PhD Position

The Computing Power of Models of Distributed Computation

Topic profile

distributed computing

topology

Tags

#models of computation

#task solvability

#combinatorial topology

Supervision

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Context

The famous *asynchronous computability theorem* (ACT) relates the existence of an asynchronous wait-free shared memory protocol for solving a decision task with the existence of a simplicial map from a subdivision of the simplicial complex representing the inputs to the simplicial complex representing the allowable outputs [1]. The original theorem relies on a correspondence between protocols and simplicial maps in round-structured models of computation that induce a compact topology. This correspondence, however, is far from obvious for computation models that induce a non-compact topology, and indeed previous attempts to extend the ACT have failed.

We are looking for

Prerequisites are a Master degree in a relevant subject (e.g., computer science or mathematics). We expect a curious, driven attitude and interest to pursue cutting-edge research.

The team

You will be part of an interdisciplinary research team at Laboratoire Méthodes Formelles in the ENS Paris-Saclay, near Paris, working at the interface between computer science and synthetic biology.

Research

The characterization of solvability of decision tasks of the ACT was recently extended to general models of computation [2]. This generalization does not consider the set of configurations of the system after a fixed number k of communication rounds, but rather builds a protocol simplicial complex on the set of infinite executions of the system. This all but guarantees that the complex is infinite and necessitates new analysis techniques. It also opens up a new set of questions. For instance, is it possible for two models to solve the same decision tasks, but for their protocol complexes to be non-isomorphic? If so, what class of tasks characterizes the combinatorial structure of a computational model?
A candidate for such a characterization is solvability of long-lived tasks, i.e., tasks that require not just one output value per process, but a sequence of output values. One example is asymptotic consensus, in which processes output a real value at every step and the agreement property stipulates that all per-process sequences of values converge to a common limit. The class of long-lived tasks also includes implementation of another computational model on top of the current one, which makes the existence of a characterization likely.

References

[1] Herlihy, Shavit. *STOC'93*. URL

[2] Attiya, Castañeda, Nowak. *DISC'23*. URL

You are interested or would like to join us?

Please mail your questions or, in case you would like to apply, a short statement of interest and a curriculum vitae to Thomas Nowak (thomas@thomasnowak.net). Applications until the end of April 2024 will receive full consideration.