< Lecture 15 >

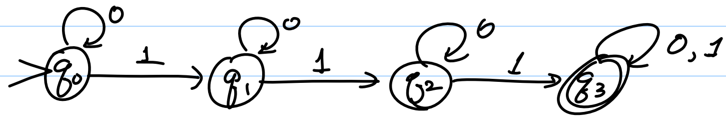
- Context free, but not regular
  - (1) $\{0^n 1^n \mid n \geq 0\}$
  - (3) $\{0^m 1^n \mid m \neq n\}$
  - (4) $\{w \mid w$ has an equal # of 0s and 1s$\}$
  - (5) $\{w w^R \mid w \in \Sigma^*\}$: palindromes of even length
  - (7) $\{w \mid w \neq w^R, w \in \Sigma^*\}$: nonpalindromes (1.46 c)
  - (6) $\{w \mid w = w^R, w \in \Sigma^*\}$: palindromes (2.4 e)
  - (8) $\{w \mid w$ is a balanced string of parentheses$\}$

write CFG for them.

How to generate regular languages by CFG?

$R_i \to a R_j$ if $\delta(q_i, a) = q_j$

$R_i \to \varepsilon$ if q_i is an accept state.



Ex)

$R_0 \to 0R_0 \mid 1R_1$

$R_1 \to 0R_1 \mid 1R_2$

$R_2 \to 0R_2 \mid 1R_3$

$R_3 \to 0R_3 \mid 1R_3 \mid \varepsilon$

- Leftmost derivation
- Ambiguous grammars
  A grammar is ambiguous if there is $w \in \Sigma^*$ for which there are at least two different parse trees (i.e, left-most derivation)

- Some ambiguous grammars can be transformed into equivalent unambiguous grammars

$E \to E+E \mid E*E \mid (E) \mid a$

vs

G_4 (p103)

- Some languages are inherently ambiguous.