



Machine Learning: Why Do We (Still) Care?

Alexander G. Ororbia II
Introduction to Machine Learning
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So what are the details of these design elements?

Representation

- Decision trees
- Sets of rules / logic programs
- Instances (instance-based learning)
- Graphical models (Bayesian/Markov networks)
- Artificial neural networks (ANNs)
- Support vector machines (SVMs)
- Model ensembles
- And many more...

Evaluation

- Accuracy
- Precision and recall
- (Mean) Squared error
- (Log) Likelihood
- Posterior probability
- Cost / Utility
- Margin
- Entropy
- Kullback-Leibler (KL) divergence
- ***And many more...***

Optimization

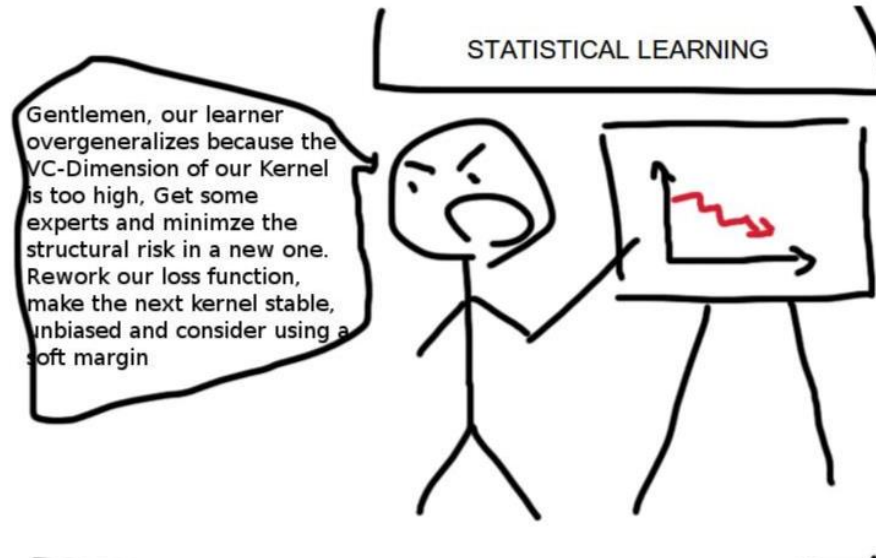
- Combinatorial optimization
 - E.g.: Greedy search
- Convex optimization
 - E.g.: Gradient descent
 - We often apply these methods to non-convex problems
- Constrained optimization
 - E.g.: Solution values that are small

ML Performance

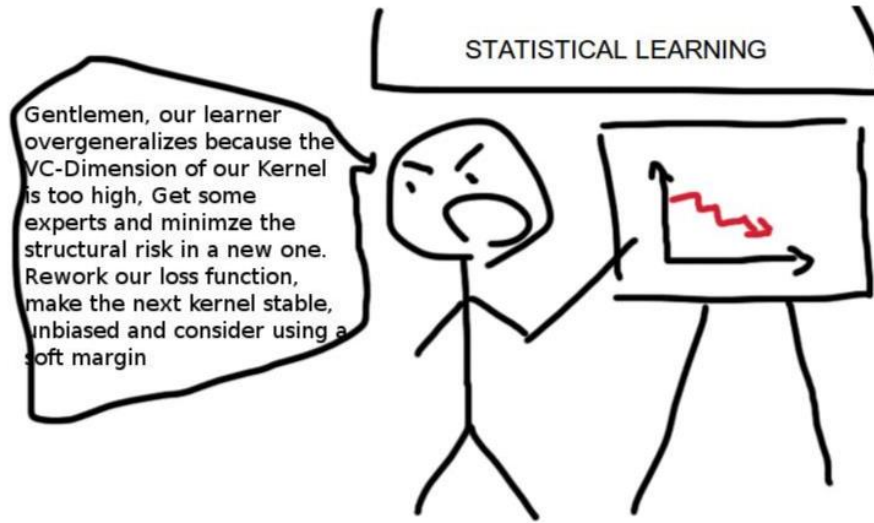
- There are several factors that affect performance:
 - **Types of training** provided
 - The form and extent of any initial **background knowledge**
 - The **type of feedback** provided
 - The **learning algorithms** used
- Success of machine learning system also depends on algorithms, e.g., inference, credit assignment
 - Algorithms control search to find and build knowledge structures (optimization is “stochastic search”)
- Learning algorithms should extract useful information from training examples (“data points”)

Though beware going off the
deep end...

