1148-68-109 **Atri Rudra*** (atri@buffalo.edu). *Arithmetic Circuits, Structured Matrices and Compressing Neural Networks.*

It is well-known that fast matrix-vector multiplication algorithms for many well-studied structured matrices $\mathbf{A}$ (e.g. those with low-displacement rank) are equivalent to small arithmetic circuit to compute $\mathbf{A} \cdot \mathbf{x}$. We note that the Baur-Strassen theorem a small arithmetic circuit to compute Ax gives a small arithmetic circuit to compute the gradient of $\mathbf{A} \cdot \mathbf{x}$ wrt $\mathbf{A}$. We implement this observation to achieve the following two empirical results:

1. Recover a number of well-known fast algorithms to compute Ax given A. E.g. we automatically learn the FFT from the Discrete Fourier matrix for dimensions up to $N = 1024$ (by learning over a restricted class of arithmetic circuits).

2. We replace a "unconstrained" layer in neural networks with structured matrix layer and *simultaneously* obtain parameter savings and accuracy improvements on some classification tasks.

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