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Preservation theorems via dual proof trees.

We define a natural deduction framework for proving preservation theorems. It automates the proof of the classical preservation theorems (under extension, substructure, and homomorphism, as well as retracts and Keisler sandwiches). It provides a simple correspondence between properties of algebraic situations and the syntactical form of preserved formula.

The methodology is constructive: It computes the form of preserved formulas from the algebraic description and given a preserved formula, it produces a logically equivalent formula in characterized form.

The framework enables the generalization of characterizations like the joint embedding and amalgamation properties. Similarly, the Scott interpolation theorem generalizes to arbitrary operators, yielding the classic definability theorms (Craig interpolation, Robinson consistency, and Svenonius') as corollaries. Also, for Cantor-Bernstein theories, every formula is equivalent to a lattice combination of existential and universal formulas. (Received July 02, 2017)