is, $\overline{M}$ is identical to M except that final and nonfinal states are interchanged.

(e) *Intersection.* Just recall that

$$L_1 \cap L_2 = \Sigma^* - ((\Sigma^* - L_1) \cup (\Sigma^* - L_2)),$$

Constructing FA from REs

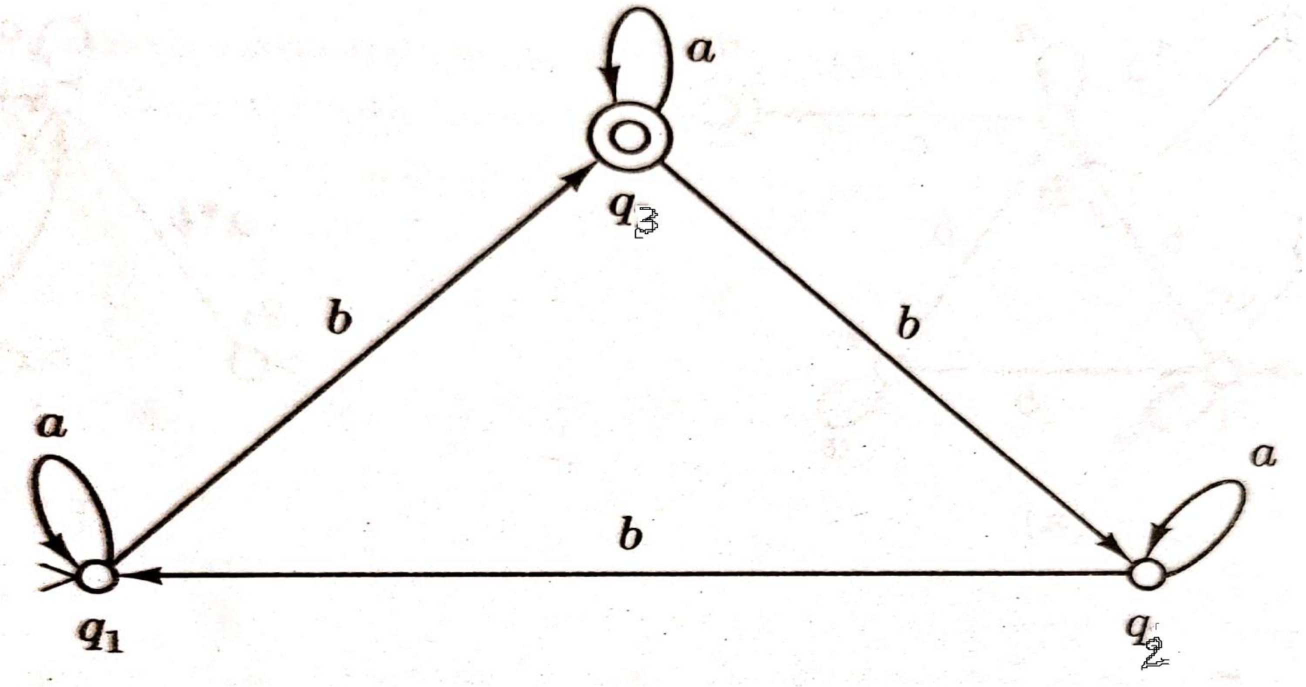
Constructing complex FA for the entire RE in incremental way.

