

AITP: How Do We Combine Our Forces?

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Two Obstacles to Strong Computer Support for Math

1. Low reasoning power of automated reasoning methods, particularly over large complex theories (**our ATPs are weak**)
2. Lack of computer understanding of current human-level (math and exact science) knowledge (**our NLP is weak**)

The Two Obstacles are related

(... and that's why we are all here, trying to understand each other ...)

- ▶ parsing human-level math may require **nontrivial reasoning with over a lot of background knowledge**
- ▶ strong automated reasoning support over large corpora may require **machine learning and reinforcement loops over vast math repositories**
- ▶ but we **don't really have vast computer-understandable math repositories** yet

How Do We Solve This Chicken And Egg Problem?

I don't know, but here are some ideas:

1. By organizing AITP and bringing the experts in these fields together!
2. By building systems with feedback (learning, reinforcement, etc.) loops that span the whole NLP-ITP-ATP toolchain, and deduce and learn over large formal and informal corpora
3. But also by making all of our component systems smarter by using both reasoning and learning

Some Examples

- ▶ A reasonable success: large-theory ATPs (hammers) get better if we learn from many related proofs – but we can likely still improve the precision a lot
- ▶ Totally open problem yet: we are just starting to build systems that could do (learn?) good conjecturing over math
- ▶ Shall we need bigger (informal) corpora for that? Can we use e.g. the GloVe analogies on arXiv as shown by Deyan Ginev to transfer concepts between (formal) math domains?
- ▶ Not sure: Current ATP systems – is the given clause loop something that should not be replaced by much more parallel (Monte-Carlo) heuristic exploration?
- ▶ Quite likely future success: Improve methods like hints and clause selection guidance by learning from thousands of long proofs