The Monotonicity and the Complexity of Cops and Robber Games

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We consider generalisations of tree-width to digraphs and the the cops and robber games related to them. In those games a team of cops tries to capture a robber on a given (di)graph. We give a short introduction to the games and a very brief survey of the current state of the art.
An important notion related to the games is monotonicity. A cop strategy is robber-monotone if the robber can never return to vertices that have already been unavailable from him. A strategy is cop-monotone if the cops never revisit any vertex.
We prove that the cop-monotonicity cost for the game characterising directed tree-width are unbounded on some classes of graphs. In some sense this means that in general there are no nice arboreal decompositions (defining directed tree-width). Finally, we use ideas obtained from the study of robber-monotonicity for the games characterising DAG-width to show that computing DAG-width is SPACE-complete.