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Predicting Root Numbers

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Can we use machine learning to efficiently predict the root number of an elliptic curve over the rationals? We observe that when given many Frobenius traces, simple interpretable models can learn to predict the root number of elliptic curves with small conductors. We then investigate a result of Serre, which says that under GRH for Artin L-functions, $O(\log(N_E)^2)$ Frobenius traces are enough to determine the root number. We observe that deep neural networks fail to learn the root number in this regime as the conductor grows, and we provide a few heuristic explanations.