ON THE HARDNESS OF COMPUTING THE DIAMETER OF A POLYTOPE

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Abstract. The diameter of a polytope P is given by the maximum length of a shortest path between a pair of vertices on P. Despite decades of studies, it is still not known whether the diameter of a d-dimensional polytope with n facets can be bounded by a polynomial function of n and d. This is a fundamental open question in discrete mathematics, motivated by the (still unknown) existence of a polynomial pivot rule for the Simplex Algorithm for solving Linear Programs. The diameter of a polytope has been studied from many different perspectives, including a computational complexity point of view. In particular, Frieze and Teng in 1994 showed that computing the diameter of a polytope is weakly NP-hard. In this talk, I will show that their hardness result can be strengthened, by exploiting the structure of a notorious and well-studied polytope in the optimization community: the fractional matching polytope. In particular, I will give an exact characterization of the diameter of this polytope, and then use it to derive strong NP- hardness (in fact, APX-hardness) for the problem of computing the diameter. Eventually, I will also show that the structure of the fractional matching polytope can be used to prove new hardness results regarding a generalized notion of diameter, called circuit-diameter, that has recently gained a lot of attention in the literature.

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