Machine Learning (SS2025)


Source: DALL.E

Kawther Aboalam

Common Terms And Machine Learning

+ Artificial intelligence is the ability of a machine to perform cognitive functions that we associate with the human mind. (understand-think-act-adapt)

+ Machine learning uses statistical techniques to give computers the ability to learn from data without being explicitly programmed.

+ Deep learning refers to artificial neural networks with at least two hidden layers. Neural networks, especially larger ones, can achieve higher performance levels compared to traditional AI methods.

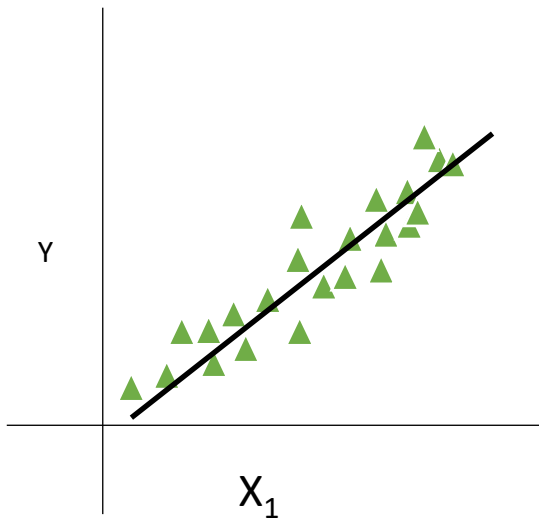+ Generative AI models are built to create new, human-like content mirroring existing data.
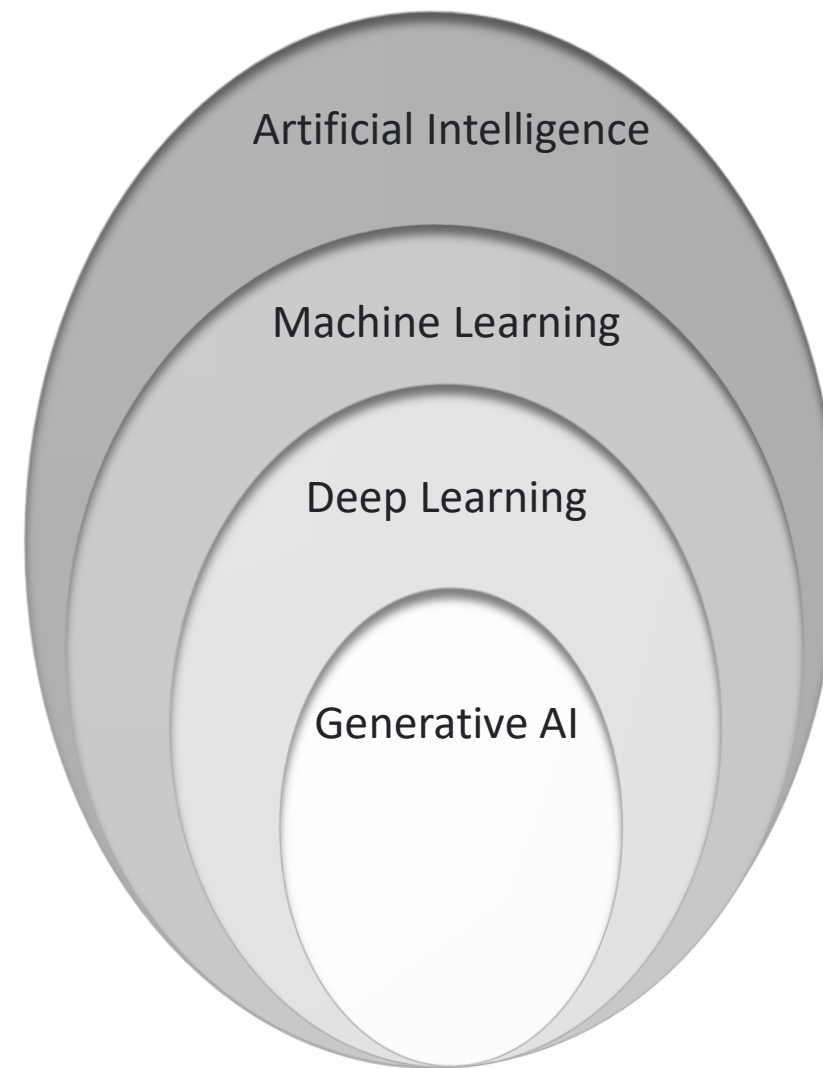
Artificial Intelligence

