

Internship proposal at the University of Copenhagen

Thomas Seiller

Title	Measurable Game Semantics
Topics	Semantics of Programs Implicit Computational Complexity
Location	Copenhagen, Denmark
Lab	Department of Computer Science University of Copenhagen
Advisor(s)	Thomas Seiller, seiller@di.ku.dk
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Context. The study of denotational semantics was initiated by Scott [1], as he gave the first mathematical model of (recursive) programs where data types are interpreted as topological spaces and programs as continuous functions. The evolution of this *theory of domains* was then mainly dictated by the goal of finding models that satisfy both *soundness* and *full abstraction*, i.e. in which that two programs are equated in the model if and only if they are observationally equivalent. This hunt for fully abstract models ended with the introduction of *game semantics* [3], that model data types as games and programs as strategies. Among the several inspirations of game semantics, Girard's linear logic and the geometry of interaction program [2] stand in good place, the latter interpreting proofs as graphs that can be understood as strategies in a *naive* game semantics model.

Aim of the internship. Recent work on the geometry of interaction program lead to the definition of models that characterise complexity classes [5]. These models were obtained by replacing graphs – i.e. strategies (in a naive game) – with a generalisation called *graphings* [4] – intuitively "measurable strategies". The aim of the internship is to build on this work to define a theory of measurable games, and provide measurable game semantics for (at least) the multiplicative fragment of linear logic.

Workplace. This internship will be supervised by Thomas Seiller, Marie Curie fellow at the University of Copenhagen (KU). The intern will be working at the Department of Computer Science of the University of Copenhagen (DIKU), as part of an international team working on different aspects of computability theory, rewriting, and complexity theory, lead by Prof. Jakob Grue Simonsen.

References

- [1] Dana Scott. Outline of a Mathematical Theory of Computation. Technical Report, OUCI, 1970.
- [2] Jean-Yves Girard. Towards a geometry of interaction. In *Proceedings of the AMS Conference on Categories, Logic and Computer Science*, 1989.
- [3] John Martin Elliott Hyland and C.-H. Luke Ong. On full abstraction for PCF: I, II, and III. *Information and Computation*, 163(2):285–408, 2000. DOI:10.1006/inco.2000.2917
- [4] Thomas Seiller. Interaction graphs: Graphings. *Annals of Pure and Applied Logic*, 2016. to appear. ArXiv:1405.6331
- [5] Thomas Seiller. Towards a *Complexity-through-Realizability* theory. ArXiv:1502.01257