Mathematics and proof presentation in Pcoq

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Pcoq

- graphical interface to the Coq system (LogiCal Team, INRIA and LRI), written in Java.

- structured data editing.

- proof-by-pointing.

- mathematical layout: 2D formulas.

- interactive development of proofs in natural language.

The Coq system

- proof assistant based on the Calculus of Inductive Constructions: typed λ-calculus with dependent and inductive types, higher order logic.

- proof and types are terms.

- proof development by sequences of tactics, simplifying the goals.

- verification of proofs by type checking.

- logical consistency of the script, undoing.

- mathematical libraries, browsing tools.

Graphical interface to Coq

- communication with the Coq engine with abstract syntax trees (AST).

- mathematical formulas are $\lambda\Pi$-terms.

3 windows:

- mathematical text: definitions, parameters, theorems, proof scripts (list of tactics), proof text, structured comments.

- state of the current proof (hypotheses, goals), proof text in natural language.

- info on the data basis of theorems, type checking, type inference.

pcoq1.jpg

Structured data edition

- selection, cut-and-paste of subtrees.

- shrinking/expansion of big structures.

- character-based editing of trees (Coq linear syntax).

pcoq2.jpg

Proof by pointing

During a proof construction, pointing to sub-expression of the goal is interpreted as a sequence of tactics:

Proofs can often be made only with the mouse.

Mathematical layout

- incremental 2D display of mathematical formulas (Tex, maple, mathematica, etc) compatible with structured edition: FIGUE toolkit (java).

Customizing layout:

- using pre-defined classes for operators (infix, exponents, fractions, etc)

- writing pretty-printing rules: PPML tool.

- in progress: compatiblity with MathML.

pcoq4.jpg pcoq3.jpg gros.gif

Interactive proof text

Use of the proof tree of the current proof: a node contains: - a (sequence of)tactic - a goal and its hypotheses - (potentially) a proof-term - a possible expansion of complex tactics (automatized, inversions, etc).

Generation of english/french text with local rules, operating on a node using informations from parent goal.

Special treatement of sequences of equalities.

Proof by pointing works everywhere in the text.

Finished subproofs are shrinked, and can be expanded.

pcoq5.jpg pcoq6.jpg

Extensions

- use of GF to generate proof texts.

- visual browsing in the data basis of theorems, hints, theories.

- compatibility with Mathml, XML.

- structured non-formal text (comments, non-generated mathematical text).