Machine Learning

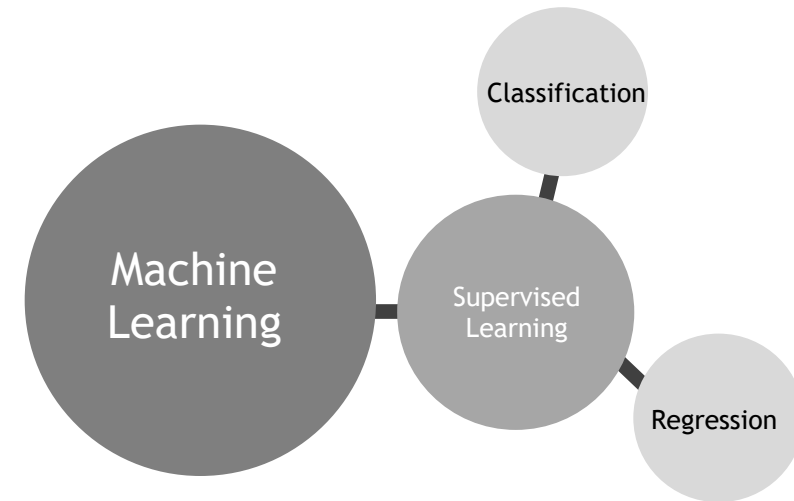Deep Learning

Generative AI

Machine Learning Paradigms

+ Supervised Learning: Training models on a dataset that provides both inputs and their corresponding correct outputs.
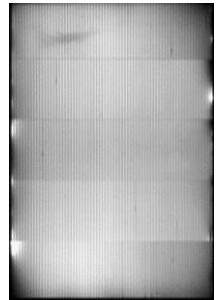
  – Classification
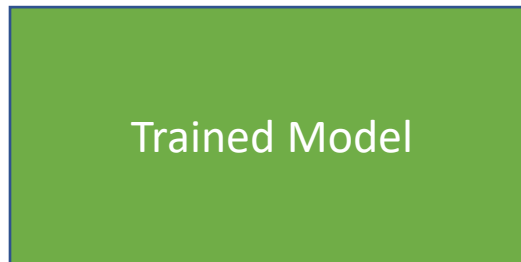
  – Regression
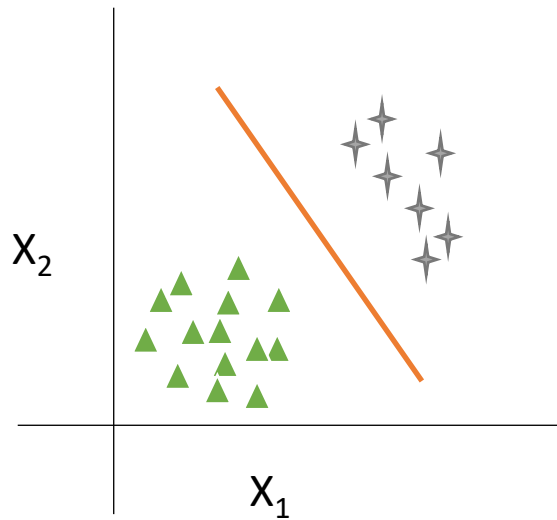
Classification

Regression

Supervised Learning - Solar Cells Classification
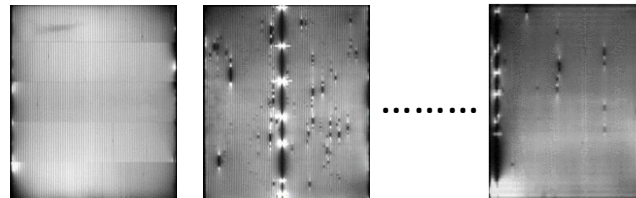
„input" variables/features

X

Trained Model

„output" variables/ „targt" variable

y

Ok / Defective

$(x^{(1)},y^{(1)})$, $(x^{(2)},y^{(2)})$, ……….. $(x^{(m)},y^{(m)})$

Training examples

Machine Learning Paradigms

+ Supervised Learning: Training models on a dataset that provides both inputs and their corresponding correct outputs.

    − Regression

    − Classification

+ Unsupervised Learning: The algorithm independently identifies patterns and insights in unlabeled data.

