Contribution ID: **51** Type: **not specified**

On the complexity of diameter and related problems in permutation groups

Tuesday, July 11, 2023 4:45 PM (20 minutes)

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Abstract: We prove that it is Π_2^{P}-complete to verify whether the diameter of a given permutation group $G = \langle A \rangle$ is bounded by a unary encoded number k. This solves an open problem from a paper of Even and Goldreich, where the problem was shown to be NP-hard. Verifying whether the diameter is exactly k is complete for the class consisting of all intersections of a Π_2^{P}-language and a Σ_2^{P}-language. A similar result is shown for the length of a given permutation π, which is the minimal k such that π can be written as a product of at most k generators from A. Even and Goldreich proved that it is NP-complete to verify, whether the length of a given π is at most k (with k given in unary encoding). We show that it is DP-complete to verify whether the length is exactly k.
Finally, we deduce from our result on the diameter that it is Π_2^{P}-complete to check whether a given finite automaton with transitions labelled by permutations from S_n produces all permutations from S_n.

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Session Classification: Track B