Mathematics > Combinatorics

On the Caccetta-Haggkvist conjecture with forbidden subgraphs

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The Caccetta-Haggkvist conjecture made in 1978 asserts that every orgraph on n vertices without oriented cycles of length <= l must contain a vertex of outdegree at most (n-1)/l. It has a rather elaborate set of (conjectured) extremal configurations.
In this paper we consider the case l=3 that received quite a significant attention in the literature. We identify three orgraphs on four vertices each that are missing as an induced subgraph in all known extremal examples and prove the Caccetta-Haggkvist conjecture for orgraphs missing as induced subgraphs any of these orgraphs, along with cycles of length 3. Using a standard trick, we can also lift the restriction of being induced, although this makes graphs in our list slightly more complicated.

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