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Multiversal polymorphic algebraic theories

We formalise and study the notion of *polymorphic algebraic theory*, as understood in the mathematical vernacular as a theory presented by equations between polymorphically-typed terms with both type and term variable binding.

The prototypical example of a polymorphic algebraic theory is Girard and Reynolds' polymorphic λ-calculus, but our framework applies more widely. It provides a unified theory of polymorphic algebraic theories with the following ingredients: *polymorphic signatures* that specify arbitrary polymorphic operators; *metavariables*, both for types and terms, that enable the generic description of metatheories; *type universes* that allow a notion of translation between theories that is parametric over different type universes; *polymorphic structures* that provide a general notion of algebraic model; and a *polymorphic equational logic* that constitutes a sound and complete logical framework for equational reasoning.

The development requires a blend of mathematical tools: presheaf categories, the Grothendieck construction, discrete generalised polynomial functors, and aspects of categorical universal algebra.

This is joint work with Marcelo Fiore.