Petri nets, processes, and Segal spaces

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Petri nets are a very useful formalism for modelling processes, with applications in many different fields of science and engineering such as chemistry, epidemiology, computer science, and business and production modelling. Their operational semantics come in two main flavours: geometric (in terms of posets, graphs, and such), and algebraic (in terms of monoids, monoidal categories, etc.). People have struggled for many years to reconcile the two viewpoints, the problem being an issue with symmetries. In this talk I will explain how the problem can be overcome with the help of some elementary homotopy viewpoints. The new formalism for Petri nets is based on polynomial-style finite-set configurations and etale maps. The processes of a Petri net P are etale maps $G \to P$ from graphs. The main result I want to arrive at is that P-processes (the geometric semantics) form a symmetric monoidal Segal space, and that this is the free prop-in-groupoids on P (thus at the same time the algebraic semantics). But most of the time will be spent just explaining Petri nets, markings, firings, and the token game.

Reference: *Elements of Petri nets and processes* [ArXiv:2005.05108].