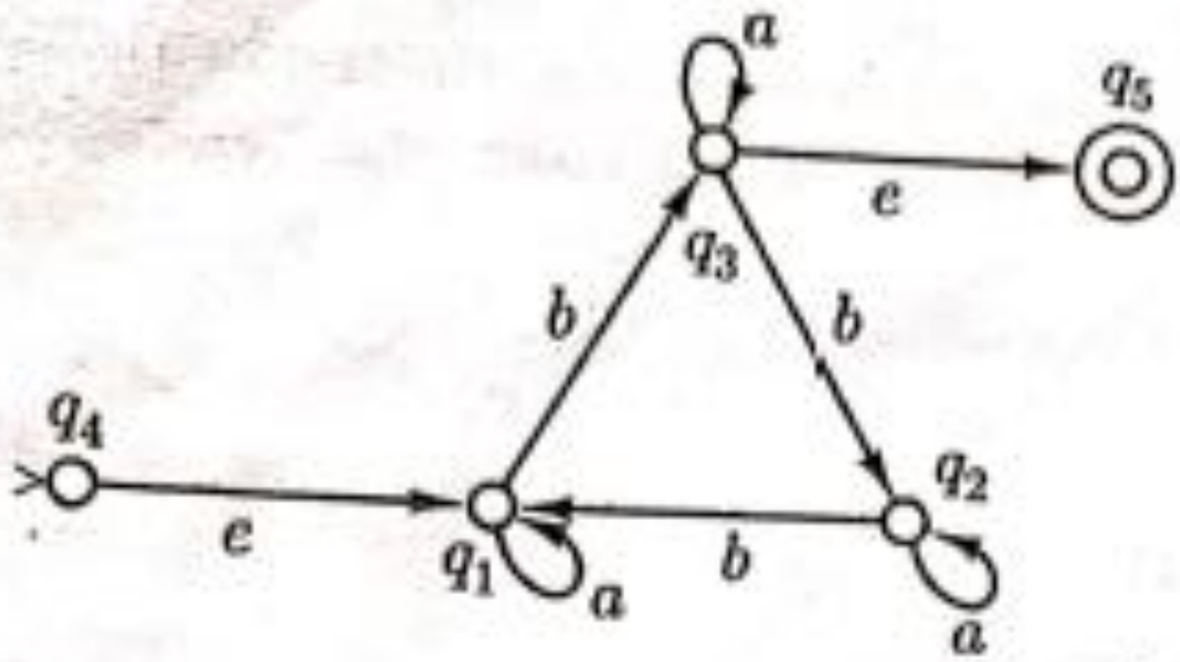
Constructing RE from FA

Constructing a RE for a given NDFA is simplified if we assume that the NDFA has two simple properties.

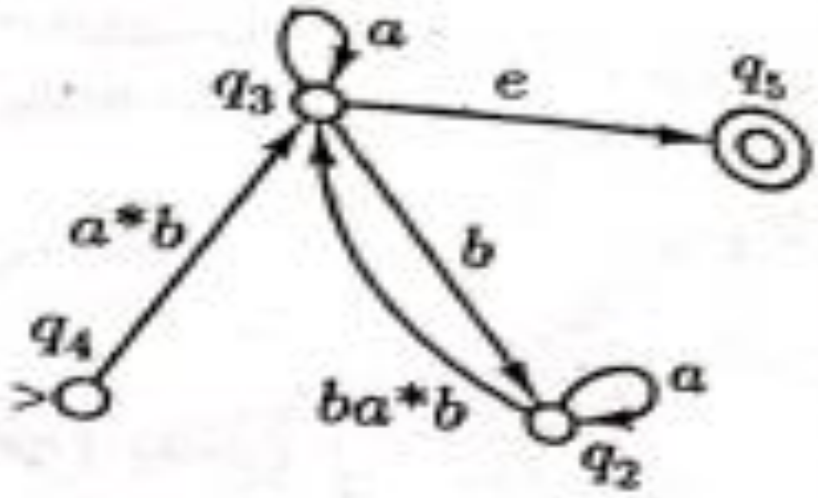
1. It has only one singe Final state.
2. There is no transition into the initial state.
3. No transition leaving final state.

EX:

