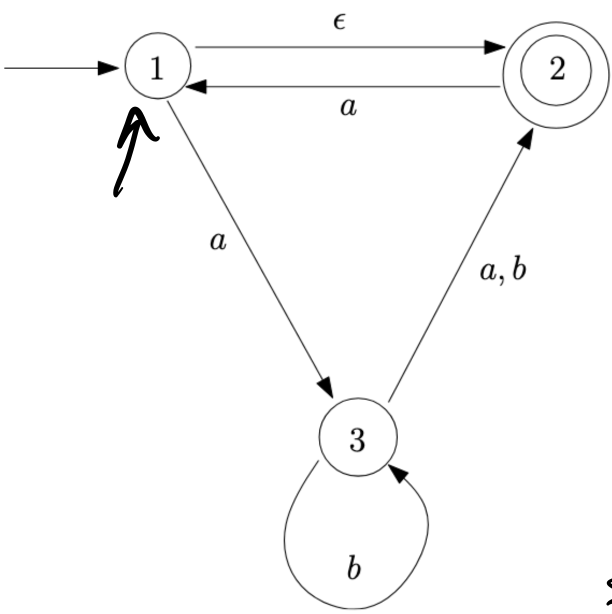
CSCI 301 - Lecture 25: NFA → DFA
Regular Closure



$(Q, \Sigma, q, \delta, F)$

	a	b	ϵ
1	$\{3\}$	$\emptyset$	$\{2\}$
2	$\{1\}$	$\emptyset$	$\emptyset$
3	$\{2\}$	$\{2,3\}$	$\emptyset$

The ε-closure of a state s in Q $C_\varepsilon(s)$ is the set of states reachable from s after 0 or more ε transitions

$C_\varepsilon(1) = \{1,2\}$

$C_\varepsilon(2) = \{2\}$

$C_\varepsilon(3) = \{3\}$

0. Start in q
1. ✓ Make 0 or more ε-transitions
2. Process a symbol
3. Make 0 or more ε-transitions

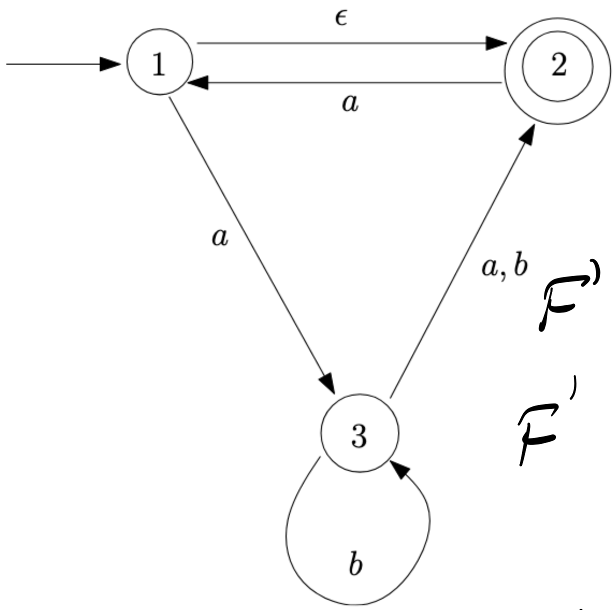
⋮

$$q' = C_\varepsilon(q) = \{1,2\}$$

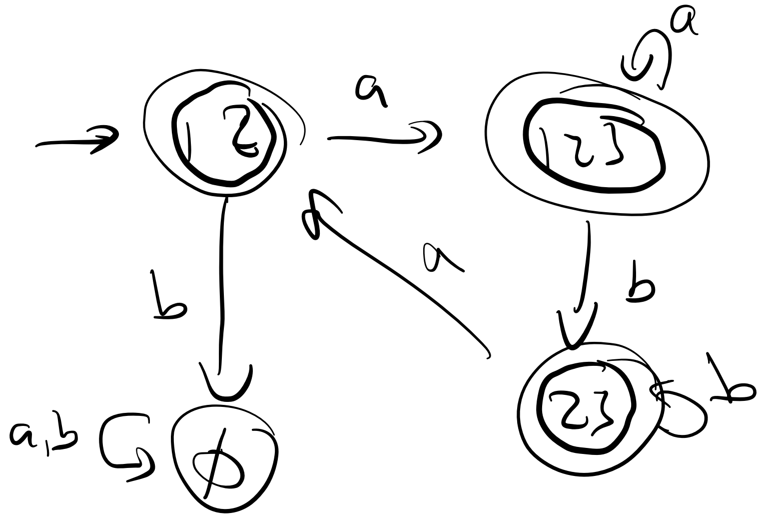
$$\delta'(S, c) = \bigcup_{s \in S} C_\varepsilon(\delta(s,c))$$

S: State in Q' (DFA)

c: Symbol in Σ



	State	a	b
F'	q' $\{1,2\}$	$\{1,2,3\}$	$\emptyset$
F'	$\{1,2,3\}$	$\{1,2,3\}$	$\{2,3\}$
	$\emptyset$	$\emptyset$	$\emptyset$
F'	$\{2,3\}$	$\{1,2\}$	$\{2,3\}$



$$F' = \{S : S \text{ contains some } f \in F\}$$

state in Q'

NFA's accept states

Regular Operations

- The **union** of two languages A and B is defined as $A \cup B = \{w : w \in A \text{ or } w \in B\}$.
- The **concatenation** or **product** of two languages A and B is defined as $AB = \{ww' : w \in A \text{ and } w' \in B\}$.
- The **closure** or **star** (or Kleene closure) of a language A is defined as: $A^* = \{u_1 u_2 \dots u_k : k \geq 0 \text{ and } u_i \in A \text{ for all } i = 1, 2, \dots, k\}$

Union: