

Introduction to Machine Learning

Lecture 00



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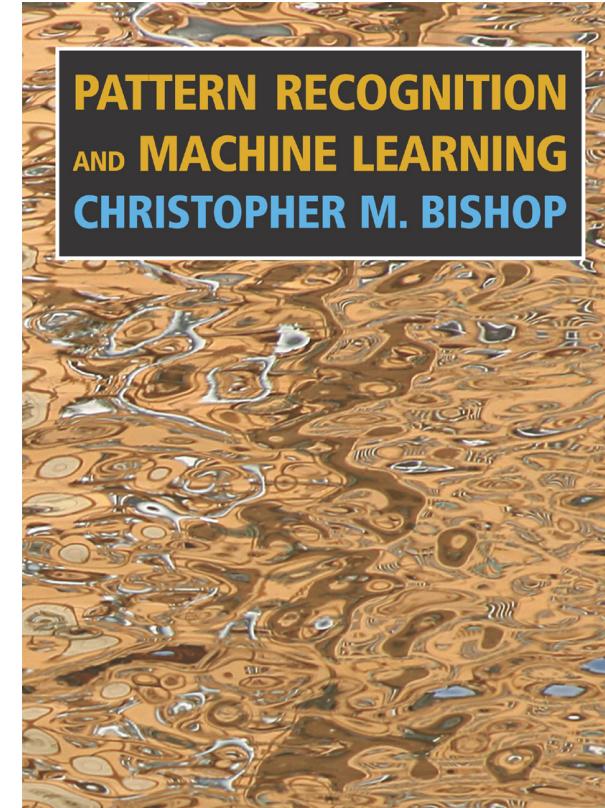
Textbook

Title: Pattern Recognition and Machine Learning

Author: Christopher M. Bishop

Publisher: Springer

Year: 2006





- ***Course Overview:*** Introduction to **machine learning** and its role in variety of real-world problems in areas such as remote sensing and image processing.



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- **Course Overview:** Introduction to **machine learning** and its role in variety of real-world problems in areas such as remote sensing and adaptive filtering.
- So, What is *machine learning*?
- Can a machine or computer learn?
- Can a machine or computer be intelligent?
- One definition of **Machine Learning**: Area of study to develop methods for computers to make (intelligent?) decisions without being explicitly programmed.



Many Sub-areas in Machine Learning

- Supervised Learning
- Unsupervised Learning
- Semi-supervised Learning
- Reinforcement Learning
- Multiple Instance Learning
- Active Learning
- Neural Networks & Deep Learning
- Transfer Learning
- Structured Learning
- Associative Learning
-



Supervised Learning

Learning mapping from input data to desired output values given labeled training data



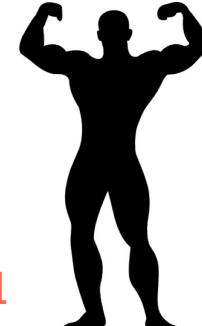
0: Macaw

1: Conure



Supervised Learning

Learning mapping from input data to desired output values
given labeled training data





Supervised Learning

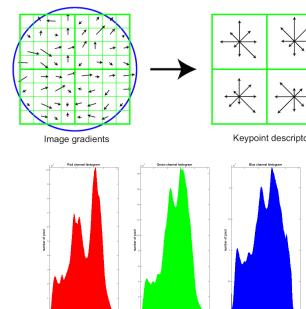
The Usual Flow (but not always)

Training:

