

# Reasoning About Staged Computation (Abstract for Invited Talk)

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**Abstract.** We report on recent progress in the design of modal dependent type theories that integrate specifications into languages for expressing staged computation.

Recently, type systems based on constructive modal logic have been proposed as an expressive basis for run-time code generation [DP96,WLPD98], partial evaluation [Dav96], and general meta-programming [MTBS99,DPS97]. In each case, we obtain a pure  $\lambda$ -calculus via a Curry-Howard correspondence between constructive proofs and functional programs. This is then extended to a full programming language through additions such as general recursion.

In this talk we generalize this approach from simple to dependent types, in essence allowing us to reason about staged computation within a type theory. We follow the methodology of Martin-Löf [ML96], separating judgments from propositions. This has already been applied successfully as a foundation for propositional modal logic [PD00], providing new insights into constructive S4, lax logic [FM97] and the monadic metalanguage [Mog91].

The discipline of the approach brings a number of issues into sharp focus. For example, the choice between intensional and extensional interpretations of modal operators determines the nature of definitional equality and vice versa. Constant and varying domain interpretations of modal logic relate to the question of persistence of code between computation stages and can be unified in the semantic framework. We illustrate these issues by means of examples and report on our current understanding of modal type theories and their meta-theory.

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