BUFFER EXTENSIONS OF BOOLEAN NETWORKS

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Abstract: Boolean networks are often used as modelling tools, for instance in the investigation of biological systems. Regulations between Boolean species are encoded in interaction graphs, and the resulting qualitative behaviours are captured in state transition graphs describing the possible dynamics according to different interpretations (e.g. synchronous or asynchronous). One drawback of adopting a Boolean approach is that regulation thresholds are inevitably "squashed", and trajectories that are visible in multilevel or continuous modelling frameworks can be lost. In this talk, I will discuss some properties of a class of Boolean networks that can be obtained by adding "buffer" variables to separate the regulation thresholds. The asynchronous dynamics of these extended networks can recover many behaviours seen in more refined models. We will see how the associated state transition graphs relate to dynamics arising from other interpretations, e.g. generalised asynchronous or most permissive dynamics, and discuss some of their properties. We will see, in particular, that if all thresholds are separated and all cycles in the interaction graph admit at least one buffer, then the asynchronous attractors are in one-to-one correspondence with the minimal trap spaces. I will conclude by outlining some open questions on buffer-extended Boolean networks.