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Up or Down: Investigating Decision Procedures

This project addressed the question: is it possible to create a computer program that determines whether a string of a formal system is a theorem of that system, and, if so, is using a top-down method (applying rules in reverse to try to reach an axiom) or a bottom-up method (deriving as many theorems as possible and seeing if any match the string in question) more efficient? The procedure was to write code to implement the two approaches, test the code, fix errors in it, and run timing tests to compare the speeds with which results were returned. The data showed that the bottom-up method was anywhere from 2 to 1800 times faster than top-down depending upon the string and the iteration limit. While these results showed bottom-up to be consistently faster than top-down, the tests were severely constrained by limited computing capacity and the results are not fully conclusive. In short trials with simple strings the bottom-up method is more efficient, but a top-down method may prove faster on more complex strings in more complicated formal systems. The main implications of this project are for mathematics. The algorithms developed can provide a tool to find formal derivations more quickly and get partial results faster.