    − Clustering

    − Dimension Reduction
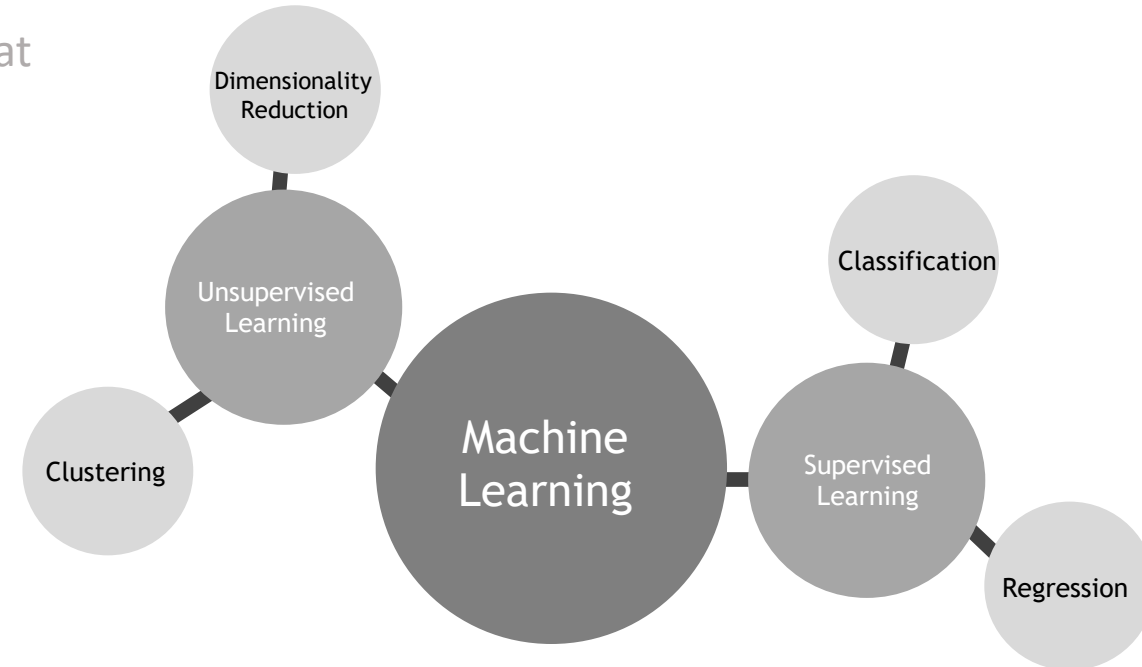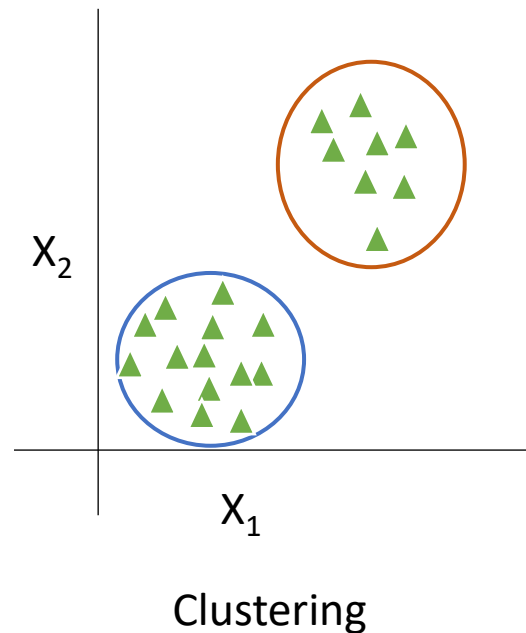
Clustering

Unsupervised Learning - Condition Monitoring

**Unlableled
Monitoring Data**

Clustering Algorithm

Results

Quelle: Wikipedia: (2021) Gasturbine GTD-4/6.3/10RM

DBSCAN

Cluster 1

Cluster 2

Outlier

DBSCAN - Density-Based Spatial
Clustering of Applications with Noise
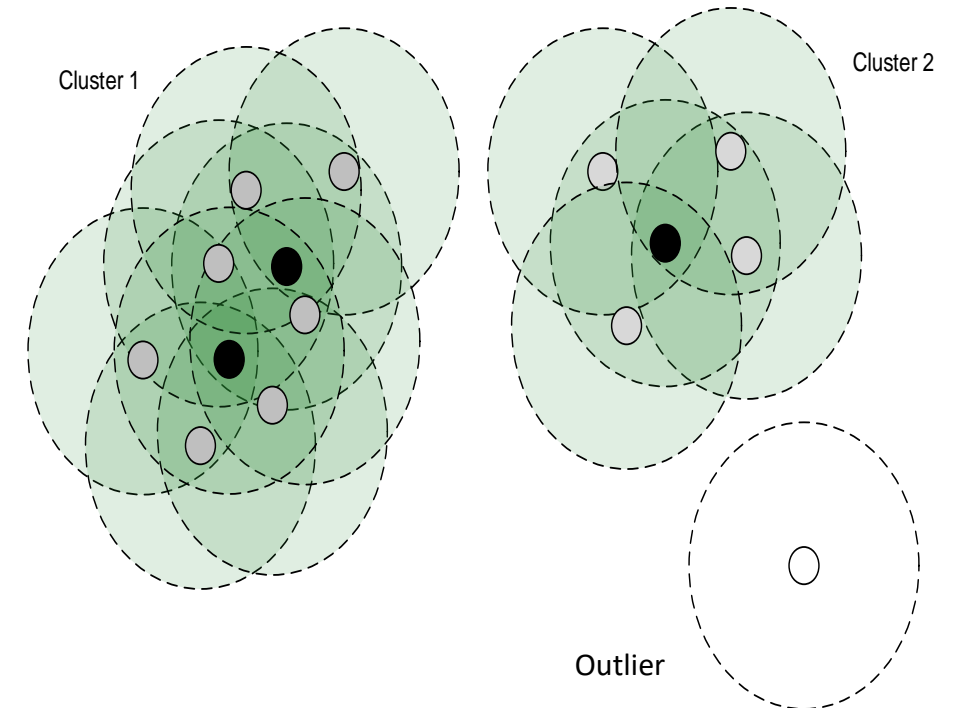
Machine Learning Paradigms

