Using neural networks to search for interesting mathematical objects.

Geordie Williamson

University of Sydney

I will survey some work done over the last 3 years searching for unusual mathematical objects with the help of neural networks. I'll focus on three problems: automated discovery of interesting polytopes, example discovery in extremal combinatorics and a possible attack on the Jones unknot problem. The approach in each case is broadly the same: we combine neural networks with some form of classical local search. There are interesting approaches and results unique to each case. I'll try to reflect on what we've learnt and outline some possibilities of where to go next.

[The polytopes work is joint with the DeepMind team
 (https://arxiv.org/abs/2503.09919, https://arxiv.org/abs/2502.05199).
The extremal combinatorics work is joint with Charton, Ellenberg and Wagner (https://arxiv.org/abs/2411.00566).
The Jones unknot work is with Charton, Narayanan and Yacobi (available soon).]