

Ruleset

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1 Grammar conversion to CNF

Checking if the following words are in G involves the use of the CYK algorithm. However R is not in CNF, so we have to convert them first as follows.

Steps involved:

- Remove ε
 - There's no epsilon, we simply add singular terms into E
- Remove all non-singular terminal symbols
 - $E_0 \rightarrow E$
 - $E \rightarrow PEE|MEE|NE|K|0|1|2|x|y$
 - $K \rightarrow 0|1|2$
 - $I \rightarrow x|y$
 - $P \rightarrow +$
 - $M \rightarrow *$
 - $N \rightarrow -$
- Remove singleton rules where RHS is non-terminal
 - $E_0 \rightarrow PEE|MEE|NE|0|1|2|x|y$
 - $E \rightarrow PEE|MEE|NE|0|1|2|x|y$
 - $P \rightarrow +$
 - $M \rightarrow *$
 - $N \rightarrow -$
 - Since K and I is not paired with any other non-terminal symbols, they can be removed altogether from the R .
- Reduce RHS to pairs of non-terminals
 - $E_1 \rightarrow EE$

- $E_0 \rightarrow PE_1|ME_1|NE|0|1|2|x|y$
- $E \rightarrow PE_1|ME_1|NE|0|1|2|x|y$
- $P \rightarrow +$
- $M \rightarrow *$
- $N \rightarrow -$

- Hence the above ruleset is the CNF of the given grammar.

2 Derivation

The given grammar illustrates the Polish notation for arithmetics. We could be higher-level about this, instead of using the CYK algorithm on a strict CFG sense. We have,

2.1 1)

The following can be derived by syntax tree deduction. Deduction constructs a viable deduction of the given word from the syntax.

$$\begin{array}{c}
 \frac{\frac{1 \quad E}{+1y} \quad \frac{1 \quad E}{PEE} \quad \frac{\frac{2 \quad E}{-2 \quad NE} \quad \frac{0 \quad E}{MEE}}{* - 20 \quad MEE}}{++1*-20 \quad PEE}
 \end{array}$$

2.2 2)

$$\begin{array}{c}
 \frac{1 \quad E \quad \frac{*x \quad N/A \quad \frac{x \quad E}{MEE}}{* *xx \quad MEE}}{+1* *xx \quad PEE}
 \end{array}$$

One branch of the above syntax tree cannot reach an endpoint. Hence the word is not part of this grammar.

2.3 3)

$$\begin{array}{c}
 \frac{0 \quad E \quad \frac{2 \quad E \quad 10 \quad N/A}{-210 \quad NE}}{*0-*210 \quad MEE}
 \end{array}$$

One branch of the above syntax tree cannot reach an endpoint. Hence the word is not part of this grammar.