Lecture 6 - Sep. 27

Lexical Analysis

DFA: Formulations
NFA: Non-Deterministic Transitions

$(Q \times \Sigma) \to Q$ total function

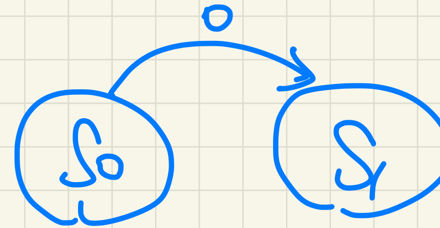
for each combination of state and alphabets, there's always a corresponding state.

$(Q \times \Sigma) \nrightarrow Q$ partial function

$add : \mathbb{Z} \times \mathbb{Z} \to \mathbb{Z}$

$div : \mathbb{Z} \times \mathbb{Z} \nrightarrow \mathbb{Z}$ e.g. $div(3, 0)$ $\perp$

$$\delta = \{ ((s_0, 0), s_1), \\ \vdots \\ \}$$



DFA: Formulation (1)

Language of a DFA

A *deterministic finite automata (DFA)* is a 5-tuple

$$M = (Q, \Sigma, \delta, q_0, F)$$

$\to q_n$

$L(M) = \{ \boxed{a_1 a_2 \dots a_n} \mid$ [redacted] $i \le n \wedge a_i \in \Sigma \wedge \delta(q_{i-1}, a_i) = q_i \wedge q_n \in F \}$

e.g., 0101

$\boxed{1 \le i \le n} \wedge q_n \in F$

e.g. $0 \le i < n \wedge \delta(q_{\cancel{i}\ i-1}, a_{i\cancel{+1}}) = q_{\cancel{i+1}\ i}$

$| a_1 | a_2 | a_3 |$

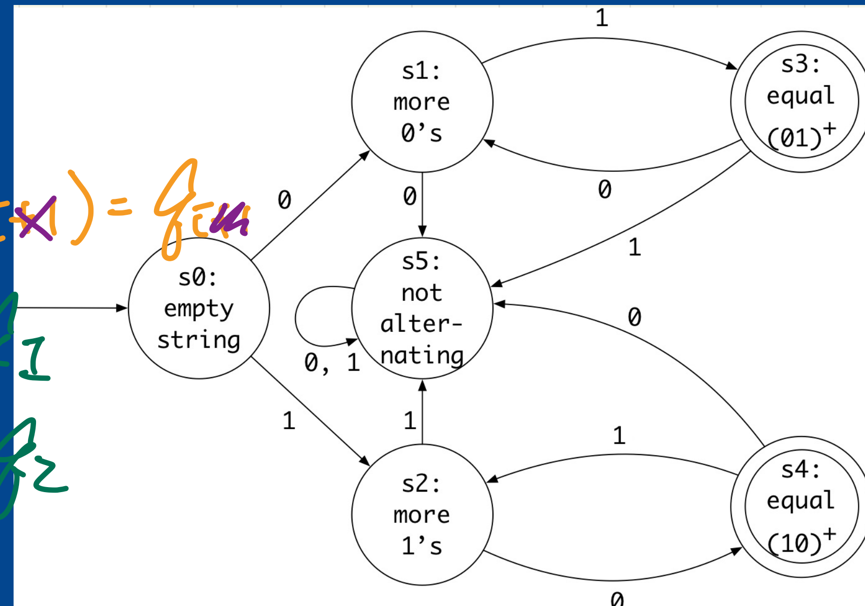
$q_0 \quad q_1 \quad q_2 \quad q_3$

$\delta(q_0, a_1) = q_1$

$\delta(q_1, a_2) = q_2$

$\vdots$

i



DFA: Formulation (2)

Language of a DFA

A *deterministic finite automata (DFA)* is a 5-tuple

$$M = (Q, \Sigma, \delta, q_0, F)$$

$$\hat{\delta} : (Q \times \Sigma^*) \to Q$$

We may define $\hat{\delta}$ recursively, using δ!

$$\hat{\delta}(q, \epsilon) = q$$

$$\hat{\delta}(q, \underbrace{xa}_{\text{last char}}) = \text{[redacted]}$$

where $q \in Q$, $x \in \Sigma^*$, and $a \in \Sigma$

$$\delta(\underbrace{\hat{\delta}(q, x)}_{q'}, a)$$

e.g., 010

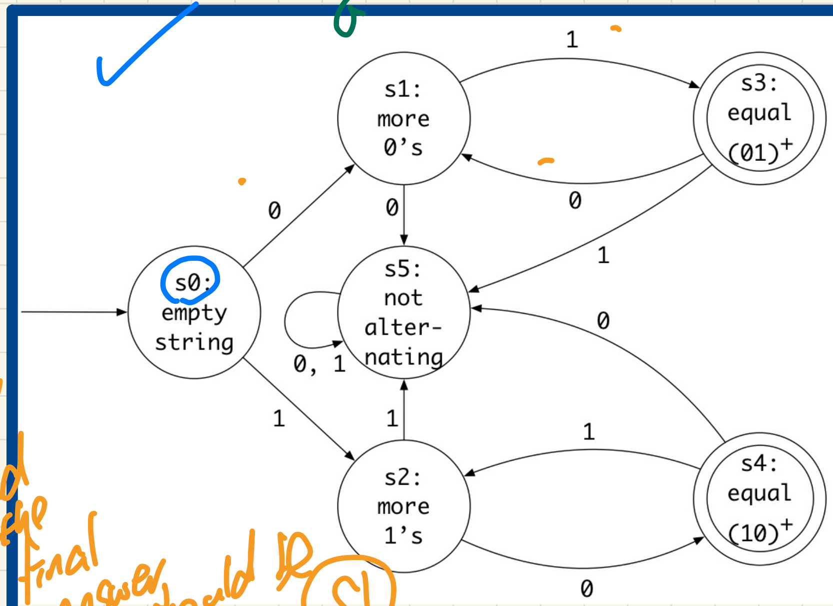
$$q \xrightarrow{x} q' \xrightarrow{a} \square$$

$$\hat{\delta}(s_0, 010)$$

$$= \delta(\hat{\delta}(s_0, 01), 0)$$

$$= \delta(\hat{\delta}(s_0, 0), 1)$$

Exercise: Finish unfolding this and the final answer should be s1.



$$L(M) = \{w \mid w \in \Sigma^* \wedge \hat{\delta}(q_0, w) \in F\}$$