

# Base Technologies for Tutoring

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## ABSTRACT

Tutoring is concerned with individuals: individual learners on different levels, with different pace in learning, individual teachers with different teaching styles, emphasizing specific examples, and individual programmers: frequently teachers themselves who create pieces of software on their own, because they are not satisfied with available products.

This issue of individualization has lead to an unmanageable variety in educational software, usually small pieces of software with a narrow thematic scope, without freedom for variants in user input, without user guidance, without making to underlying math knowledge transparent. The trend is being reinforced by systems supporting applet generation etc -- but not supporting the requirements of freedom for input, of user guidance and of transparent knowledge.

This talk identifies 3 basic technologies powerful enough to promise general accomplishment of 3 basic requirements in tutoring:

- (1) The technology of Computer Theorem Proving (CTP) provides most general means to prove "satisfiability modulo a theory" for user input; this allows to check user input as generous and liberal as possible.
- (2) Program interpretation in debug-mode is a general means for user guidance: a program describing how to solve a problem is stopped at "break points", and the interpreter hands over control to the user (or a dialog module).
- (3) Transparent knowledge is again provided by CTP technology: all the math knowledge is represented in a human readable format (traditional language of math) on a separate language level, which can be inspected from the context of any "break point".

The technologies mentioned are considered general enough to cover both, algebra and geometry (while other domains like graph theory and others are not yet considered).

The feasibility of exploiting these technologies for educational math software is demonstrated by experiments at Graz [www.ist.tugraz.at/projects/isac](http://www.ist.tugraz.at/projects/isac), performed with Isabelle <http://isabelle.in.tum.de>.

## Keywords

tutoring , computer theorem proving , human readable math knowledge , interpretation in step mode , Isabelle