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Premise Selection for Mathematics by Corpus Analysis and Kernel Methods

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Abstract Smart premise selection is essential when using automated reasoning as a tool for large-theory formal proof development. This work develops learning-based premise selection in two ways. First, a fine-grained dependency analysis of existing high-level formal mathematical proofs is used to build a large knowledge base of proof dependencies, providing precise data for ATP-based re-verification and for training premise selection algorithms. Second, a new machine learning algorithm for premise selection based on kernel methods is proposed and implemented. To evaluate the impact of both techniques, a benchmark consisting of 2078 large-theory mathematical problems is constructed, extending the older MPTP Challenge benchmark. The combined effect of the techniques results in a 50 % improvement on the benchmark over the state-of-the-art Vampire/SInE system for automated reasoning in large theories.

Keywords Automated reasoning in large theories · Machine learning · Premise selection · Automated theorem proving

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