Our goal: regular $\Leftrightarrow$ automatic

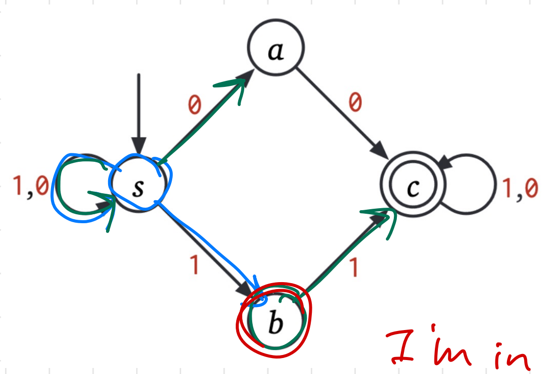
subset construction

reg exp $\rightarrow$ NFA $\rightarrow$ DFA

DFA $\rightarrow$ NFA: trivial

NFA $\rightarrow$ reg exp

NFA $\rightarrow$ DFA via subset construction



$w = 0110100 1$

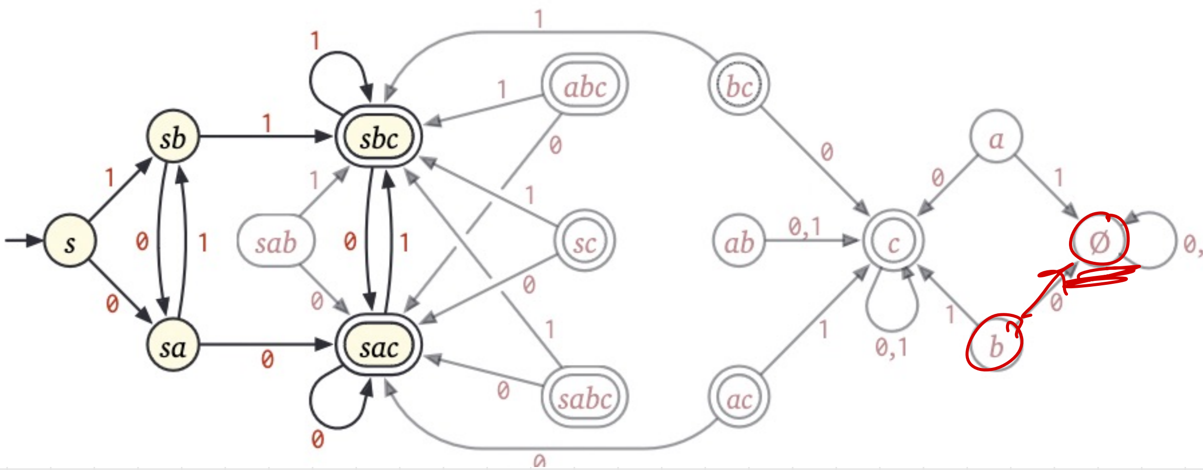
I'm in b.

$$\bigcup_{b} \underbrace{\delta(b,0)} = \{\} = \emptyset$$

$$\{s\} \xrightarrow{0} \{s,a\} \xrightarrow{1} \{s,b\} \xrightarrow{1} \{s,c,b\}$$

try to draw subset DFA

- reachable states only



Given NFA $= (Q, s, A, \delta)$,
define DFA M'

$$Q' = \mathcal{P}(Q)$$

$$s' = \{s\}$$

$$A' = \{q' \subseteq Q' : q' \cap A \neq \emptyset\}$$

$$\delta'(q', a) = \bigcup_{q \in q'} \delta(q, a)$$

Context-free Languages $\rightsquigarrow$ reg exp

A language is context-free if it can be generated by a context-free grammar.

ex

$S \to A$
$S \to B$
$A \to 0A$
$A \to 0C$
$B \to B1$
$B \to C1$
$\boxed{C \to \varepsilon}$
$\boxed{C \to 0C1}$

S
A
$0A$
$00A$
$\boxed{000A}$
$0000C$
$00000C1$
$00000\varepsilon 1$
000001

Σ: symbols / alphabet / terminals $\{0,1\}$

Γ: non-terminals $\{S, A, B, C\}$

R: production rules $D \to w$, where $D \in \Gamma$ and $w \in (\Sigma, \Gamma)^*$

$S \in \Gamma$: starting non-terminal

$L(D)$: language of non-terminal D = set of strings generated by D

$L(C)$?

C
$0C1$

C
ε ✓

$\{0^n 1^n : n \geq 0\}$

$G = (\Sigma, \Gamma, R, S)$

$L(G) = L(S)$

$S \to A \mid B$

$A \to 0A \mid 0C$

$B \to B1 \mid C1$

$C \to 0C1 \mid \varepsilon$

$\{0^n 1^m : m \neq n, \; m+n > 0\}$

$\{0^n 1^m : m < n\}$

$\{0^n 1^n : n \geq 0$

```
START():
  if [redacted]
      ALPHA()
  else
      BRAVO()
```

```
ALPHA():
  if [redacted]
      print(0)
      ALPHA()
  else
      print(0)
      CHARLIE()
```

```
BRAVO():
  if [redacted]
      BRAVO()
      print(1)
  else
      CHARLIE()
      print(1)
```

```
CHARLIE():
  if [redacted]
      return
  else
      print(0)
      CHARLIE()
      print(1)
```

what is $L(S)$?

B

$B1$

$B1111$

$C1111$

$0^n 1^n 1$

$\{0^n 1^m : m > n\}$