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Arrival and Multi-Arrival Problems

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Consider particle routing in a network from a source to a sink, where movement is governed by a state-dependent rule: upon visiting a node v, a particle departs via the next outgoing arc in a predefined cyclic order specific to that node. Deciding whether the sink is reachable by a single particle in such a network is known as the Arrival problem. This problem lies in the class NP $\cap$ co-NP, though its solvability in polynomial time remains open. In this talk, after reviewing the Arrival game and the basic results about it, I consider Multi-Arrival, an extension of the original problem that accounts for potentially exponentially many particles moving simultaneously. The goal is to compute the final distribution of particles in the sinks, given an initial configuration. A quasi-polynomial-time algorithm for Multi-Arrival on the class of tree-like directed multigraphs will be presented, which in the case of bounded contracted height, yields a polynomial-time algorithm.

This is joint work with Jonah Leander Hoff and Matthias Mnich.