Boğaziçi
MATH COLLOQUIUM

Large Values of the Riemann Zeta Function: Code, Data, Experiment

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Abstract:

One of the oldest open questions about the Riemann zeta function ζ is its precise growth rate on the critical line, a question even the Riemann Hypothesis would not settle. The best proved bounds for the record value of $|\zeta(1/2+it)|$ up to height T are far from the rate predicted by random matrix theory. I describe a numerical search, implemented with an AI assistant, that found every successive record up to height $3 \cdot 10^{17}$. Each record, called a "zeta champion", is certified by interval arithmetic and by Turing's method for counting zeros, with the completeness of the champions list conditional on the Riemann Hypothesis. The resulting data have already revealed some striking phenomena, among them that a zeta champion is an almost-period of ζ. This project started at the American Institute of Mathematics workshop "AI and Number Theory" and is joint work with the Champions Team.

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