# Regular Operations and Closure Proofs

Sipser 1.2 (pages 47-63)

# Regular languages are closed under:

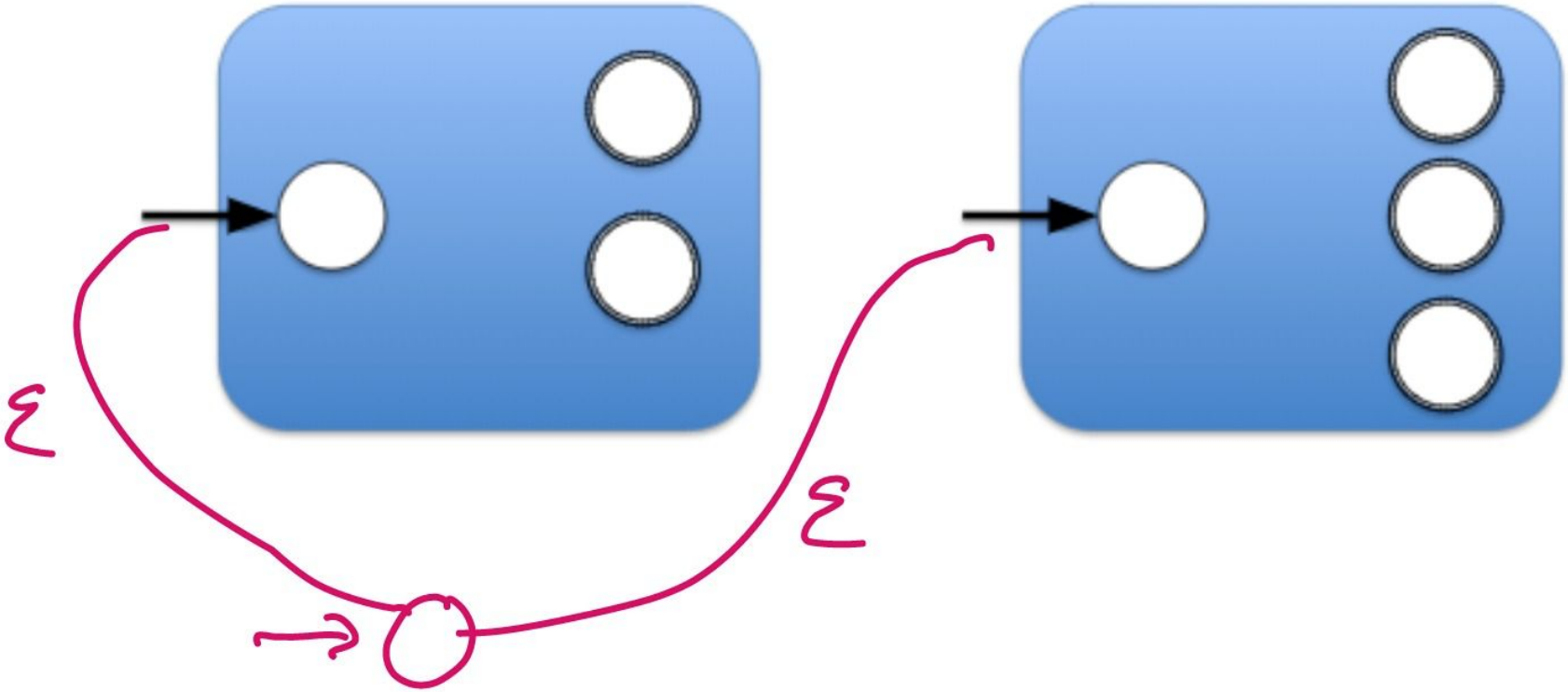
- complement
- **union**
- intersection
- **concatenation**
- **star**

# a sample proof

LaTex files on the web site

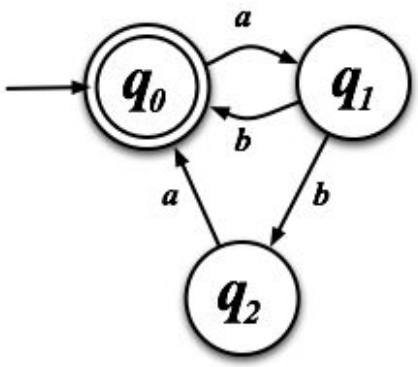
# Your turn...

closure under union!



# NFA

- A ***nondeterministic finite automaton (NFA)*** is a 5-tuple $(Q, \Sigma, \delta, q_0, F)$, where
  - $Q$ is a finite set called the **states**
  - $\Sigma$ is a finite set called the **alphabet**
  - $\delta: Q \times \Sigma\varepsilon \rightarrow P(Q)$ is the **transition function**
  - $q_0 \in Q$ is the **start state**
  - $F \subseteq Q$ is a set of **accept states**
- In-class exercise:



# NFA computation

- Let $N=(Q, \Sigma, \delta, q_0, F)$ be a NFA and let $w$ be a string over the alphabet $\Sigma$
- Then $N$ **accepts** $w$ if
  - $w$ can be written as $w_1 w_2 w_3 \ldots w_m$ with each $w_i \in \Sigma\varepsilon$ and
  - There exists a sequence of states $s_0, s_1, s_2, \ldots, s_m$ exists in $Q$ with the following conditions:

1. $s_0 = q_0$
2. $s_{i+1} \in \delta(s_i, w_{i+1})$ for $i = 0, \ldots, m-1$
3. $s_n \in F$