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Murmurations from functional equations

Unexpected and striking oscillations in the average a_p values of sets of elliptic curves, dubbed murmurations, were recently discovered using techniques from data science. Since then, similar patterns have been discovered for many other types of arithmetic objects. In this talk we present a new approach for studying murmurations, revolving around mean values of L-functions in the critical strip and guided by random matrix theory. With our approach, we prove murmurations in many cases conditional on standard conjectures, and unconditionally for all GL1 automorphic representations. To handle the case of elliptic curves knowledge is needed of the distribution of conductors of elliptic curves when ordered by height, which is of independent interest.