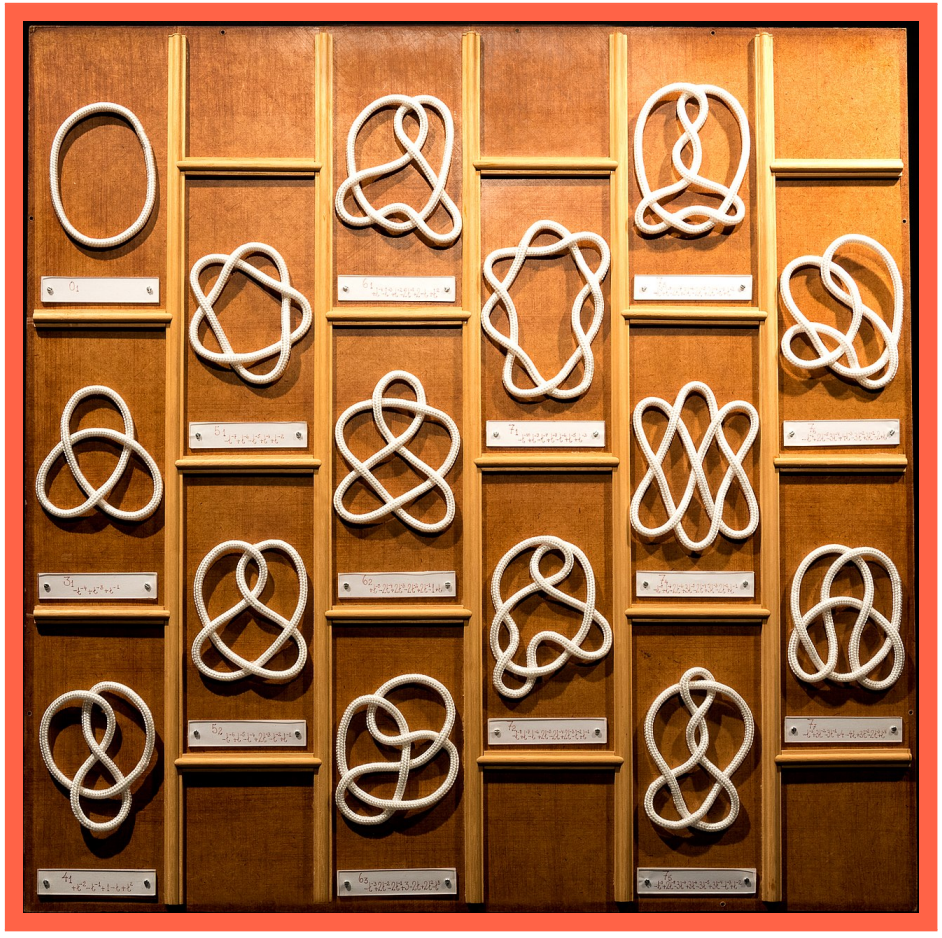
What is...machine learning in mathematics - part 8?

Or: Predicting properties

Prediction is key

- Prediction = guessing a property without full information
- Example (real-world) House price prediction is semi-difficult
- Example (math) Predicting properties of graph, manifolds, curves *etc.*

Properties of knots



- Knot = a piece of string in $\mathbb{R}^3$
- Example (knot property) Min. # of crossings, genus, unknotting number *etc.*
- Problem A lot of knot properties are difficult to compute

Too many knots...

- Problem 2 There are many different knots, and properties vary drastically
- Example (real-world) DNA and proteins form knots, and knot properties determine the chemical behavior
- Question How to predict knot properties?

