New bounds on Klarner’s constant

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Abstract: Polyominoes are edge-connected sets of cells on the square lattice. The study of polyominoes originated in statistical physics and is now a popular field in combinatorial geometry. A major goal in this area is to determine the limit growth rate of polyominoes, also known as “Klarner’s constant” and usually denoted by $\lambda$. Until recently, the best known lower and upper bounds on $\lambda$ were 3.98 and 4.65, resp.

We bounded $\lambda$ from below by investigating the growth rates of polyominoes on “twisted” cylinders. Using a supercomputer, we estimated the growth rate of polyominoes on a cylinder of perimeter 27, proving that $\lambda \geq 4.0025$ and thus braking the “mythical 4 barrier”. We also developed a new technique for showing that $\lambda \leq 4.5685$, which is the first improvement of the upper bound on $\lambda$ for over 40 years.

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