Parallel Session: Proof Theory

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The computational side of intuitionistic deep inference

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Deep inference is a branch of proof theory that aims to give a uniform language of formal proofs. To describe a given logic, one would give only its connectives and a set of inference rules as primitive derivations; the structure of proofs is then entirely determined by the formalism. To allow such generality, proofs and proof transformations are both fine-grained and highly explicit. It then becomes interesting to examine the computational consequences of these two properties via the Curry-Howard correspondence.

In this talk I will survey recent and ongoing work on the computational meaning of deep-inference proofs for intuitionistic logic. Various proof-theoretic constructions have resulted in the following: a novel perspective on intersection types and resource lambda-calculi; a proposed solution to the problem of non-confluence in probabilistic lambda-calculi; and lambda-calculi with fine-grained ("atomic") normalization. Present work attempts to extend the latter to "optimal reduction".

There is a technical as well as a conceptual thread through this work. The technical one is that all contributions rely fundamentally on the "medial" rule that is characteristic of, and unique to, deep inference. This rule in particular embodies the property that proofs are fine-grained, and in a computational interpretation, it allows experimentation with novel computational behaviour. The conceptual thread is that, in a computational interpretation, the explicit nature of proofs gives invaluable guidance in such experimentation, ensuring that computation remains well-behaved.