SpecEdit
An IDE for TLA+

1. Riwan Cuinat, Ciprian Teodorov and Joël Champeau. SpecEdit: Projectional Editing for TLA+ Specifications
Overview

Introduction

Objectives and choices

Architecture

Creation of a projectional editor

Plaintext support

Customization of user experience

SpecEdit in practice

Conclusion and perspectives
One of the good things about TLA+ is that if [...] [you don’t] understand what a TLA+ construct means, [...] [you] can look it up in a math book. Math books don’t write math in ASCII, they use standard mathematical symbols.
Objectives and choices

- SpecEdit, an IDE:
  - Exposing only the mathematical syntax to the user,
  - Translating it to the ASCII version for backward compatibility.

- Technology: JetBrains MetaProgramming System (MPS)

- Advantages:
  - Projectional editing
  - Mathematical notation support
  - Adequate input mechanisms
I - Creation of a projectional editor
• No grammar
• MPS Structure Language (Abstract Syntax)
• Need to convert the grammar into MPS Concepts
• Result: Metamodel with 110 interconnected Concepts

\[
G.\text{Module} ::= \text{AtLeast4}(\text{"-"}) \& \text{tok}(\text{"MODULE"}) \& \text{Name} \& \text{AtLeast4}(\text{"-"}) \\
& \ (\text{Nil} \ | \ \text{tok}(\text{"EXTENDS"}) \& \text{CommaList}(\text{Name})) \\
& \ (\text{G.Unit}^{*}) \\
& \ \text{AtLeast4}(\text{"="})
\]

```
concept Module extends Unit

  implements <none>

  properties:

  properties:

  ModuleName : Name

instance can be root: true

children:

alias: <no alias>

SetOfUnits : Unit[0..n]

short description: <no short description> SetOfModuleNameList[1]
```
MPS Editors

- View and Controller (in MPS model-view-controller pattern)
- Cells (which contain other cells or text)
- Style (indentation, color, etc.)
II - Plaintext support
Custom paste handler

- In charge of managing paste events
- Integration of ANTLR modules in MPS
  - Lexing, parsing, visiting
  - Overriding of the methods of the visitor
  - Transpiling (ASCII TLA+/MPS Language TLA+)
- Plugin inserting an entry in the context menu
Custom persistence model (+TextGens)

- Models are saved in an XML-based format
- Similar approach (different source)
- Rewriting loading/saving strategy
- Plugin (set as a ModelFactoryProvider)
III - Customization of user experience (UX)
Free editing support

- Prohibited by default (Context menu for completion)
- "Editable" property: Not enough (syntactic error)
- Node instantiation triggered for given string via transformation menus and aliases
Optional field management

- Side transformations (available when users type from the left or right part of a cell)
- Combination with hidden fields
- Definition of actions to be executed on a given written string to unhide fields

```xml
<default> editor for concept Module
node cell layout:

[ -
  ---- MODULE { ModuleName } ----
  ?[ - EXTENDS % SetOfModuleName % ]
  (- % SetOfUnits % /empty cell: <default> -)
  ---------------------------
  -]

show if (editorContext, node)->boolean {
  node.SetOfModuleNames.ListM.isNotEmpty;
}
IV - SpecEdit in practice
Concrete example

- Elasticsearch
- Comparison of the rendering between TLA+ Toolbox and SpecEdit

\[
\text{CommittedValuesDescendantsFromInitialValue} = \forall v \in \text{InitialVersions} : \\
\forall n \in \text{Nodes} : v = \text{initialAcceptedVersion}[n] \\
\forall v \in \text{SUBSET}(\text{initialConfiguration}) : \\
\text{IsQuorum}(v, \text{initialConfiguration}) \\
\forall n \in \text{votes} : \text{initialAcceptedVersion}[n] \leq v \\
\forall m \in \text{messages} : \\
\text{CommittedPublishRequest}(m) \\
\Rightarrow [\text{prevT} \mapsto 0, \text{prevV} \mapsto v, \text{nextT} \mapsto m.\text{term}, \text{nextV} \mapsto m.\text{version}] \in \text{descendant}
\]
Conclusion and perspectives

- Projectional approach
- Merging of the existing syntaxes
- Need to formalize a new language model
- Not yet a full-fledged IDE
- Meant at epitomizing what can be achieved through projectional editing
- Further research directions: Model federation and tabular/graphical projections
Project repository: github.com/RiwanC/SpecEdit
Demo video: youtu.be/8JGlZt_DNt8