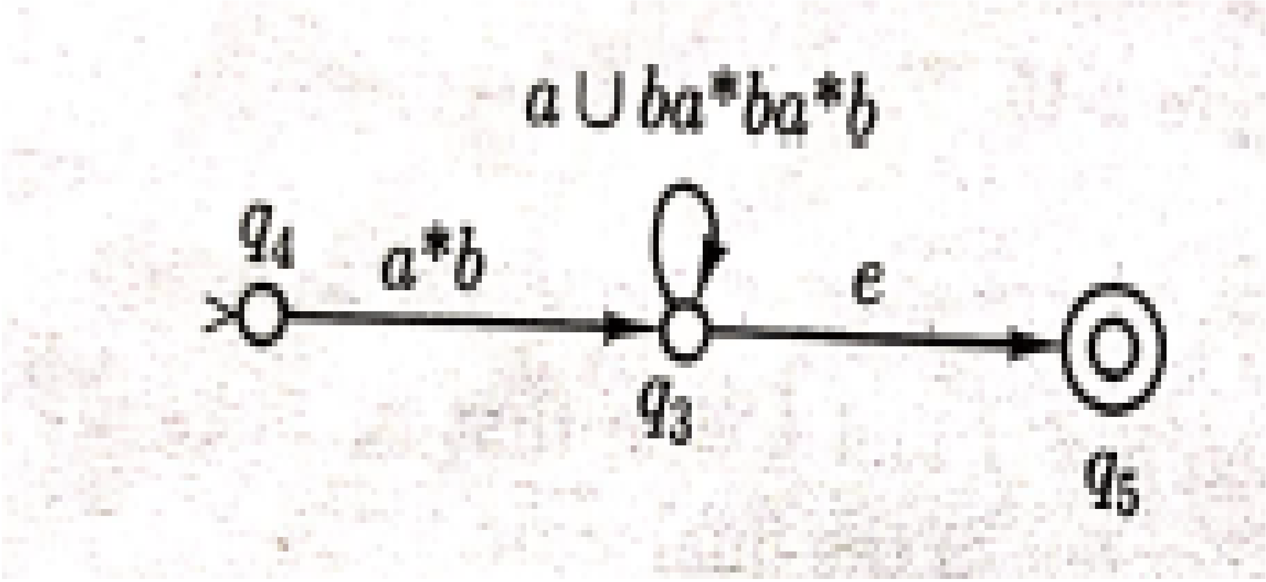


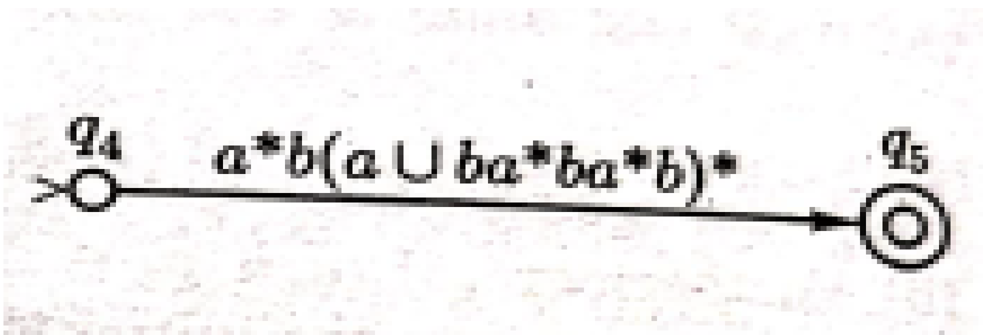


(a)

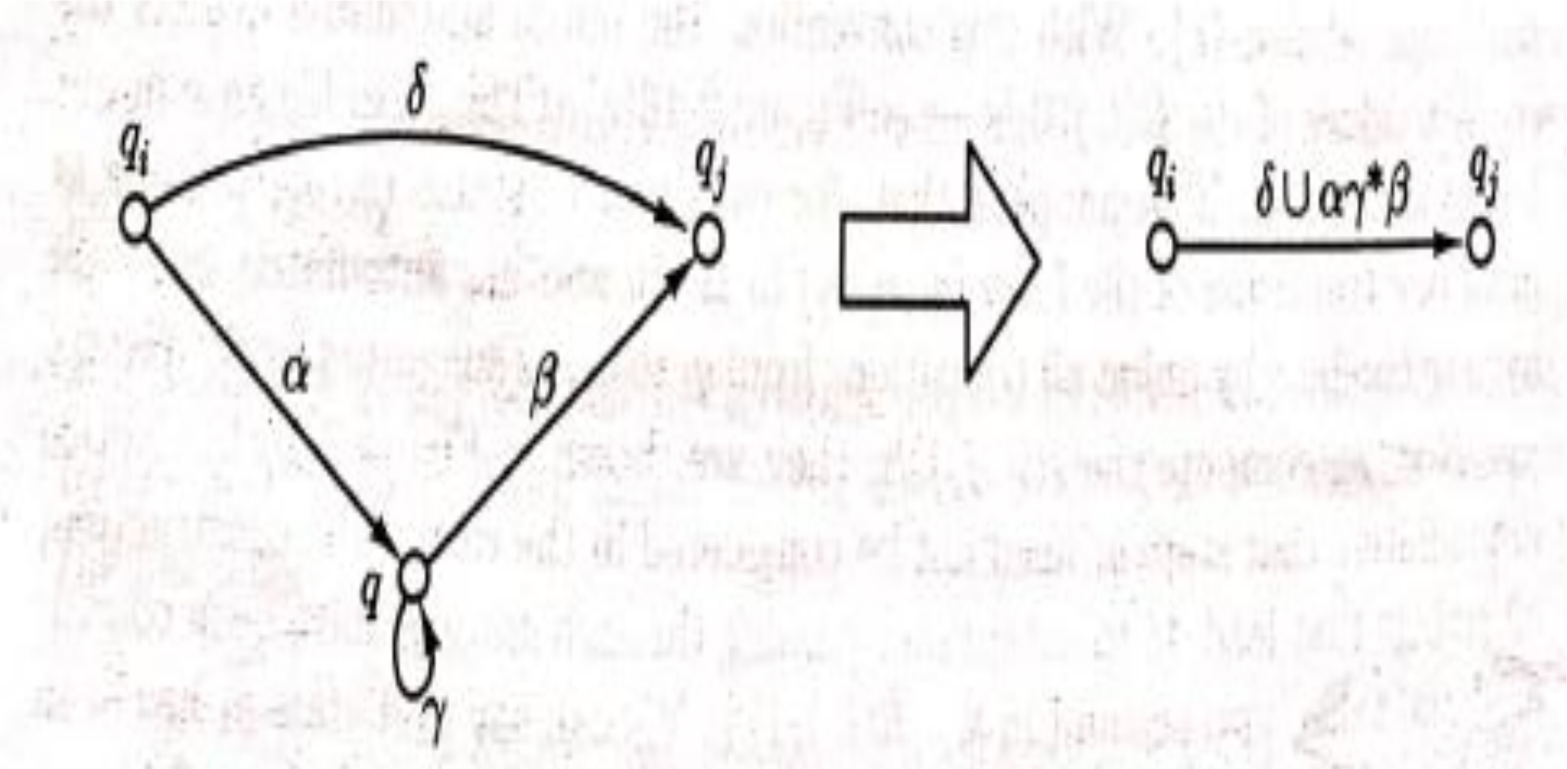


(b)


$a \cup ba^*ba^*b$
q_4
a^*b
e
q_3
q_5



q_4
$a^*b(a \cup ba^*ba^*b)^*$
q_5



q_i
δ
q_j
α
β
q
γ
q_i
$\delta \cup \alpha\gamma^*\beta$
q_j