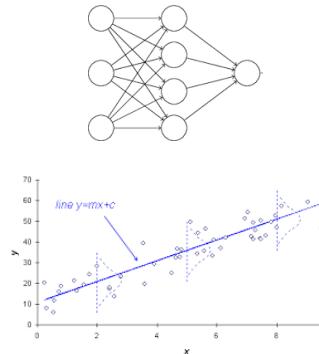
Collect
Labeled
Training Data



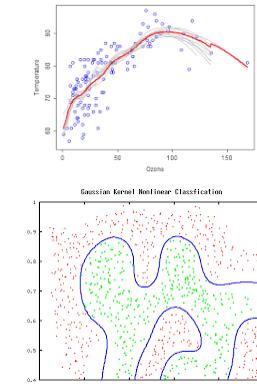
Extract
Features



Select a
Model

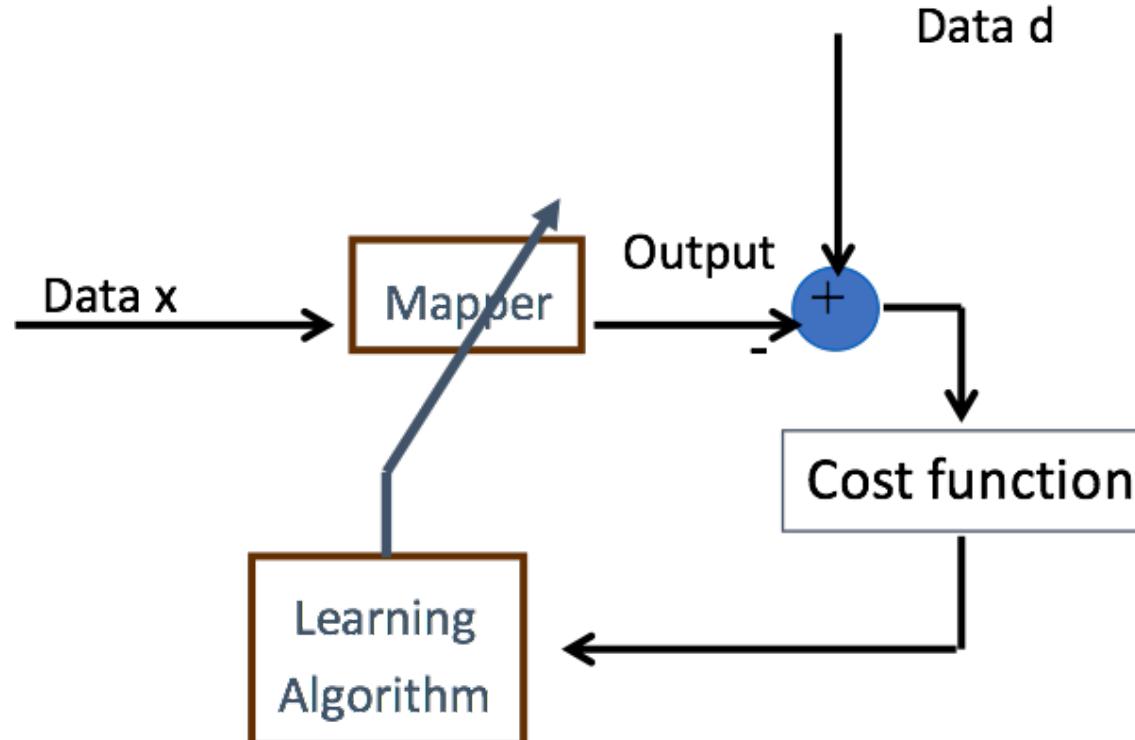


Fit the
Model





Block Diagram of a Learning System





Supervised Learning

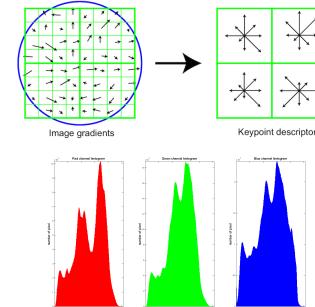
The Usual Flow (but not always)

Testing:

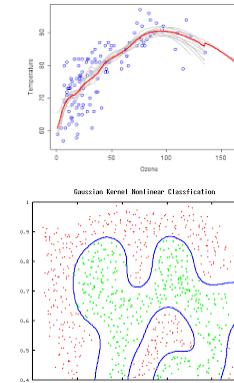
Given
Unlabeled Test
Data



Extract
(the same)
Features



Run It Through
Your Trained
Model





(Subset of) Challenges

How do you know if you have *representative* training data?

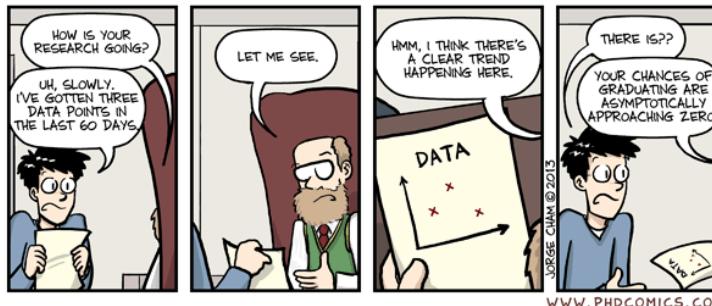
How do you know if you extracted *good* features?

How do you know if you selected the *right* model?

