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## Terminal Embeddings\*

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**Abstract**

In this paper we study *terminal embeddings*, in which one is given a finite metric  $(X, d_X)$  (or a graph  $G = (V, E)$ ) and a subset  $K \subseteq X$  of its points are designated as *terminals*. The objective is to embed the metric into a normed space, while approximately preserving all distances among pairs that contain a terminal. We devise such embeddings in various settings, and conclude that even though we have to preserve  $\approx |K| \cdot |X|$  pairs, the distortion depends only on  $|K|$ , rather than on  $|X|$ .

We also strengthen this notion, and consider embeddings that approximately preserve the distances between *all* pairs, but provide improved distortion for pairs containing a terminal. Surprisingly, we show that such embeddings exist in many settings, and have optimal distortion bounds both with respect to  $X \times X$  and with respect to  $K \times X$ .

Moreover, our embeddings have implications to the areas of Approximation and Online Algorithms. In particular, [ALN08] devised an  $\tilde{O}(\sqrt{\log r})$ -approximation algorithm for sparsest-cut instances with  $r$  demands. Building on their framework, we provide an  $\tilde{O}(\sqrt{\log |K|})$ -approximation for sparsest-cut instances in which each demand is incident on one of the vertices of  $K$  (aka, terminals). Since  $|K| \leq r$ , our bound generalizes that of [ALN08].

**Keywords**— embedding, distortion, terminals

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