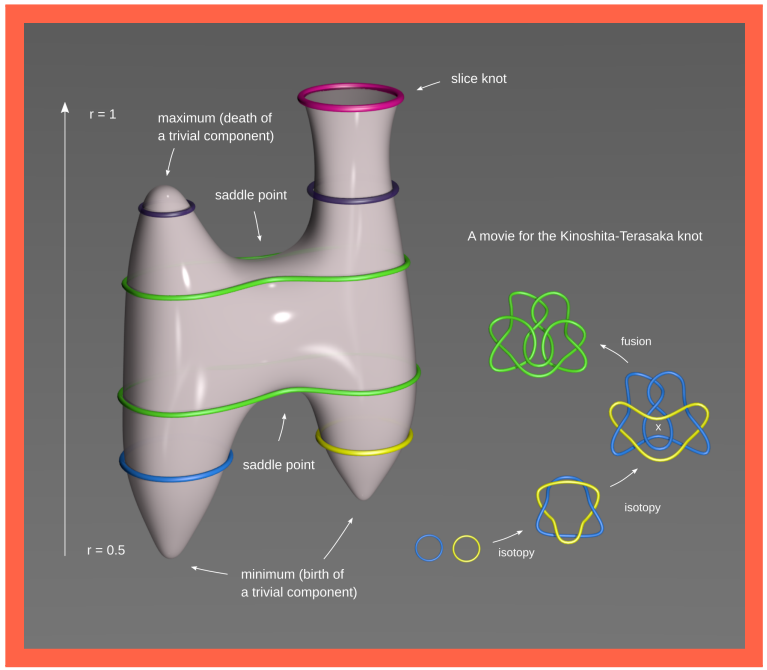
Enter, the theorem

With $> 90\%$ accuracy, a neural network (NN) predicted

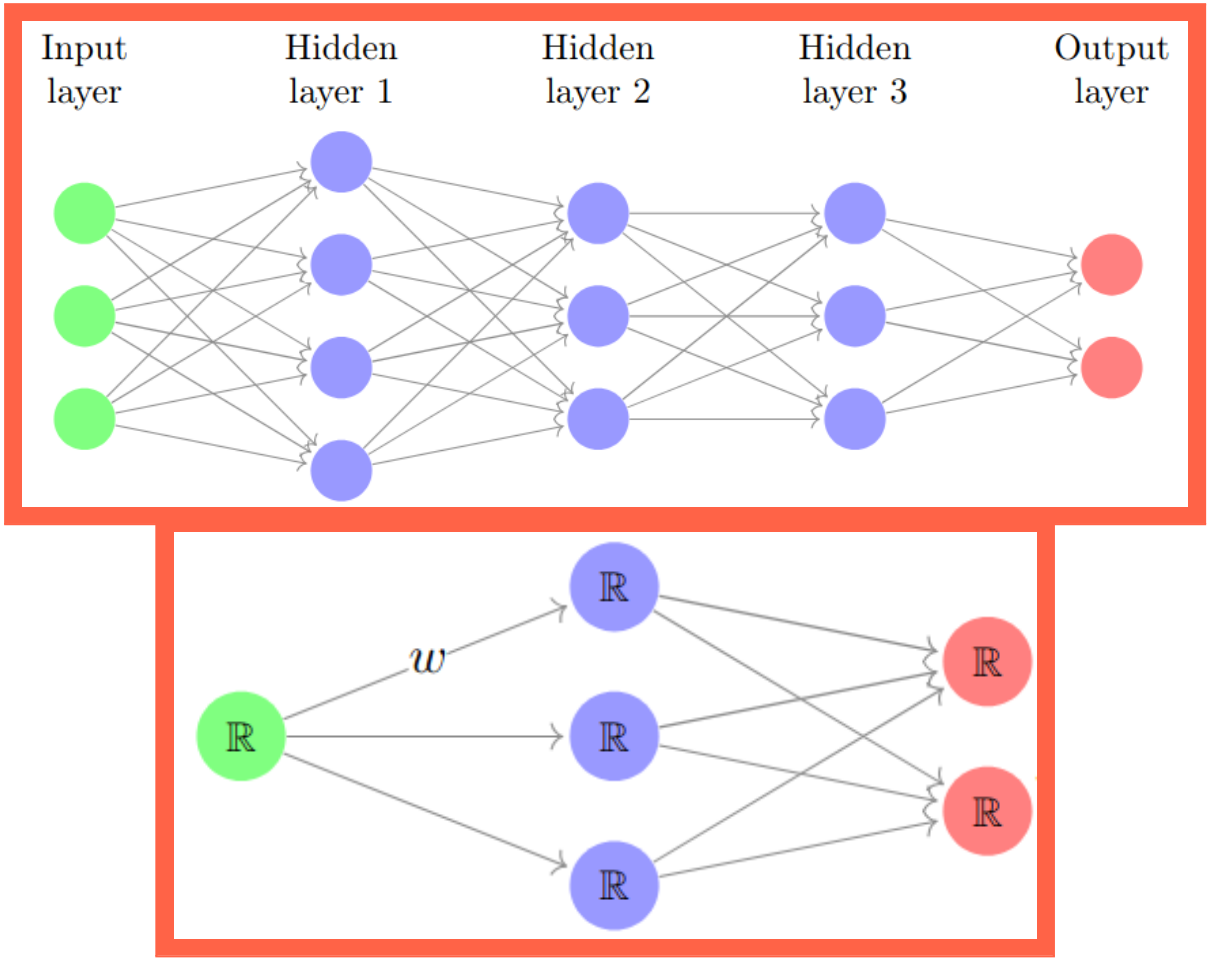
quasi-positivity and the slice genus

Then they established (with proof!) these properties for some knots

- Quasi-positive = it has a braid presentation with only positive braid generators, up to conjugation
- Slice genus = minimal genus of a surface bounding the knot in $\mathbb{R}^4$ smoothly



Easy is enough



- Interestingly the used network was quite simple
- Above A vanilla NN
- Great Vanilla NNs are enough for many nontrivial math problems

Thank you for your attention!

I hope that was of some help.