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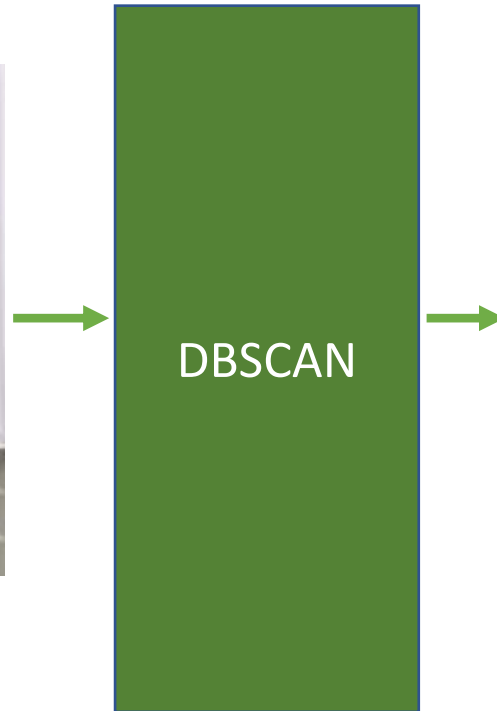+ Self-Supervised Learning: Models learn from unlabeled data by predicting parts of the input data itself, without external labels.

Self-Supervised Learning: Autoencoders for ECG Anomalies Detection

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+ Self-Supervised Learning: Models learn from unlabeled data by predicting parts of the input data itself, without external labels.

+ Semi-Supervised Learning: when only part of the given input data has been labeled.

