Speaker: Go Hashimoto(joint work with Daniel Găină)

Title: Model-theoretic Forcing in Transition Algebra

Abstract: We study Löwenheim-Skolem and Omitting Types theorems in Transition Algebra, a logical system obtained by enhancing many sorted first-order logic with features from dynamic logic. The sentences we consider include compositions, unions, and transitive closures of transition relations, which are treated similarly to actions in dynamic logics to define necessity and possibility operators. We show that Upward Löwenheim-Skolem theorem, any form of compactness, and joint Robinson consistency property fail due to the expressivity of transitive closures of transitions. In this non-compact many-sorted logical system, we develop a forcing technique method by generalizing the classical method of forcing used by Keisler to prove Omitting Types theorem. Instead of working within a single signature, we work with a directed diagram of signatures, which allows us to establish Downward Löwenheim-Skolem and Omitting Types theorems despite the fact that models interpret sorts as sets, possibly empty. Building on a complete system of proof rules for Transition Algebra, we extend it with additional proof rules to reason about constructor-based and/or finite transition algebras. We then establish the completeness of this extended system for a fragment of Transition Algebra obtained by restricting models to constructor-based and/or finite transition algebras.

Relevant paper: Go Hashimoto and Daniel Găină, *Model-theoretic Forcing in Transition Algebra*, In Proceedings of Mathematical Foundations of Computer Science (MFCS 2025), Warsaw, Poland, 25-29 August, 2025 `https://arxiv.org/abs/2506.22828`