Batch Learning Approaches

- **Empirical Risk Minimization (ERM)**
  - Fixed at training time: class of decision rules \( h : X \rightarrow Y \), loss, \( x \) and \( y \)
  - Strategy: minimize training loss

- **Conditional Probability Models**
  - Fixed at training time: class of models for \( P(Y|X) \), \( x \) and \( y \)
  - Strategy: max conditional likelihood or MAP (or Bayes)

- **Generative Models**
  - Fixed at training time: class models for \( P(Y,X) \)
  - Strategy: max likelihood or MAP (or Bayes)

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Batch Learning for Classification

- **ERM**
  - Decision Trees
  - Perceptron
  - Linear SVMs
  - Kernel SVMs

- **Conditional Probability**
  - Logistic Regression
  - Conditional Random Fields
  - Ridge Regression

- **Generative**
  - Multinomial Naïve Bayes
  - Multivariate Naïve Bayes
  - Linear Discriminant

Other Methods
- Logical rule learning
- Gaussian Processes
- Neural Networks
- RBF Networks
- Boosting
- Bagging
- Parametric (Graphical) Models
- *-Regression
- *-Multiclass

Methods + Theory + Algorithms + Practice

Batch Learning for Struct Prediction

- **ERM**
  - Structural SVMs

- **Conditional Probability**
  - Conditional Random Fields

- **Generative**
  - Hidden Markov Model

Other Methods
- Maximum Margin Markov Networks
- Markov Random Fields
- Bayesian Networks
- Statistical Relational Learning
- Markov Logic Networks

Online Learning

- **Expert Setting**
  - Weighted Majority
  - Exponentiated Gradient

- **Bandit Setting**
  - EXP3
  - UCB1

Other Methods
- Hedge
- Follow the Leader
- Zooming
- Partial Monitoring
- Contextual Bandits
- Dueling Bandits
- Coactive Learning

Unsupervised Learning

- **Clustering**
  - K-Means

Other Methods
- Spectral Clustering
- Latent Dirichlet Allocation
- Latent Semantic Analysis
- Multi-Dimensional Scaling

Other Tasks
- Outlier Detection
- Novelty Detection
- Dimensionality Reduction
- Non-Linear Manifold Detection

Other Methods
- Machine Learning for Data Science
- Math Found for the Information Age
- Machine Learning Theory
Other Learning Problems and Applications

- Recommender Systems, Search Ranking, etc.
  - CS4300 Information Retrieval
    → Cristian Niculescu-Danescu-Mizil
- Reinforcement Learning and Markov Decision Processes
  - CS4758 Robot Learning
- Computer Vision
  - CS4670 Intro Computer Vision
    → Serge Belongie
- Natural Language Processing
  - CS4740 Intro Natural Language Processing
    → Lillian Lee
    → Claire Cardie

Other Machine Learning Courses at Cornell

- INFO 3300 - Data-Driven Web Pages
- CS 4700 - Introduction to Artificial Intelligence
- CS 4780/5780 - Machine Learning for Intelligent Systems
- CS 4786/5786 - Machine Learning for Data Science
- CS 4758 - Robot Learning
- CS 4782 - Probabilistic Graphical Models
- OR 4740 - Statistical Data Mining
- CS 6780 - Advanced Machine Learning
- CS 6783 - Machine Learning Theory
- CS 6784 - Advanced Topics in Machine Learning
- CS 6756 - Advanced Topics in Robot Learning
- ORIE 6740 - Statistical Learning Theory for Data Mining
- ORIE 6750 - Optimal learning
- ORIE 6780 - Bayesian Statistics and Data Analysis
- MATH 7740 - Statistical Learning Theory