Summary: The Fault-Tolerant Facility Placement problem (FTFP) is a generalization of the classic Unpacitated Facility Location Problem (UFL). In FTFP we are given a set of facility sites and a set of clients. Opening a facility at site $i$ costs $f_i$ and connecting client $j$ to a facility at site $i$ costs $d_{ij}$. We assume that the connection costs (distances) $d_{ij}$ satisfy the triangle inequality. Multiple facilities can be opened at any site. Each client $j$ has a demand $r_j$, which means that it needs to be connected to $r_j$ different facilities (some of which could be located on the same site). The goal is to minimize the sum of facility opening cost and connection cost. The main result of this paper is a 1.575-approximation algorithm for FTFP, based on LP-rounding. The algorithm first reduces the demands to values polynomial in the number of sites. Then it uses a technique that we call adaptive partitioning, which partitions the instance by splitting clients into unit demands and creating a number of (not yet opened) facilities at each site. It also partitions the optimal fractional solution to produce a fractional solution for this new instance. The partitioned fractional solution satisfies a number of properties that allow us to exploit existing LP-rounding methods for UFL to round our partitioned solution to an integral solution, preserving the approximation ratio. In particular, our 1.575-approximation algorithm is based on the ideas from the 1.575-approximation algorithm for UFL by Byrka et al., with changes necessary to satisfy the fault-tolerance requirement.

Keywords: facility location; approximation algorithms

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