

A tutoring system to practice theorem proving in Fitch

Sicco Verwer, Mathijs de Weerd, Jonne Zutt

Delft University of Technology

{s.e.verwer, m.m.deweerd, j.zutt}@st.ewi.tudelft.nl

015-2784516

Abstract

In this interactive event we demonstrate a web-based software tool to teach theorem proving in propositional logic, called Bop. This tool is a proof editor in the Fitch proof system that can give hints, proofsteps, or even complete proofs to the student.

Keywords: Theorem proving, tutoring system

1 Introduction

This interactive event is intended to demonstrate a software tool to assist bachelor students in learning to prove theorems in propositional logic, called Bop. In this document we first describe the tool Bop. Then we give the details of the event itself.

2 Description of Bop

This interactive event demonstrates a software tool, called Bop, which assists bachelor students in learning to prove theorems in propositional logic. This tool is a proof editor in the Fitch proof system [1]. The Fitch proof system uses an intuitive proof notation in the form of diagrams. This notation and the simple rules of inference make the Fitch system an ideal system for learning logic. Bop consists of a web-based graphical user interface (the client) and a theorem prover for propositional logic (the server). This setup allows students to learn how to construct proofs from wherever they have an internet connection. A second-year course on logic at the Delft University of Technology makes use of this tool [3]. The basic idea of the Bop program is as follows:

- A student would like to (learn to) prove a theorem and enters this theorem in the web-client program.
- The student first tries to construct the proof himself using the interface to edit the proof.
- The program automatically detects proven steps and notifies the student when he has completed the proof.

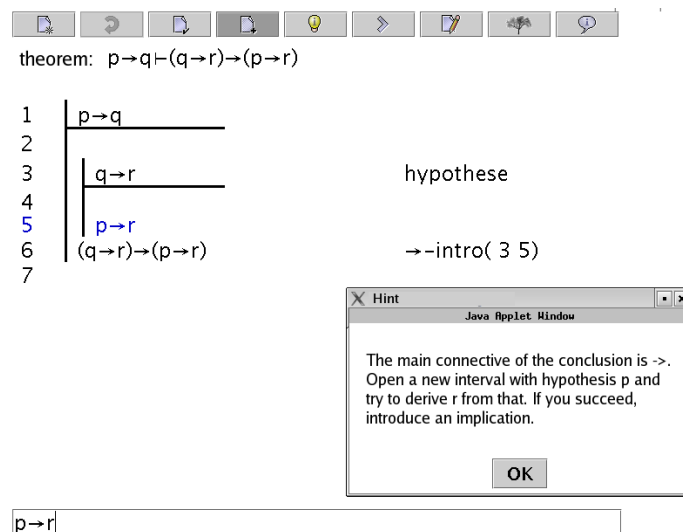


Figure 1: A screenshot of the BOP program. A student is trying to prove a theorem in propositional logic and has just pressed the HINT button. A popup window displays a hint which will help the student complete his prove of this theorem.

- When the student is unable to construct the proof, i.e. when he or she gets stuck at some point in the proof, he or she can use three functions to continue making progress:
 - HINT: ask the theorem prover to provide a textual hint.
 - STEP: ask the theorem prover to provide the next step in a correct proof.
 - PROOF: ask the theorem prover to provide the complete proof.

The goal of Bop is to train students in completing a proof. The theorem prover communicates with the client to make sure that the hints and steps provided lead to a correct proof. The hints provided to the student are based on the rules which the prover uses to infer a proof. The underlying algorithm is inspired by [2]. We show that the technique of searching in a space of instructive hints is a simple, yet effective method for tutoring logic. In the second-year course it turned out that students used the program mainly to practice for an exam; they found the program very useful and easy to use. Figure 1 shows a screenshot of the BOP program.

3 The Event

We would like to demonstrate this program to teachers and assistants of courses in logic. People who would like to participate should have some knowledge of propositional logic.

When you come to this event you will not only get to know Bop, and learn to construct proofs in the system of Fitch yourself, but you will also get some insight in how to use an automatic theorem prover for teaching how to proof. We will show the idea behind the web-interface, and the technical details of checking proofs and providing hints.

The event consists of:

- an introduction to the tool, including an example (10 minutes),
- 20 minutes in which each participant can try to prove a couple of theorems using this tutoring tool (at a computer), and in which they can fill in a questionnaire,
- an explanation of the technical design of the tool (10 minutes), and
- a discussion based on a questionnaire (5 minutes).

About 20 to 30 participants can join this event per session.

References

- [1] Fredric Brenton Fitch. *Symbolic Logic*. the Ronald Press Company, New York, 1952.
- [2] Frederic D. Portoraro and Robert E. Tully. *Logic with SYMLOG - Learning Symbolic Logic by Computer*. Prentice Hall, Englewood Cliffs, New Jersey 07632, 1994.
- [3] Sicco E. Verwer and Jonne Zutt. Bop, a tutoring system for theorem proving in Fitch, 2004. <http://logica.ewi.tudelft.nl/>.