Online Parsing, Type Checking and Advanced Editor for Controlled Languages in GF

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The Problem

All UIs based on **word prediction** are helpful only in strictly left-to-right manner. In order to change something in the middle the user should remove everything until the point where the change should be made.

The old **syntax editor** does not have this problem but the users have to manipulate the abstract syntax directly.

Why do not merge?

The two UIs does not merge easily because:

1. **When** we should use the predictive editing and **when** the syntax editor?
2. The parser produces **forest** of abstract syntax trees instead of only one.

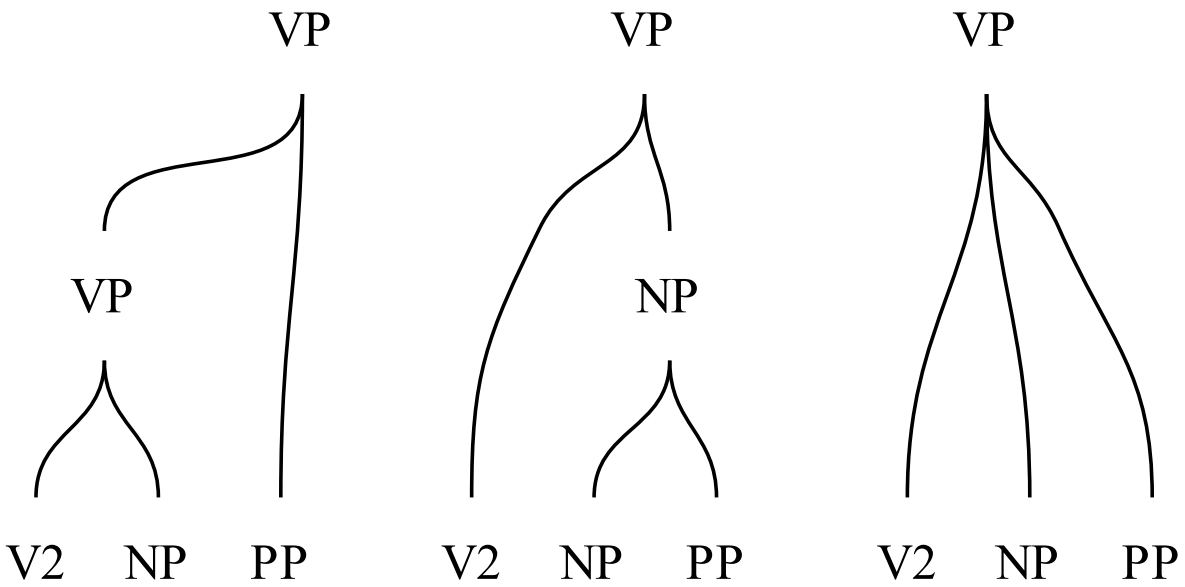
Solution to Problem 1

When and When?

- the user should **use predictive editing all the time**
- the UI should allow editing **not only of complete sentences but also of sub-phrases**

Solution to Problem 2

The Forest Deforestation



Incremental and Online Parser

Incremental Parser - reads the input from left to right and updates the parse forest incrementally after every consumed token

Online Parser - capable of producing partial parse tree even before the whole input was produced

New in GF: the parsing is now online since we can do deforestation of the partial parse forest

The First Prototype of the New UI

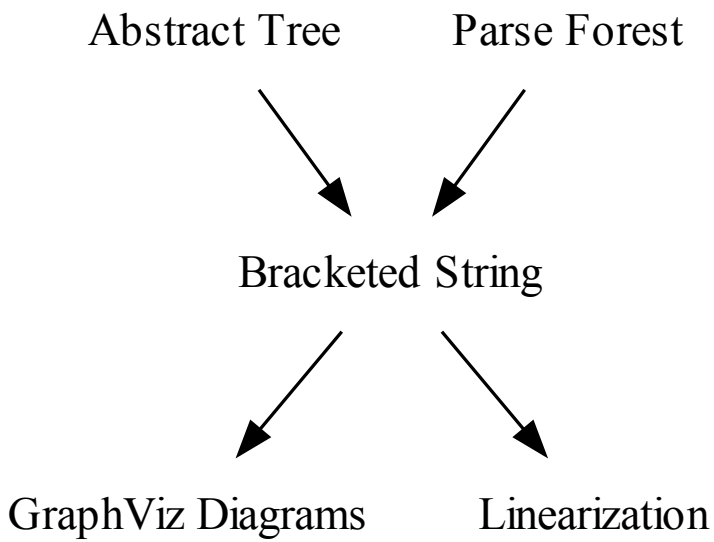
Available online but still hidden:

`http://www.grammaticalframework.org:41296/editor`

- uses the incrementality for word prediction and the online capabilities to produce **phrases like in the syntax editor**.
- still only **readonly phrases**
- autocorrection for **phonetic mutations**
- word completion for **variable names**
- integrated **type checking**
- **multi-line** editor
- improved **grammar browser**
- still under development - incompatibilities between the **different browsers**

Bracketed Strings

- Representation for text annotated with the matching categories
- Now central structure in the GF interpreter - both parsing and linearization



Example of Ambiguity

$(S_0\ (NP_1\ \mathrm{I})\ (VP_2\ (V2_3\ \mathrm{saw})\ (NP_4\ \mathrm{the\ man})\ (PP_5\ \mathrm{with\ the\ telescope})))$

$?0 = PredVP\ \ ?1\ \ ?2$

$?1 = i\_NP$

$?2 = AdvVP\ (ComplV2\ ?3\ ?4)\ ?5$

$\quad \mid ComplV2\ ?3\ (AdvNP\ ?4\ ?5)$

$?3 = see\_V2$

$?4 = the\_man\_NP$

$?5 = with\_the\_telescope\_PP$

Note: possible partial translation

Example of Discontinuity

($Command_{0,0}$ ($Action_{1,0}$ switch) ($Device_{2,0}$ the lights) ($Action_{1,1}$ on))

?0 = *CAction light* ?1 ?2

?1 = *switchOn light switchable*

...

Bracketed Strings for Robust Parsing

A Naive Receipe for Robust Parser:

- Parse with GF and in case of success, return the the parse tree
- If it fails return the bracketed string
  (S the original input is here)

More Seriously:

- Bracketed String can be produced by any **statistical parser**.
- **Partial abstract syntax trees** can be produced by GF for the fragments which are in the scope of the grammar.

Related:

- Mixed free text + controlled language

Incremental Type Checking

We type check the parse forest instead of individual trees.

This allows us:

- to type check shared sub trees in the forest only once
- to detect the type error locations in the input

Not integrated with the word completion - too hard.

Summary

- combines **Syntax Editing and Predictive Editing**
- completion for **variable names**
- autocorrection for **phonetic mutations**
- integrated **type checker**
- **multi-line** editor
- improved **grammar browser**
- some ideas for integration of **statistical parsers**