1. Catalytic reaction system (CRS)

A *catalytic reaction system* (CRS) consists of a set X of 'molecule types', a set $\mathcal{R}$ of 'reactions', an assignment C describing which molecule(s) catalyse which reaction(s), and a subset F of X consisting of a 'food set' of basic building block molecule types (e.g. freely available from the environment). Here a 'reaction' refers to a process that takes one or more molecule types (the 'reactants') and produces one or more molecule types as output ('products'). C can be viewed as a subset of $X \times \mathcal{R}$.

The notion of a CRS arises naturally in biochemistry (eg. in the metabolism network for *E. Coli*), as well as in simulation models for early life (such as the binary polymer model; see Fig. 1) and many other generative and collectively autocatalytic processes (for example in thinking of the economy as an autocatalytic network in which items are combined and transformed into new products using objects (tools, factories etc) that facilitate the process; see Fig. 1).

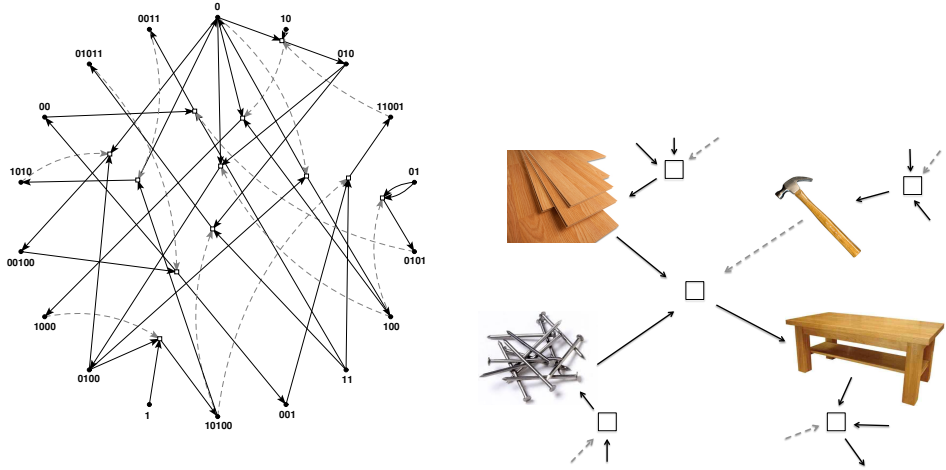

Figure 1. *Left:* A CRS consisting bit strings of 0's and 1's, in which the reactions concatenate strings. The food set here consists of strings of length at most 2, squares correspond to reactions, dots to molecule types and catalysis is indicated by dashed arrows. *Right:* the notion of the economy as a CRS (due to S. Kauffman). A 'reaction' involves using items to create a new object (e.g. boards and nails to build a table) and this process ('reaction') is 'catalysed' by an object (hammer) that facilitates the reaction without being a reactant of it (i.e. it is not used up by the process). The resulting product (table) may then be a reactant or catalyst of further 'reactions'.