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Logic Beyond Formulas: Generalising Logic to Graphs

Logics are not invented, they are discovered by pursuing logical principles. In this talk, I will present a generalisation of propositional logic for reasoning about graphs rather than formulas, that we have recently discovered. It is well known that, propositional formulas correspond to graphs, where nodes are labelled by atoms, and there is an edge between two nodes whenever the two nodes are connected by a conjunction. In this way, propositional formulas generate a subclass of graphs called co-graphs. What we discovered is that it is possible to extend propositional logic to all simple graphs, not just co-graphs. In this logic, we can treat prime graphs with more than two nodes, such as the path on four vertices, which do not correspond to formulas, as new logical connectives. In this talk, I will explain the logical principals that we follow to discover this logic, which is furthermore canonical, in the sense that it is minimal with respect to our logical principles.

This work was first communicated at the conference LICS'20:

http://dx.doi.org/10.1145/3373718.3394763

An extended version of the paper is also available:

https://arxiv.org/pdf/2012.01102

There are also online talks on the topic:

https://satoss.uni.lu/members/ross/img/GraphShort.mp4

https://satoss.uni.lu/members/ross/img/LICS2020final.mp4