Teaching proofs with D∃∀DUCTION PAT2023

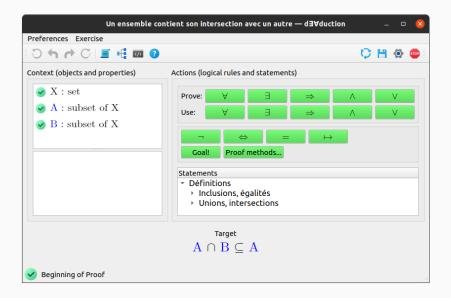
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- an open source graphical proof assistant based on L∃∀N
 a prototype, written in Python and PyQt
- for helping students to learn proofs

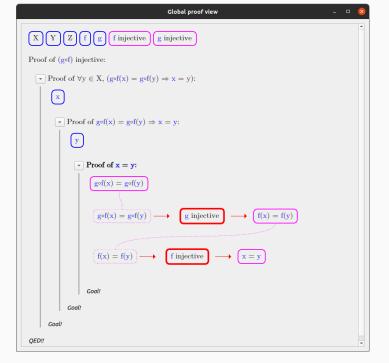
experimental but used with real students at SU; viewpoint from which I am developping this app: undergrad math students in a French univ

• aimed primarily at (French?) undergraduate math students All math students must learn proofs, but not all are willing to learn another computer language

Choose file and exercise — d∃∀duction	8
5 5 1	
Files Exercises	
Exercises	
 Exercices 	
On ensemble contient son intersection avec un autre	
 Inclus dans les deux implique inclus dans l'intersection Transitivité de l'inclusion 	
	•
Let X be a set. Let A, B be two subsets of X. Prove that $A \cap B \subseteq A$.	
5	/ Text mode
Quit	Start exercise



- students should write down their own proof
 so a teacher feedback is required...
- a proof tree provide a global view on the proof



D∃∀DUCTION with real students

• a tool, not a target

target = write proofs without DEAduction

• where is the semantics?

e.g. ask open questions: trying to prove a false statement helps building counter-examples

• mostly set theory and ϵ/δ

content is taken from the classical math course they follow in parallel

so that they can put what they learn into practice

• students do something!

They still need feedback: app not designed to stand entirely on its own

but most of the time students work at their own pace

- can design exercise sheets in a separate L∃∀N file annotated Lean files, with metadata for DEAduction in comments
- can customize the interface (e.g. restrict some functionalities)
 - e.g. remove negate button
 - e.g. decide which defs necessitate unfolding

- not a full L $\exists \forall N \mbox{GUI}$
- not reliable
- not complete
- not easy to install

What it should be

- more fun!
- more ergonomic
- with more learning tools (graphical representation?)

Visual tools? e.g. diagrams for set theory

• with more maths

go beyond naive set theory and elementary analysis

for this, need an interface for computing / entering mathematical objects

• with more developers!

The Lean side is under-developed

DEAduction has benefited a lot from feedback:

if you have any idea of how to improve, please share!

- Patrick Massot (help with Lean and first Python-Lean interface)
- First dev team:
 - Marguerite Bin (code sent to Lean),
 - Florian Dupeyron (global architecture and much more),
 - Antoine Leudière (expert PyQt),
 - and later Sébastien Julliot (Pyinstaller package)
- Camille Lichère, Zoé Mesnil (first exercise session)
- Isabelle Dubois (extensive feedback)

- https://github.com/dEAduction/dEAduction
- https://perso.imj-prg.fr/frederic-leroux/telechargerd∃∀duction/
- Bartzia, I., Beffara, E., Meyer, A., Narboux, J.. Proof assistants for undergraduate mathematics education: elements of an a priori analysis. 2023. hal-04087080
- Kerjean, M., Le Roux, F., Massot, P., Mayero, M., Mesnil, Z., Modeste, S., Rousselin, P. (2022, October). Utilisation des assistants de preuves pour l'enseignement en L1: Retours d'expériences. *Gazette de la SMF, 174*.