

# Succinct Representations of Graphs

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## Abstract

For a fixed graph property  $Q$ , the complexity of the problem: Given a graph  $G$ , does  $G$  have property  $Q$ ? is usually investigated as a function of  $|V|$ , the number of vertices in  $G$ , with the assumption that the input size is polynomial in  $|V|$ . In this paper the complexity of these problems is investigated when the input graph is given by a succinct representation. By a succinct representation it is meant that the input size is polylog in  $|V|$ . It is shown that graph problems which are approached this way become intractable. Actually, no “nontrivial problem could be found which can be solved in polynomial time. The main result is characterizing a large class of graph properties for which the respective “succinct problem” is  $NP$ -hard. Trying to locate these problems within the  $P$ -Time hierarchy shows that the succinct versions of polynomially equivalent problems may not be polynomially equivalent.