A deterministic finite automata is a 5-tuple $(Q, q_0, \Sigma, \delta, F)$ where:

1) $F \subseteq Q$ is accepting states

2) $\delta : Q \times \Sigma \longrightarrow Q$

Automata accepts input x if starting from q_0, automata ends up in one of states in F

A nondeterministic finite automata is a 5-tuple $(Q, q_0, \Sigma, \delta, F)$ such that

1) $F \subseteq Q$ is accepting states

2) $\delta : Q \times \Sigma \cup \{\epsilon\} \to 2^Q$ set of all subsets of Q

Automata accepts an input x if starting from q_0, it is possible to end up in a state of F

Example $(Q_1, q_0^1, \Sigma, \delta_1, F_1)$

$(Q_2, q_0^2, \Sigma, \delta_2, F_2)$

Suppose F_1, F_2 accepting sets A_1 & A_2.

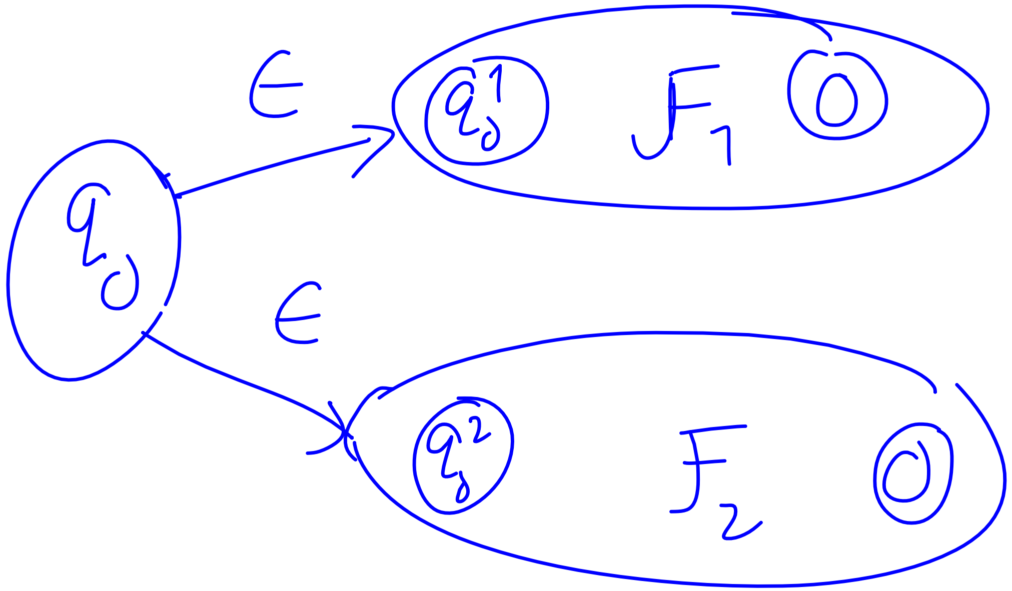
Design an automata to accept $A_1 \cup A_2$.

Let $Q = Q_1 \times Q_2$

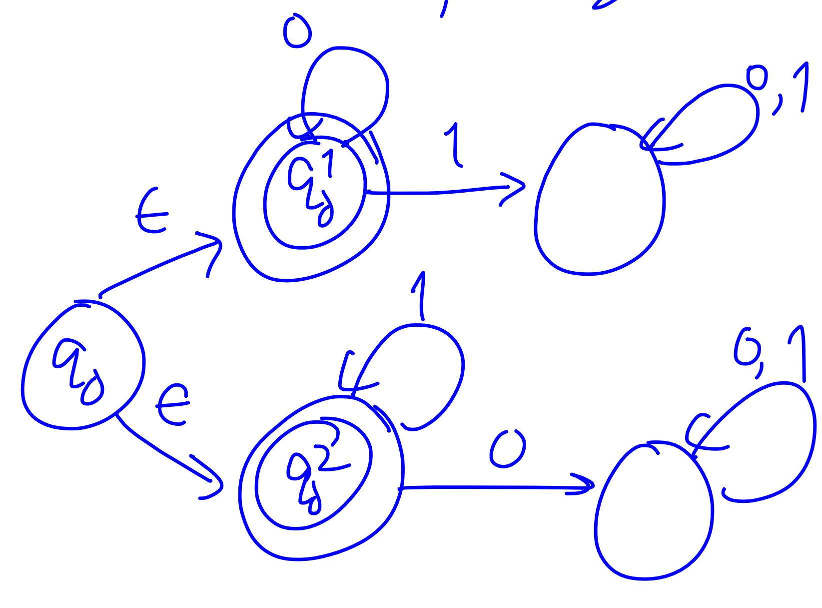
$q_0 = \langle q_0^1, q_0^2 \rangle$

$\langle q_1, q_2 \rangle \xrightarrow{a} \langle \delta_1(q_1, a), \delta_2(q_2, a) \rangle$

$F = F_1 \times Q_2 \cup Q_1 \times F_2$



$A_1 = 0^*, \quad A_2 = 1^*$



Theorem: A set accepted by an NFA is also accepted by a DFA.

proof: Let $\mathcal{F} = (Q, q_0, \Sigma, \delta, F)$ be an NFA

Define $\mathcal{F}_D = (2^Q, \{q_0\}, \Sigma, \delta_D, F_D)$

$$F_D = \{ H \mid H \subseteq Q \ \& \ H \cap F \neq \emptyset \}$$

$$\delta_D : 2^Q \times \Sigma \rightarrow 2^Q$$

$$\delta_D(H, a) = \{ q \mid q \text{ is reachable from } p,\ p \in H, \text{ on reading } a \}$$