$()(())$ $()()()$ $((((()))))$ $)($

Let S = set of balanced $()$

S is not regular: $S \cap (^*)^* = (^n)^n$

which is not regular

Let E = set of valid expressions

$E \cap (^* x)^* = (^n x)^n$ which is not regular

$\therefore E$ is not regular

$E \rightarrow V$

$E \rightarrow I$

$E \rightarrow E + E$

$E \rightarrow E * E$

$E \rightarrow (E)$

$V \rightarrow FV'$

$V' \rightarrow CV'$

$V' \rightarrow e$

$F \rightarrow a \mid b \mid c \mid \cdots \mid z \mid \_$

$C \rightarrow F \mid D$

$D \rightarrow 0 \mid 1 \mid 2 \mid \cdots \mid 9$

$I \rightarrow DI'$

$I' \rightarrow DI' \mid e$

$x0 * 2 + y$

$E \rightarrow E * E \rightarrow V * E + E$

$\rightarrow FV' * E + E$

$\rightarrow xCV' * E + E$

$\rightarrow xDV' * E + E$

$\rightarrow x0 * E + E$

$\rightarrow x0 * I + V$

$\rightarrow x0 * DI' + FV'$

$\rightarrow x0 * 2 + y$

Context Free Grammar $\subseteq V - \Sigma \times V^*$ (rules)

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

V: set of symbols; $\Sigma \subseteq V$: set of terminals; R: rules; S: start symbol

CFG for $a^n b^n$:

$S \to aSb$

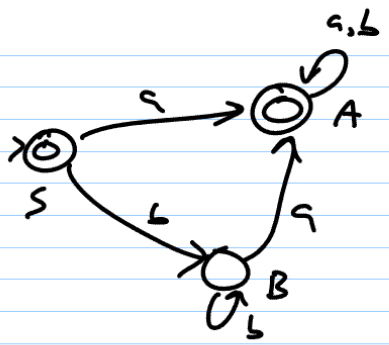
$S \to e$

$aaaabbbb$ $\quad S \to a\underline{S}b \to a\underline{aSb}b$

$\to aaa\underline{S}bbb$

$\to aaaa\underline{S}bbbb$

$\to aaaabbbb$



$S \rightarrow aA$

$S \rightarrow bB$

$A \rightarrow aA$

$A \rightarrow bA$

$B \rightarrow aA$

$B \rightarrow bB$

$S \rightarrow e$

$A \rightarrow e$