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Yu Ma* (midsummer@berkeley.edu). *Tensor flattening approaches to estimate lower bound of small matrix multiplication tensor's border ranks.*

Matrix multiplication efficiency lies at the heart of every computer algorithm. Strassen's algorithm initiated a new field of complexity theory looking for improvements on this problem. One popular approach in recent years is to evaluate the border ranks of tensor representations of matrix multiplications, written as $M_{\langle n,m,l \rangle}$. Unfortunately, even small sized problems such as determining the tensor rank of $M_{\langle 3,3,3 \rangle}$ has not yet been solved. This project presents a detailed overview and applications of a newly emerged method, tensor flattening, that has shown to successfully assist evaluating lower bound of the border rank of $M_{\langle n,n,n \rangle}$. Furthermore, we specifically looked into the merits and limitations of Young flattening, proposed by Landsberg in 2013, with preliminary computational and theoretical investigation of its applications on small scaled rectangular matrix multiplication tensors. We end with a discussion of the implications of these results as well as the potential for generalization to other complexity problems. (Received August 28, 2018)