Abstract

An f-Sensitive Distance Oracle with stretch α preprocesses a graph $G(V, E)$ and produces a small data structure that is used to answer subsequent queries. A query is a triple consisting of a set $F \subset E$ of at most f edges, and vertices s and t. The oracle answers a query (F, s, t) by returning a value $\tilde{d}$ which is equal to the length of some path between s and t in the graph $G \setminus F$ (the graph obtained from G by discarding all edges in F). Moreover, $\tilde{d}$ is at most α times the length of the shortest path between s and t in $G \setminus F$. The oracle can also construct a path between s and t in $G \setminus F$ of length $\tilde{d}$. To the best of our knowledge we give the first nontrivial f-sensitive distance oracle with fast query time and small stretch capable of handling multiple edge failures. Specifically, for any $f = o(\frac{\log n}{\log \log n})$ and a fixed $\epsilon > 0$ our oracle answers queries (F, s, t) in time $\widetilde{O}(1)$ with $(1 + \epsilon)$ stretch using a data structure of size $n^{2+o(1)}$. For comparison, the naïve alternative requires $m^f n^2$ space for sublinear query time.