Cubical Computational Type Theory and RedPRL

(invited talk abstract)

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Joint work with Carlo Angiuli, Evan Cavallo, Robert Harper and Jonathan Sterling.

Recent research revealed the deep connection between type theory and homotopy theory, which inspired a series of new type theories. The characteristic new features are univalence and higher inductive types, which have led to a fruitful development of synthetic homotopy theory. Unfortunately, those new features were originally introduced as axioms and disrupted the computational content of type theory, which affects their practicality in mechanizing proofs.

To date, the most promising approach to enjoy new features inspired by homotopy theory while retaining computational content is through cubical structure. Cohen et al. constructed a type theory based on De Morgan cubes with both univalence and higher inductive types. Influenced by their work, we also built a type-theoretic semantics with all the features, but instead based on Cartesian cubes. In addition to using a different cubical structure, our semantics is built from computational content directly, following a computation-first methodology which itself is interesting.

RedPRL is our first proof assistant based on the new semantics, inheriting the PRL style pioneered by the Nuprl proof assistant, which is also based on the computation-first methodology (but without cubical structure). We are also developing different proof assistants with distinct proof theories, in hope to create the best tools for mechanizing homotopy theory and other mathematics.

In this talk, I will describe how the computation-first methodology works, compare two cubical type theories and discuss **Red**PRL.