How do you know if you trained the model *well*?



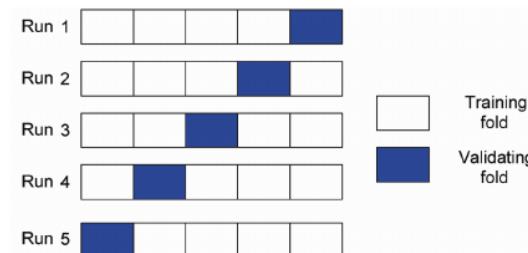
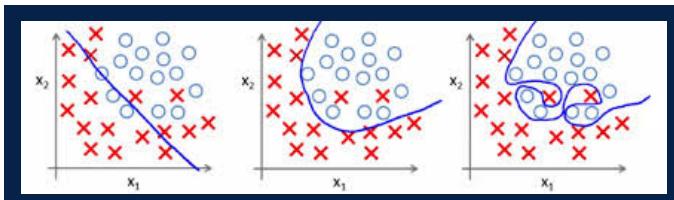
Gets Loads and Loads of Data



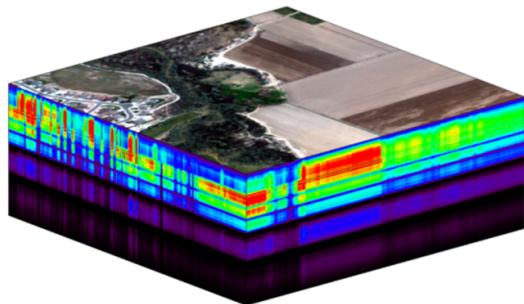
Partition (thoughtfully) into Training, Validation, & Testing Data

Conduct Cross-Validation

Carefully Select Evaluation Metrics



Obtaining Labeled Training Data is often hard, expensive, and sometimes infeasible...



