

PROOFBUDDY

Acquiring Proof Competence with Friendly Assistance

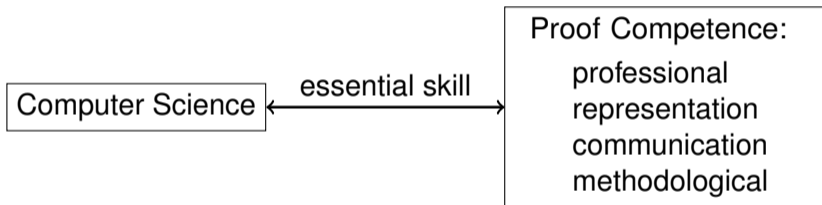
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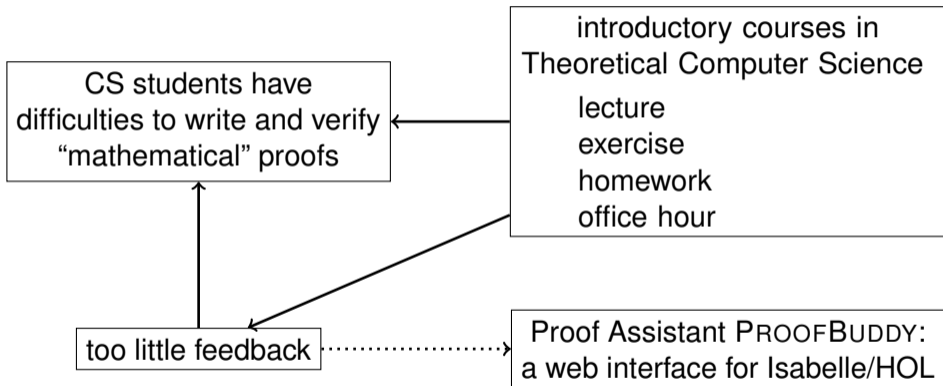
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Introduction



Introduction



Proof Assistants

Advantages

- provide instant feedback (correctness, completeness)
- can help students to write and verify proofs
- often resemble functional programming

Disadvantages

- hard to get started
- lots of (sometimes unintuitive) features to learn
- requires installation

Opportunities of a Web Interface

no installation

restrict features for specific learning goals and exercises

introduce features one by one

individual feedback for students

collect data about the students' behavior/challenges

exercises tailored to students' learning needs

Comparisons to other Approaches

Lean: web introduction

Coq: web interface jsCoq

Isabelle/HOL:

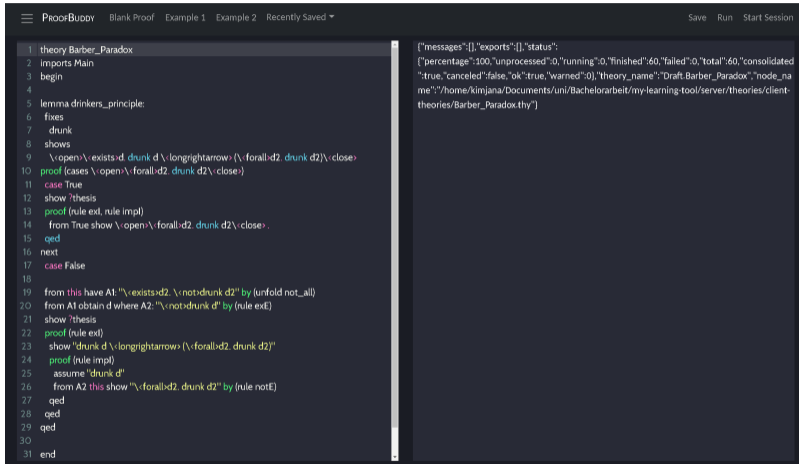
- several simple proof assistants available on the web,
but none with the full power of Isabelle/HOL

- Clide: but never used for teaching and now defunct

not aware of any systematic use

of behavioral data from a proof assistant

PROOFBUDDY



```

ProofBuddy  Blank Proof  Example 1  Example 2  Recently Saved ▾  Save  Run  Start Session

1 theory Barber_Paradox
2 imports Main
3 begin
4
5 lemma drinkers_principle:
6   fixes
7     drunk
8   shows
9     \open>\exists>d. drunk d \longrightrightarrow> (\forall>forall>d2. drunk d2)\close>
10  proof (cases \open>\forall>forall>d2. drunk d2\close>)
11    case True
12    show ?thesis
13    proof (rule exI, rule impI)
14      from True show \open>\forall>forall>d2. drunk d2\close> .
15    qed
16  next
17    case False
18
19  from this have A1: "\exists>d2. \not>drunk d2" by (unfold not_all)
20  from A1 obtain d where A2: "\not>drunk d" by (rule exE)
21  show ?thesis
22  proof (rule exI)
23    show "drunk d \longrightrightarrow> (\forall>forall>d2. drunk d2)"
24    proof (rule impI)
25      assume "drunk d"
26      from A2 this show "\forall>forall>d2. drunk d2" by (rule notE)
27    qed
28  qed
29  qed
30
31 end

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Figure: Screenshot of the interface of a prototype of PROOFBUDDY

Teaching Approach

MSc course in automated reasoning at DTU, spring 2023

- testing the tool

- first-order logic

- functional programming

BSc course on proof competence acquisition at TUB, summer 2023

- back-and-forth transformation*

- between formal and pen-and-paper proofs*

- 1st, propositional and first-order logic

- 2nd, inductive data structures and more functional programming

long term: use of behavioral data for didactic research

Comparisons to other Approaches

Lean: first and second year course
at Carnegie Mellon University

Coq: master course at University of Potsdam

Isabelle:

master course in semantics at TU München
Computational Metaphysics at FU Berlin

Conclusion

PROOFBUDDY,
a web interface for the Isabelle proof assistant for teaching
web interface alleviates some issues for students
and opens many new opportunities
short term plan: test our approach in a MSc and a BSc course
long term plan: carry out didactic research