

Companion to Machine Learning

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Introduction

0.1 What is Machine Learning

Machine Learning is the field of study that gives computers the ability to learn from data without being explicitly programmed. This is good for problems that require a lot of fine-tuning or for which using a traditional approach yields no good solution. Machine Learning's data dependency allows it to adapt to new data and gain insight for complex problems and large amounts of data.

0.2 Applications of Machine Learning

Machine Learning can be used for a range of tasks and can be seen used in:

- Analyzing images of products on a production line to automatically classify them (Convolutional Neural Net)
- Forecasting company revenue based on performance metrics (Regression or Neural Net)
- Automatically classifying news articles (NLP using Recurrent Neural Networks)
- Summarizing long documents automatically (Natural Language Processing)
- Building intelligent bot for a game (Reinforcement Learning)

0.3 Types of Machine Learning

Supervised Learning

Hands-On Machine Learning

In supervised learning, the training set you feed to the algorithm includes the desired solutions, called labels. (e.g determining if an email is spam would be trained a dataset of example emails labelled as spam or not spam.)

Some commonly used supervised learning algorithms are:

- k-Nearest Neighbors
- Linear Regression
- Logistic Regression
- Support Vector Machines (SVMs)
- Decision Trees and Random Forests
- Neural Networks

Unsupervised Learning

Hands-On Machine Learning

In unsupervised learning, the training data is unlabeled and the system tries to learn without guidance. The system will try and automatically draw inferences and conclusions

about the data and group it as such. (e.g. having a lot of data about blog visitors. Using a clustering algorithm we can group and detect similar visitors).

Some important unsupervised learning algorithms are:

- Clustering
 - K-Means
 - DBSCAN
 - Hierarchical Cluster Analysis
- Anomaly detection and novelty detection
 - One-class SVM
 - Isolation Forest
- Visualization and dimensionality reduction
 - Principal Component Analysis (PCA)
 - Kernel PCA
 - Locally Linear Embedding (LLE)
 - t-Distributed Stochastic Neighbor Embeedding (t-SNE)
- Association rule learning
 - Apriori
 - Eclat

Semisupervised Learning

Hands-On Machine Learning

Labelling can be very time-consuming and costly, often there will be plenty of unlabelled and a few labelled instances. Algorithms that deal with data that is partially labeled is called semisupervised learning. A good example of this is Google Photos. Google clusters and groups your photos based on facial recognition (unsupervised) and then you can label one photo and it will be able to label every picture like that (supervised). Most semisupervised learning algorithms are combinations of unsupervised and supervised algorithms.

Reinforcement Learning

Hands-On Machine Learning

Reinforcement Learning is a learning algorithm based on a reward system. The learning system, called an agent, can observe the environment, select and perform actions, and get rewards in return (or penalites in the form of negative rewards). It will then learn by itself what the best strategy, called a policy, to get the most reward over time. A policy defines what action the agent should choose when it is in a given situation.

Sources

Throughout this compendium, each piece of information will be formatted as such.

Name / Description of fact	Source
Information about fact.	

The location which currently contains “Source” could potentially be filled with a variety of sources. Here is how to find the source based off the shortened form.

- **Hands-On Machine Learning** refers to Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, 2nd Edition by Aurélien Géron

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