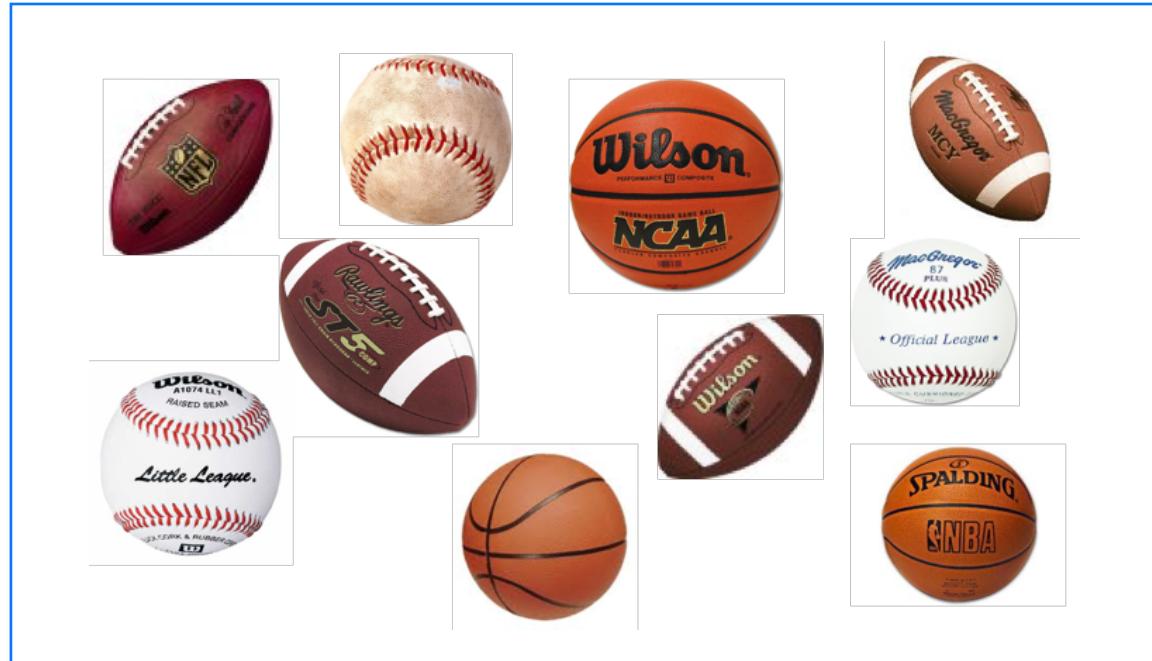
From NEON
neonscience.org





Unsupervised Learning

Learning structure from data *without any labels*





Unsupervised Learning

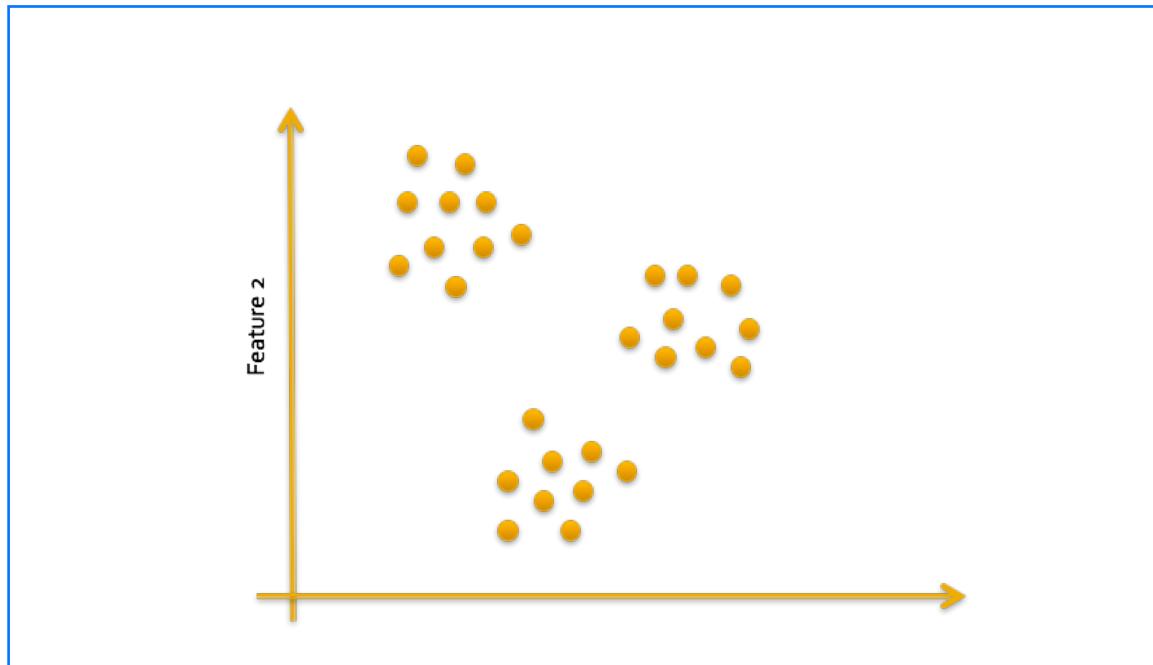
Learning structure from data *without any labels*





Unsupervised Learning

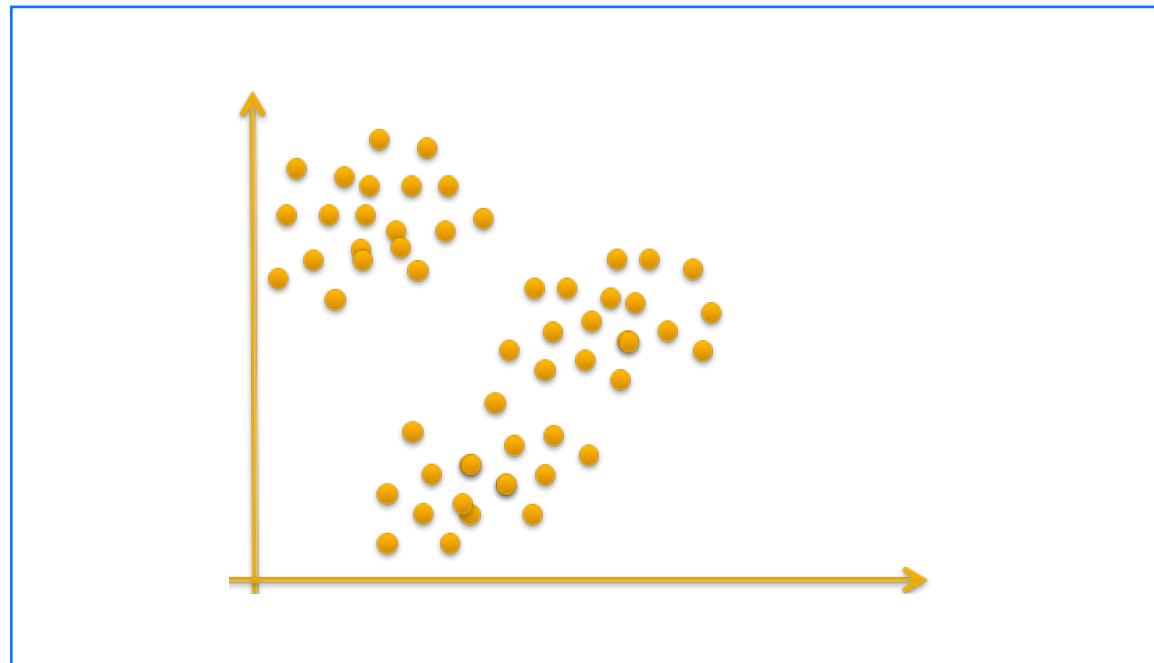
Learning structure from data *without any labels*





