

Neural Reasoning for Mathematical Discovery

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In this talk, I will motivate set-theoretic Neural Reasoning and present the first such neural network, the Sphere Neural Network, which achieves the rigour of symbolic-level Aristotelian syllogistic reasoning (the beginning of the history of logical reasoning) and its variants, through constructing a sphere configuration as an Euler diagram (semantic model). Being limited by vector embeddings (spheres with zero radius), traditional Neural Reasoning (supervised deep learning) cannot achieve rigorous syllogistic reasoning, but can make good predictions. Thus, the ability to engage in rigorous syllogistic reasoning becomes the watershed between vector-based neural reasoning (using training data) and sphere-based neural reasoning (using set-theoretic semantics). Mathematical discovery can be pursued as a fully automated loop of neural reasoning, starting with traditional vector-based neural networks for mathematical prediction and followed by set-theoretic neural networks for evaluation and updating predicted vectors. The first step is to extend Sphere Neural Networks for mathematical branches that are built on set theory.