

633-600: Midterm Topic Review

- Introduction
- Supervised learning in general
- Neural networks
- Reinforcement learning
- Decision tree learning
- Genetic algorithms

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Introduction

- Representation of target function
- Hypothesis space
- Issues
- Broader questions

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Exam Details

- 75 minutes + α : If all of you arrive early (say 10 minutes), we can start immediately.
- This is a closed-book exam.
- You may bring one sheet of **handwritten** notes: US letter sized, both sides can be used. Printing or photocopying not allowed. **Write your name on the sheet.**
- No electronic device other than a clock/watch is allowed.

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Supervised Learning

- Classification, Regression
- Computational learning theory
 - Prob. of success, error threshold, complexity of hypothesis space, etc.
 - Training error vs. true error
 - Version space, version space exhaustion, theorem
 - PAC learning
 - Dichotomy, Shattering, VC dimension
 - Sample complexity, Mistake bound
- Model selection, generalization

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Neural Networks

- Threshold units, linear separability
- Gradient descent, gradient concept, limitations
- Multilayer networks
- Representational power
- Backpropagation
- Hidden layer representations
- Generalization, overfitting, validation, early stopping

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Decision Tree Learning

- Learn to approximate **discrete-valued** target functions.
- Step-by-step decision making.
- Inductive bias: **small trees** over large trees.
- Concept of information, relating to probability of events, uncertainty, and surprisal, and entropy.
- Information gain measure for attribute choice.
- Regression trees
- Overfitting and ways to avoid it: prepruning vs. postpruning.

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Reinforcement Learning

- $V^\pi(s)$
- Optimal policy $\pi^*(s)$
- Q -learning.
- $\delta(s, a)$ and $r(s, a)$, and Q .
- Relationship between $V^*(s)$ and $Q(s, a)$.
- Convergence of Q -learning.
- Policy: random, ϵ -greedy, greedy, etc.
- Nondeterministic Q -learning.
- SARSA: difference with Q -learning.
- Eligibility traces.
- $TD(\lambda)$: formulation, role of λ .

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Genetic Algorithms

- Basic components.
- GABIL issues and solutions.
- Schema theorem.
- Genetic programming.
- Baldwin effect.

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