Unsupervised Learning

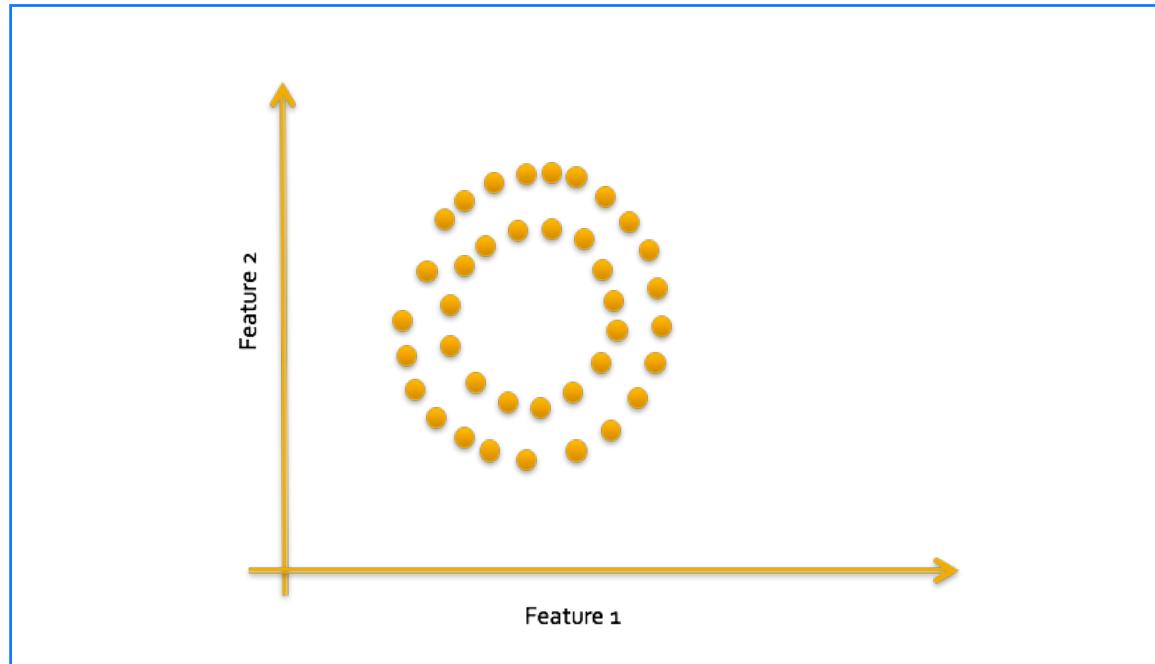
Learning structure from data *without any labels*





Unsupervised Learning

Learning structure from data *without any labels*





Other Sub-areas of Machine Learning

Semi-supervised Learning - some training data labeled, some not, use all during training

Reinforcement Learning - reinforcement based on action in an environment so to maximize/minimize a reward/penalty

Active Learning - obtaining labels online from a user/oracle in an *intelligent* fashion

Transfer Learning - having labels on a related problem and transferring it to the task of interest

Multiple Instance Learning – have only imprecise labels for training data

Manifold Learning – non-linear dimensionality reduction of embedded data while preserving characteristic properties



Before Next Class:

- Read Chapter 1 (Introduction) and Appendix B (Linear Algebra) in the Textbook
- Prepare to be able to run and use Python 3 Jupyter Notebooks in class. Easiest method is to install Anaconda. See:
<http://jupyter.readthedocs.io/en/latest/install.html>
- Complete Homework 0 (including the git and python tutorials)