A lower bound on the average length of reduction in linear λ-terms

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Abstract: Lambda calculi are formal systems which play a prominent role in logic and computer science, being central to various disciplines such as proof theory and the theory and design of programming languages. In this work, we focus on the (untyped) linear lambda calculus, which is related to linear logic and which enjoys a number of intriguing connections with combinatorial objects such as maps (graphs on surfaces). Motivated by the problem of the average-case complexity of normalisation for this calculus, we present a lower bound for the expected number of steps required to reduce a random linear lambda-term to its normal form. To do so, we study the expected number of occurrences of various patterns in these lambda-terms and their corresponding rooted cubic maps. This is joint work with Olivier Bodini, Bernhard Gittenberger, Michael Wallner, and Noam Zeilberger.