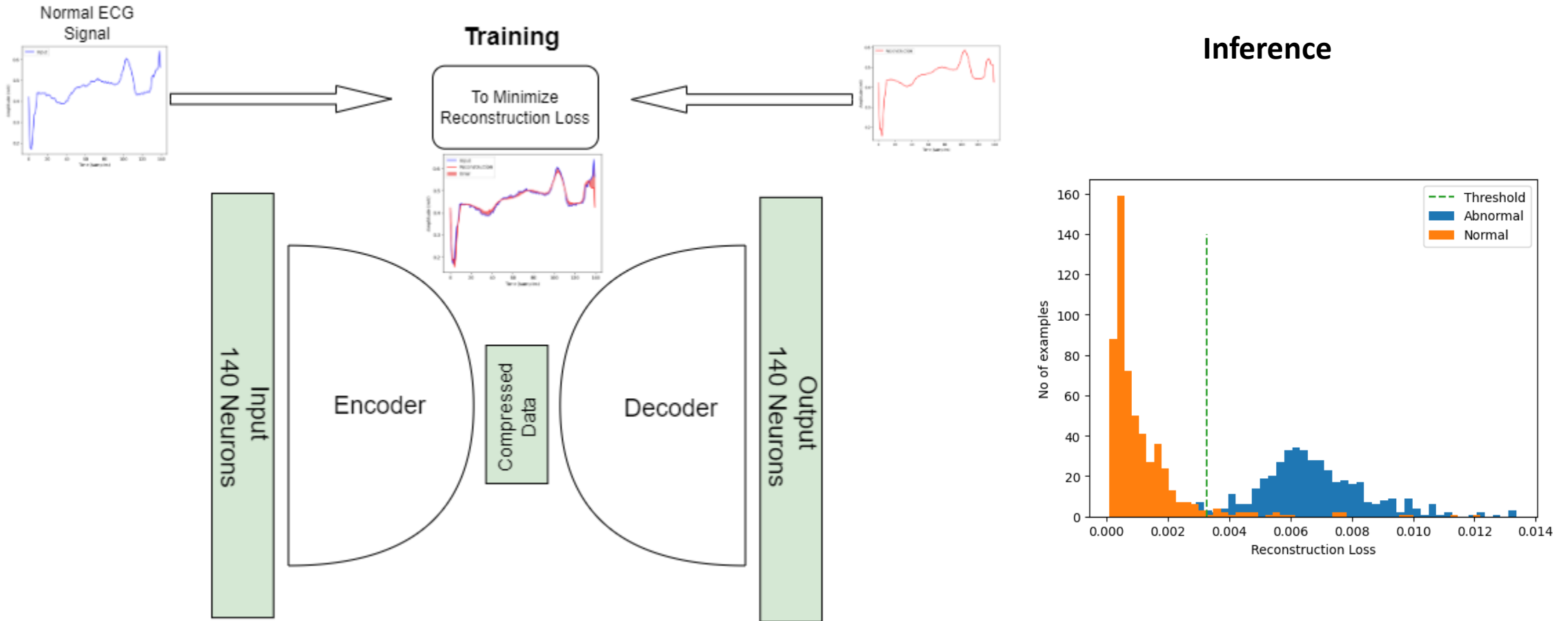+ Reinforcement Learning: agents learning by themselves how to behave in their environments.
