Formal Methodology

Or: How to do theoretical machine learning research

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Goals of Theory in Machine Learning

- derive intuitions, insights and principles for devising and understanding learning algorithms
- develop foundations for understanding machine learning in general, as well as specific observed phenomena

Significance

- will others care (or can they be convinced to care) about this result?
- have others worked on it?
- is it interesting, important, trivial, vacuous, surprising, new, already known?
- are there interesting special cases?
- what is the practical significance?
- consider significance before and after getting results

Techniques for Proving Theorems

- use intuition
- transform, rephrase and simplify problem
- make rough "back of envelope" calculations first
- look at small cases or simple special cases
- run experiments
- use maple / mathematica
- read!
- talk to others for ideas
  (but make clear if okay for others to work on it)
- consider possibility that claim may be false

Checking Your Proof

- like programs, proofs need testing and debugging
- write out all steps carefully
- explain in detail to someone else
- check consistency with what's already known and/or empirical results
- try to simplify proof