

# Introduction to CL – CFG-Parsing

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## 1 Left Corner relation – Transitive Closure

We do a least fixpoint computation to compute the closure. Initialize every set  $LC(A)$  with the one-step left-corner relation items and add those that come in indirectly until no new candidates are found. This algorithm can be further optimized: In line 7, only those (non)terminals  $C$  should be considered which have been added in the last **while** round, or the initialization, if it's the first.

```
1 for  $A \rightarrow B\beta \in P$  do  $LC(A) = \{B\}$ 
2  $changed = true$ 
3 while  $changed$  do
4      $changed = false$ 
5     for  $A \in N$  do
6         for  $B \in LC(A) \cap N$  do
7             for  $C \in LC(B)$  do
8                 if  $C \notin LC(A)$  then  $LC(A) = LC(A) \cup \{C\}$ ;  $changed = true$ 
```

## 2 Extraction of complete parse trees

`extract_trees` extracts all trees rooted in the nonterminal  $N$  reaching from  $s$  to  $e$  in the chart. To get all full parse trees, call `extract_trees(S, 0, n)` if  $S$  is in  $\mathcal{C}[0, n]$ . Otherwise, the input string is not in the language of the grammar.

```
extract_trees( $N, s, e$ )
  if  $e = s + 1 \wedge N \rightarrow a_e \in P$  return  $\{tree(N)\}$  // preterminal leaf
  result_trees =  $\{\}$ 
  for all  $k \in \mathcal{B}[s, e]$  // check all split points
    for all  $A \in \mathcal{C}[s, k]$  // check all possible left daughters
      for all  $B \in \mathcal{C}[k, e]$  // check all possible right daughters
        if  $N \rightarrow AB \in P$  // look for appropriate productions
          left_trees = extract_trees( $A, s, k$ )
          right_trees = extract_trees( $B, k, e$ )
          for left in left_trees
            for right in right_trees add  $tree(N, left, right)$  to result_trees
  return result_trees
```

## 3 Parse-tree extraction – run time

Because the number of parse trees may be exponential, this parse tree extraction algorithm has exponential worst case complexity.

## 4 Bottom-up vs. Earley/left corner parsing

Bottom-up parsing is advantageous in cases where all sub-constituents derived by a given grammar are useful, e.g., in robust parsing, where sub-constituents can be used to construct a partial representation of the input string's content.

Earley or left-corner parsing have a better average case run-time for cases where only complete parses are of interest and efficiency is important.