THE ASYMPTOTIC COMPLEXITY OF MATRIX REDUCTION OVER FINITE FIELDS

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Abstract. Consider an invertible $n \times n$ matrix over some field. The Gauss-Jordan elimination reduces this matrix to the identity matrix using at most n^2 row operations and in general that many operations might be needed.

In [1] the authors considered matrices in $\mathrm{GL}(n,q)$, the set of $n \times n$ invertible matrices in the finite field of q elements, and provided an algorithm using only row operations which performs asymptotically better than the Gauss-Jordan elimination. More specifically their 'striped elimination algorithm' has asymptotic complexity $\frac{n^2}{\log_q n}$. Furthermore they proved that up to a constant factor this algorithm is best possible as almost all matrices in $\mathrm{GL}(n,q)$ need asymptotically at least $\frac{n^2}{2\log_q n}$ operations.

In this talk we will show that the 'striped elimination algorithm' is asymptotically optimal by proving that almost all matrices in $\mathrm{GL}(n,q)$ need asymptotically at least $\frac{n^2}{\log_q n}$ operations.

References

[1] D. Andrén, L. Hellström and K. Markström, On the complexity of matrix reduction over finite fields, Adv. in Appl. Math. **39** (2007), 428–452.