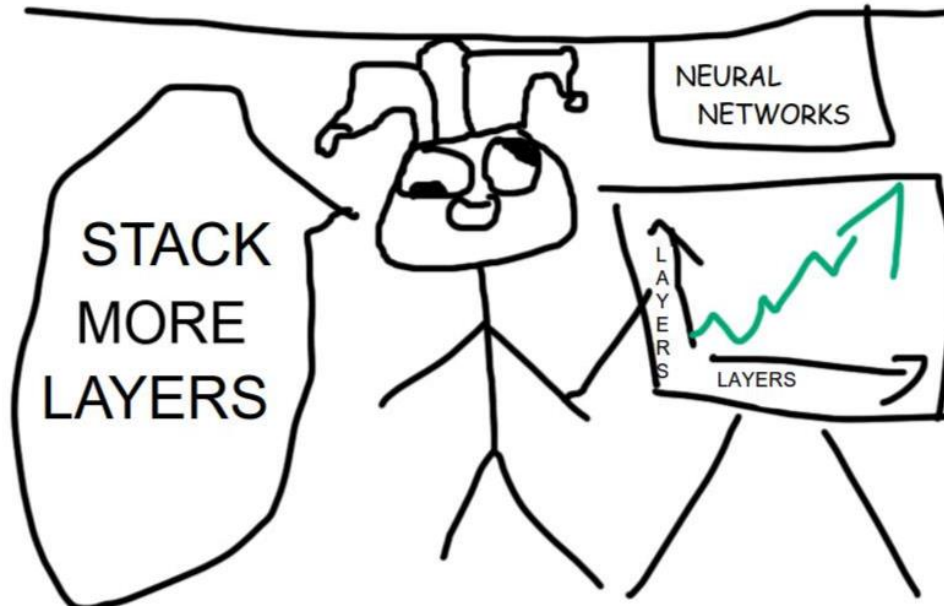
We still have a lot to learn....



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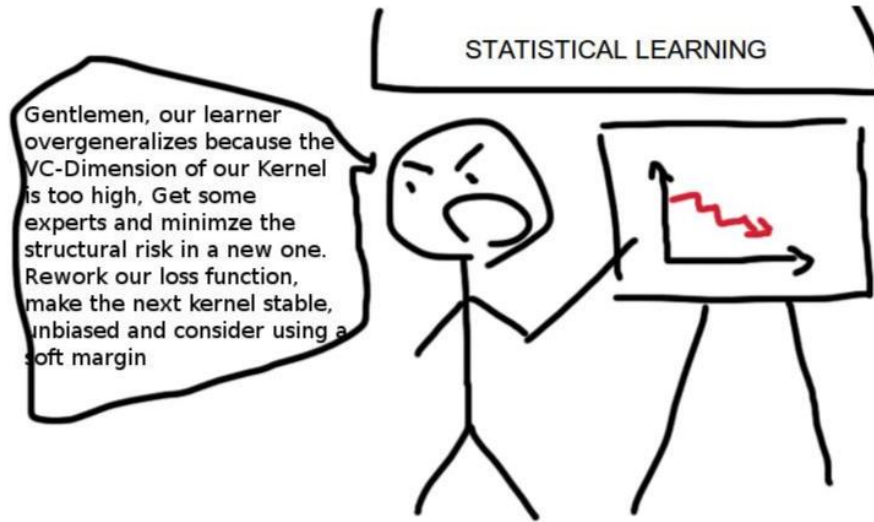


Deep Learning

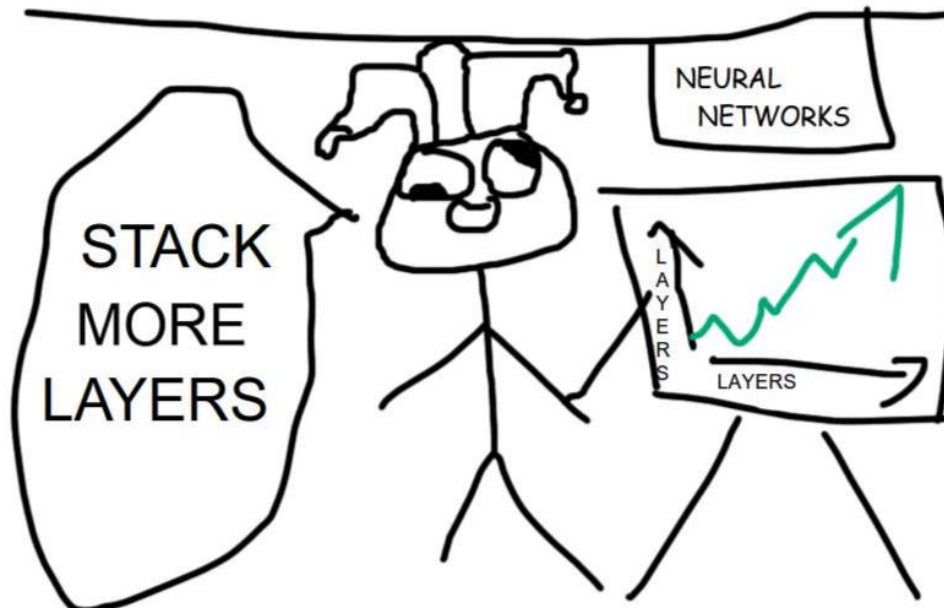


<https://www.reddit.com/r/machinegoofingoff/>

We still have a lot to learn....



Deep Learning



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Conclusions

- Simple overview of general machine learning
- Coverage of some foundational machine learning ideas / concepts
 - These ideas certainly apply to “deep learning”
 - Three key components to an ML system
 - Representation
 - Evaluation
 - Optimization
- Practical considerations!
 - Think about your problem first!

QUESTIONS?

Deep robots!

Deep questions?!

