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A Sparse Johnson-Lindenstrauss Transform using Fast Hashing

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Abstract: The \emph{Sparse Johnson-Lindenstrauss Transform} of Kane and Nelson (SODA 2012) provides a linear dimensionality-reducing map $A \in R^{m \times u}$ in ℓ_2 that preserves distances up to distortion of $1 + \varepsilon$ with probability $1 - \delta$, where $m = O(\varepsilon^{-2} \log 1/\delta)$ and each column of A has $O(\varepsilon m)$ non-zero entries.
The previous analyses of the Sparse Johnson-Lindenstrauss Transform all assumed access to a $\Omega(\log 1/\delta)$-wise independent hash function.
The main contribution of this paper is a more general analysis of the Sparse Johnson-Lindenstrauss Transform with less assumptions on the hash function.
We also show that the \emph{Mixed Tabulation hash function} of Dahlgaard, Knudsen, Rotenberg, and Thorup (FOCS 2015) satisfies the conditions of our analysis, thus giving us the first analysis of a Sparse Johnson-Lindenstrauss Transform that works with a practical hash function.

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