3.3. Chop-and-Expand Context-Free Parser in a logic language

Recall that in logic programming $[A|X]$ represents the list whose head is the element A and whose tail is the list X.

Here is a logic program which realizes a Chop-and-Expand parser:

1. $\mathit{parse}(G, [\,], [\,]) \leftarrow$
2. $\mathit{parse}(G, [A|X], [A|Y]) \leftarrow \mathit{terminal}(A),\ \mathit{parse}(G, X, Y)$ // CHOP
3. $\mathit{parse}(G, [A|X], Y) \leftarrow \mathit{nonterminal}(A),\ \mathit{member}(A \rightarrow B,\ G),$ // EXPAND
   $\mathit{append}(B, X, Z),\ \mathit{parse}(G, Z, Y)$
4. $\mathit{member}(A, [A|X]) \leftarrow$
5. $\mathit{member}(A, [B|X]) \leftarrow \mathit{member}(A, X)$
6. $\mathit{append}([\,], L, L) \leftarrow$
7. $\mathit{append}([A|X], Y, [A|Z]) \leftarrow \mathit{append}(X, Y, Z)$

together with the clauses which define which are the terminal symbols and the nonterminal symbols.

The first argument of *parse* is a context-free grammar, the second argument is a list of terminal symbols and nonterminal symbols (that is, a sentential form), and the third argument is a word represented as a list of terminal symbols. We assume that context-free grammars are represented as lists of productions of the form $x \rightarrow y$, where x is a nonterminal symbol and y is a list of terminal and nonterminal symbols.

We have that $\mathit{parse}(G, [s], W)$ holds iff from the symbol s we can derive the word W using the grammar G.

EXAMPLE 3.3.1. The grammar $G = \langle \{a, b\}, \{S\}, \{S \rightarrow aSb,\ S \rightarrow ab\}, S \rangle$ is represented by the clauses:

$\mathit{terminal}(a) \leftarrow$

$\mathit{terminal}(b) \leftarrow$

$\mathit{nonterminal}(s) \leftarrow$

together with the list $[s \rightarrow [a, s, b],\ s \rightarrow [a, b]]$ which represents its productions. The left hand side of the first production is assumed to be the start symbol. For this grammar G the goal $\leftarrow \mathit{parse}([s \rightarrow [a, s, b],\ s \rightarrow [a, b]],\ [s],\ [a, a, b, b])$ is true.

Note that in the clause $\mathit{member}(A, [B|X]) \leftarrow \mathit{member}(A, X)$, we do not require that A is different from B. Indeed with this clause, the query of the form $\mathit{member}(A, l)$, where A is a variable and l is a ground list, generates by backtracking all members of the list l with all their multiplicity. □