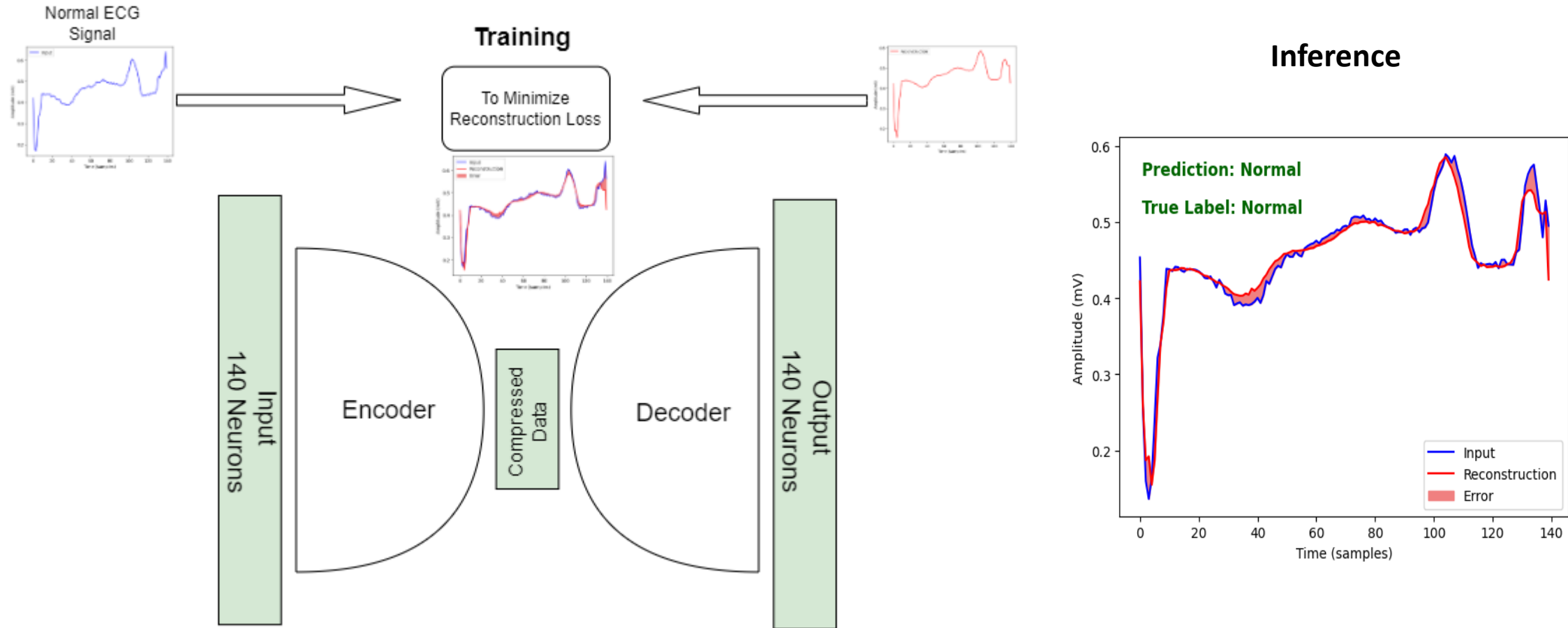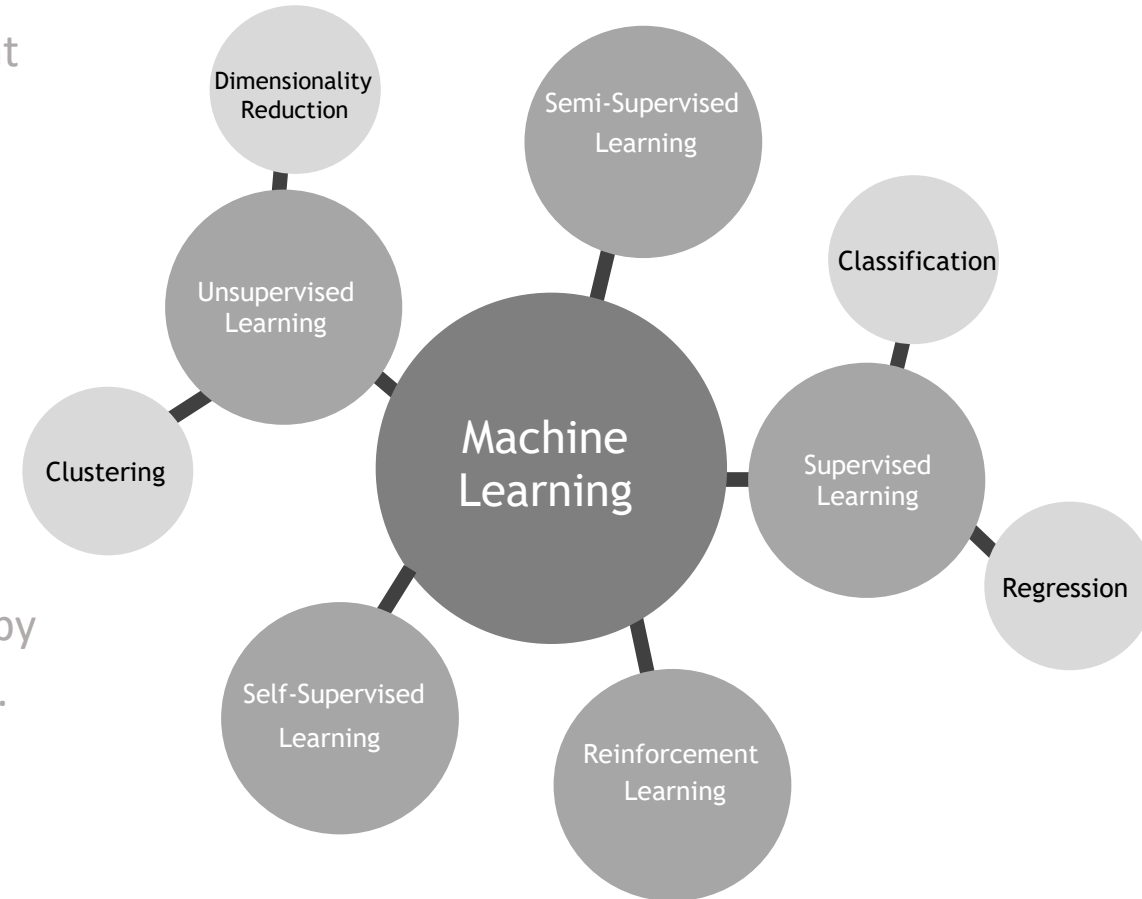
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