Advanced Machine Learning

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1. Introduction, Artificial Scientific Discovery
2. Basic Neural Network Structure
3. Stochastic Gradient Descent, Backpropagation
4. Loss functions, Overfitting, Dropout, Adaptive Gradient Descent, Convolutional Networks
5. Representation Learning: Goals, Principal Component Analysis
6. Basic Autoencoders
7. Contractive Autoencoder, Shannon's Information Theory: Compression and Information
8. Entropy, Bayes Formula
9. Bayes, Gaussian Random Processes
10. Inductive Bias, Fisher Information, Information Geometry
11. Natural Gradient, Kullback-Leibler Divergence, Mutual Information
12. Mutual Information, Learning Probability Distributions, Normalizing Flows
13. Invertible Neural Networks, Convolutional and Conditional Invertible Networks
14. Boltzmann Machines General Theory
15. Restricted Boltzmann Machines, Conditional Sampling, Variational Autoencoder
16. Variational Autoencoder, Generative Adversarial Networks
17. Generative Adversarial Networks, Recurrent Neural Networks
18. Recurrent Neural Networks, Graph Neural Networks
19. Graph Neural Networks, Attention Mechanisms Basics
20. Attention, Differentiable Neural Computer, Transformers
21. Transformers and Examples, Implicit Layers
22. Implicit Layers, Hamiltonian and Lagrangian Networks, Reinforcement Learning Overview
23. Reinforcement Learning: Policy Gradient and Q-Learning

24. Advantage Actor-Critic, Trust Regions,Proximal Policy Optimization

25. Reinforcement Learning: Continuous actions, Model-based, Monte Carlo Tree Search

26. Active Learning for Network Training: Uncertainty Sampling and other Approaches

27. Bayesian Optimal Experimental Design, Active Learning: Gaussian Processes and Networks

28. Turing Machines, Algorithmic Kolomogoroff Complexity, Universal Levin Search

29. Solomonoff's Algorithmic Probability and Theory of Induction, Conclusions/Outlook

30. Materials

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