

An Improved E-Learning Tool for Parsing-as-Deduction

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Abstract: This paper presents an extended version of the CL-Taskbox introduced at DELFI 2019. The e-learning tool for the so-called parsing-as-deduction approach has been expanded with the generation of random tasks of several difficulty levels. Additional to aiding the learner in solving the tasks by providing constant visual feedback, a new feature that allows to draw freehand directly on the page aims at teachers who use the tool for explanations.

Keywords: computational linguistics, e-Learning, context-free grammar, formal grammar, parsing

The CL-Taskbox is an e-learning tool for parsing-as-deduction and was presented first in [We19]. Parsing-as-deduction is a general approach to parsing of formal grammars that is formalized as deduction [Pe83]. Every step of the parsing process is stored in a table as an item that corresponds to a configuration in the working of an algorithm. The items apply to deduction rules which lead to the creation of new items. This repeats until a final item indicates a successful derivation or no new items can be derived. Such parsing tasks are usually carried out by students of computer science or computational linguistics as part of the homework to a course about parsing, compiler construction or similar. Writing down the parsing process might include repeating comparisons between items and the definitions of deduction rules, long searches for mistakes if the result does not line up with the expectation, as well as feedback delayed to the point when the corrected homework is returned.

Based on latest web-technologies the CL-Taskbox² is freely accessible via any common web browser without the need to install additional software. The tool guides the user in performing parsing steps by a simple drag-and-drop mechanic and provides instant visual feedback about correct or wrong operations.

The current version incorporates a newly invented, dedicated difficulty metric for parsing tasks and a mapping of that score to the three levels easy, medium and hard. The generation algorithm starts off with a trivial task and increases its difficulty until the desired level is reached and the task is presented to the user. Automatic task generation and the way of providing visual feedback are inspired by the tool Exorciser of ETH Zürich [Ts04].

Another new noteworthy feature is the possibility to activate a drawing mode. Choosing from a palette of different colours the user is able to directly draw on the page, underline corresponding elements in items and definitions or take side notes to aid thinking. This

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² The CL-Taskbox is available at cl-taskbox.de.

feature is inspired by [Kh22] where users may activate a drawing mode to help them solve math problems. The drawing mode is also useful for teachers to support their explanations with some scribbles.

Current solvable tasks include top-down, shift-reduce, CYK, Earley, Earley with passive items and left-corner parsing for context-free grammars.

The pool of available tasks will be extended with further algorithms for CFG like LR(k) and probability calculation for parsing PCFGs. Other formalisms like CCG or LAG will be added along with their dedicated parsing algorithms.

Perform cfg-cyk parsing with the given input and grammar.

Id	Item	Rule	Backpointers
1	[A,0,1]	scan A -> a {}	
2	[B,2,1]	scan B -> b {}	
3	[A,1,1]	scan A -> a {}	
4	[B,3,1]	scan B -> b {}	

New Help Check
 w = a a b b
 $G = \langle N, T, S, P \rangle$ $N = \{S, X, A, B\}$ $T = \{a, b\}$ $S = S P = \{$
 $S \rightarrow A X,$ $S \rightarrow A B,$ $A \rightarrow a,$ $B \rightarrow b,$
 $X \rightarrow S B. \}$
 Scan: $[A, i, 1]$ $A \rightarrow w_i \in P$
 Complete: $\frac{[B, i, l_1] [C, i + l_1, l_2]}{[A, i, l_1 + l_2]} A \rightarrow B C \in P$
 Goal: $[S, 0, 4]$

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