

Title	計算可能性と複雑さに関する研究：ラムダ計算の新しいモデルと有用な情報の定義について
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# Abstract

Core topics in computability and complexity were revisited, in order to generate new insights. In computability theory, we considered structures of the lambda calculus. We wanted to obtain a better understanding of the properties of structures of the lambda calculus, by studying structures more general than the already established ones.

For this purpose, we introduced a new notion for combinatory algebras, called reflexivity. Reflexivity can be characterized as the algebraic counterpart of the Meyer-Scott axiom for combinatory and lambda models. With reflexivity, we defined strongly reflexive combinatory algebras. Strongly reflexive combinatory algebras can interpret the lambda calculus, but are more general than lambda algebras.

Strongly reflexive combinatory algebras relate to the known structures in the following way: they are exactly the retracts of combinatory models, and a strongly reflexive combinatory algebra that satisfies stability is a lambda algebra.

In algorithmic complexity, we gave an overview of results related to logical depth. Logical depth is a notion that uses Kolmogorov complexity to capture the amount of useful information in strings. The definition of logical depth uses a significance level. We proved that similarly to sophistication, a related definition, logical depth is unstable with respect to the significance level: the value of logical depth changes a lot with only small changes to the significance level. For sophistication it was suggested to interpret the notion as a function in the significance level, because of this instability.

We showed that interpreting logical depth as a function in the significance level entails that it is not always possible to straightforwardly compare the logical depth of two different strings. This makes the usability of the current definition of logical depth uncertain. We hereby argued that it is necessary to reconsider the basis for the definition, and clarify the assumptions and requirements behind it.

*Keywords:* Lambda calculus, combinatory algebra, reflexivity, Kolmogorov complexity, logical depth