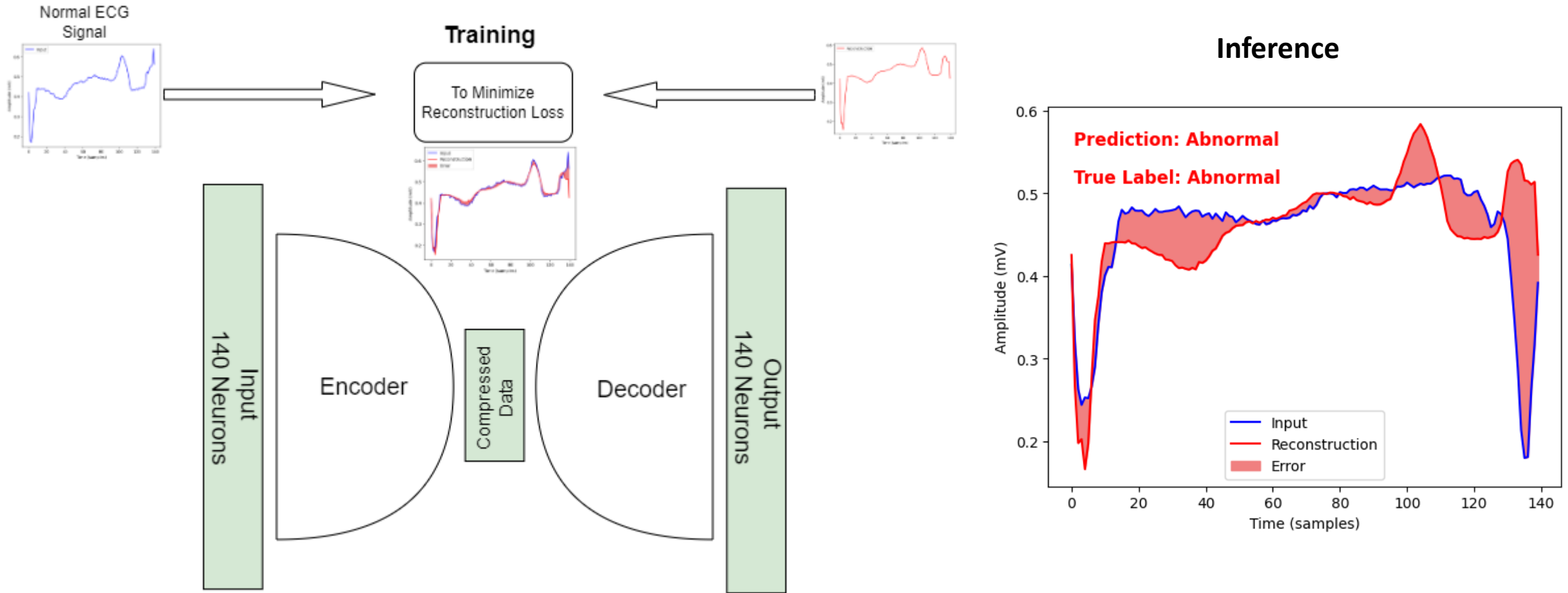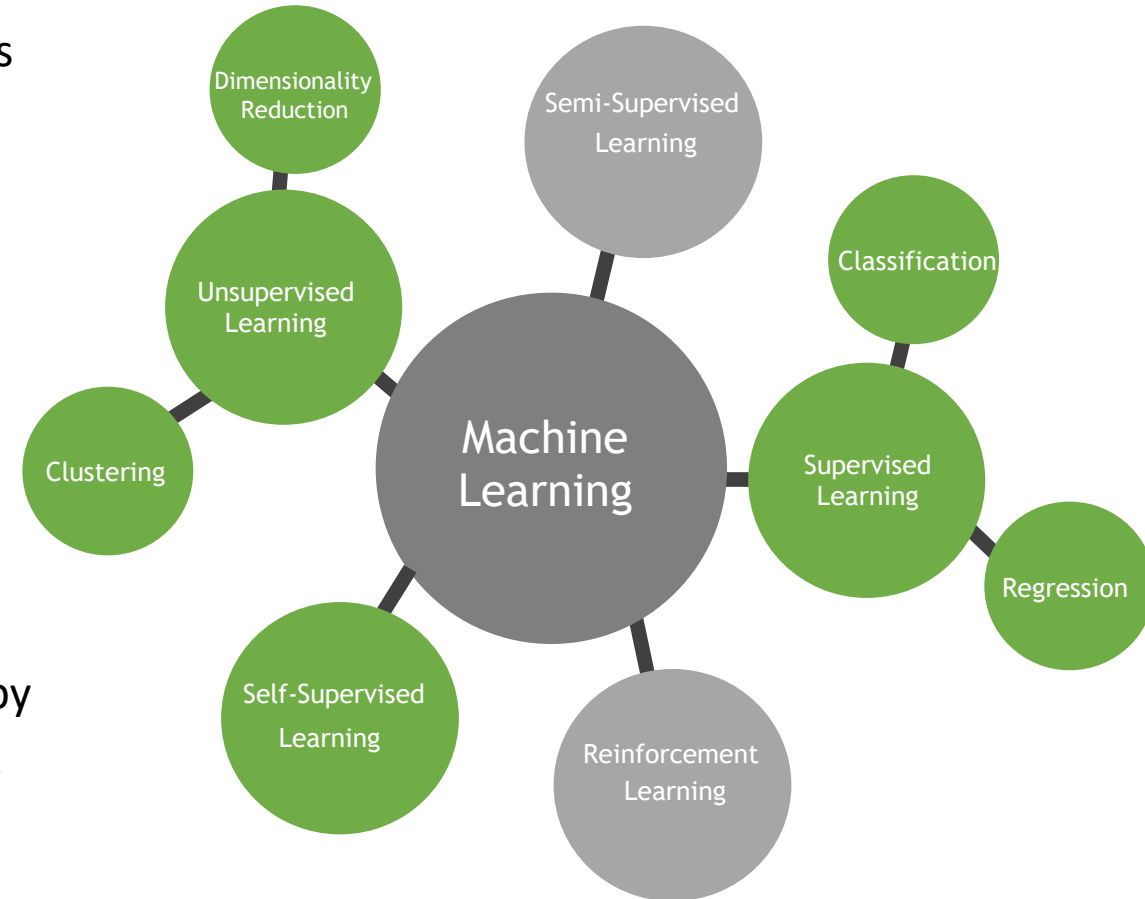
Course Topics

