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Machine Learning for Number Theory: A Few Cases On Elliptic Curves

Xiaoyu Huang

Temple University

Elliptic curves are central to number theory and cryptography, with rich arithmetic structure that played a key role in the proof of Fermat's Last Theorem. Starting with the recently observed murmurations of arithmetic L-functions, which have led to theoretical breakthroughs, there is growing interest in applying machine learning to elliptic curves to uncover new patterns and conjectures. We present two case studies: using machine learning to predict properties of Tate-Shafarevich groups, and applying transformer models to infer L-function data. These models achieve high accuracy even without access to traditional number-theoretic tools such as functional equations, and we report partial interpretability of the learned patterns.