Weekly Report

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Machine Learning

Machine Learning Overview (1/2)

https://ocw.nctu.edu.tw/course_detail-v.php?bgid=1&gid=1&nid=563&v5=bu4x368abN8

Prerequisite

- Machine learning-based actions are influenced by past experience.
- All data are from a fixed, unknown probability distribution, i.e., identical and independent distribution (IID).

Types of Machine learning

- Supervised learning: classification, regression
  Supervised learning is based on a set of training inputs and outputs.
- Unsupervised learning: clustering, density estimation
  Unsupervised learning is focused on capturing the inherent organization of data
- Semi-supervised learning is based on limited labeled data but a lot of unlabeled data
- Reinforcement learning: AlphaGo
  Reinforcement learning has reward functions that actions are taken to maximize the notion of cumulative reward.

In Supervised learning, every example is represented by a pair consisting of features/variables/attributes: x and a label: y.

A training set containing N examples is represented by
X=$\{x^t, y^t\}_{t=1}^N$

The mismatch between Hypothesis Class (Prediction class) & Concept Class (Actual Class): false positive and false negative.

Choosing a hypothesis:
Calculate Empirical Error/ Empirical Risk/Training Error/Loss Function
Empirical Error calculates the portion of training instances that predictions do not match the training set.

$E(h|X)=\frac{1}{N}\sum_{t=1}^{N}(h(x^t) \neq y^t)$

Machine Learning Overview (2/2)

https://ocw.nctu.edu.tw/course_detail-v.php?bgid=1&gid=1&nid=563&v5=VDiY8C-B6qE

The most specific hypothesis: S v.s. the most general hypothesis: G

Version Space:

- The set of hypotheses that are more general than S and more specific than G forms the version space.
- The number of hypotheses in a version space is infinite.

Reference Material Study:

A Few Useful Things to Know about Machine Learning (by Pedro Domingos)

https://sites.astro.caltech.edu/~george/ay122/cacm12.pdf

Machine Learning = Representation + Evaluation + Optimization

Mathematical Background: Linear Algebra

Norm Function

- Definition of norm
  Norm is a quantity describing the size of a vector.
- Norm characteristics
- Variants of norm (one-norm, two-norm, p-norm, and infinite-norm)

Linear Algebra

- Definitions of linear dependent & linear independent
- Inverse matrix, transport matrix, determinant, rank
- Eigenvalue and eigenvector

Programming

- Use NumPy (Numerical Python) to calculate inverse matrix, transpose matrix, matrix multiplication, determinant, eigenvalue, and eigenvector.