+ Data

Nr.	Date	To-do list
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2	27.03.2025	Data Preparation and Feature Engineering, Regression_1
3	03.04.2025	Regression_2
4	10.04.2025	Model Selection and Cross-Validation
5	17.04.2025	Principal Component Analysis
6	24.04.2025	Classification_1
7	01.05.2025	Workers' Day
8	08.05.2025	Classification_2
9	15.05.2025	Neural Networks_1
10	22.05.2025	Neural Networks_2
11	29.05.2025	Holiday
12	05.06.2025	Autoencoders/Variational Autoencoder
13	12.06.2025	Lecture-free days
14	19.06.2025	Holiday
15	26.06.2025	k-means/ DBSCAN Clustering
16	03.07.2025	Wrap-up Meeting

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+ **Self-Supervised Learning**

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Course Assessment

+ A 3-hour written exam (100% of the final grade)

  – The exam consists of **two tasks:**

    Task 1: 30 multiple-choice questions (**MCQS**) in **20 minutes** (**30%**)

    Task 2: A programming task with **3 subtasks** in **160 minutes** (**70%**)

+ Plus up to **15 bonus points** can be earned through lab assignments.

Bonus Points Table

Bonus Points	A1	A2	A3	A4	A5	A6	Total
Maximum score	0	3	3	3	3	3	15

Material

+ Slides of the lecture (on ILIAS)

+ The following books are used to prepare for the lecture
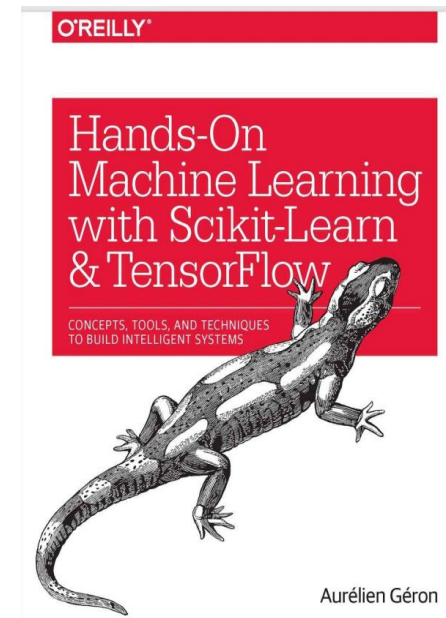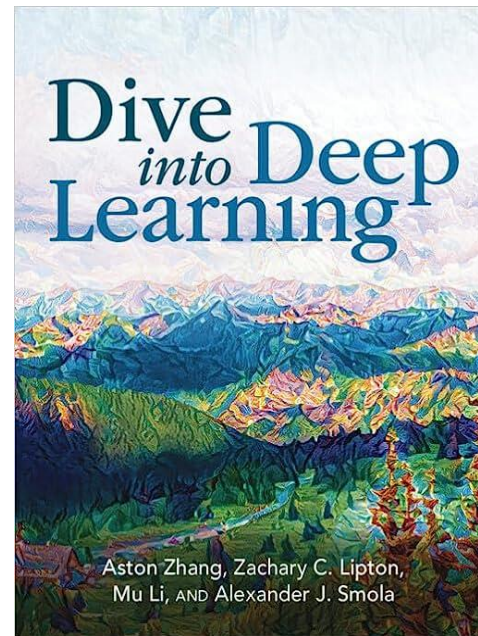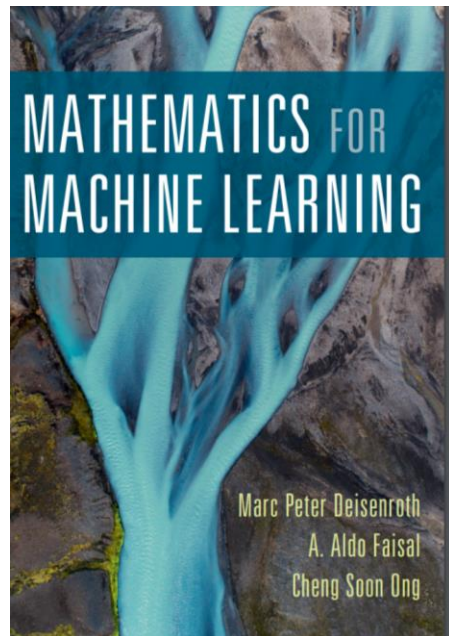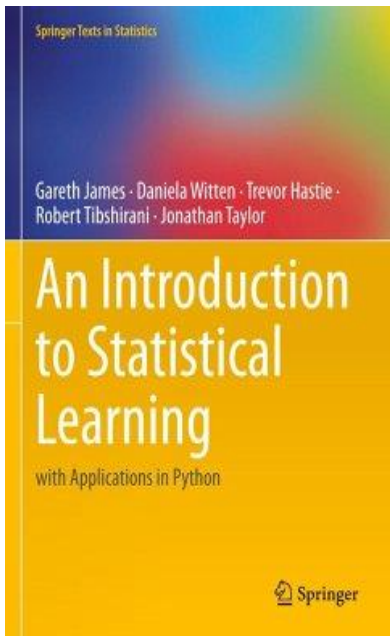
+ Stanford University Course: CS231n: Deep Learning for Computer Vision

www.h-ka.de

Manfred Strohrmann