MASCHINELLES LERNEN AM BEISPIEL EINER ÜBERSTEUER-ERKENNUNG.

SUPERVISED MACHINE LEARNING MIT MATLAB.

BMW GROUP

Rolls-Royce
Motor Cars Limited

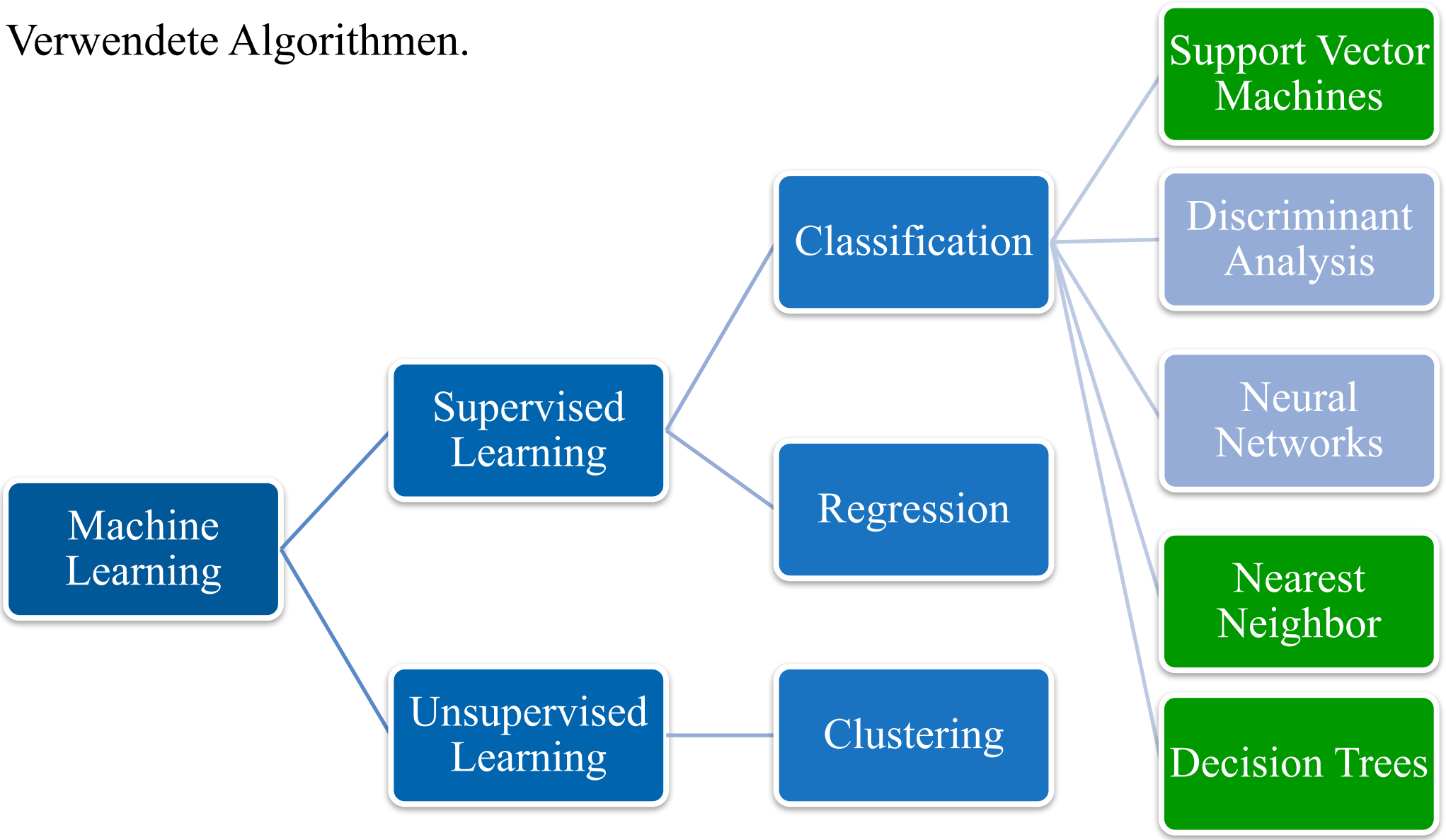
MOTIVATION.

Evaluierung der „Statistics and Machine Learning“ Toolbox von MATLAB

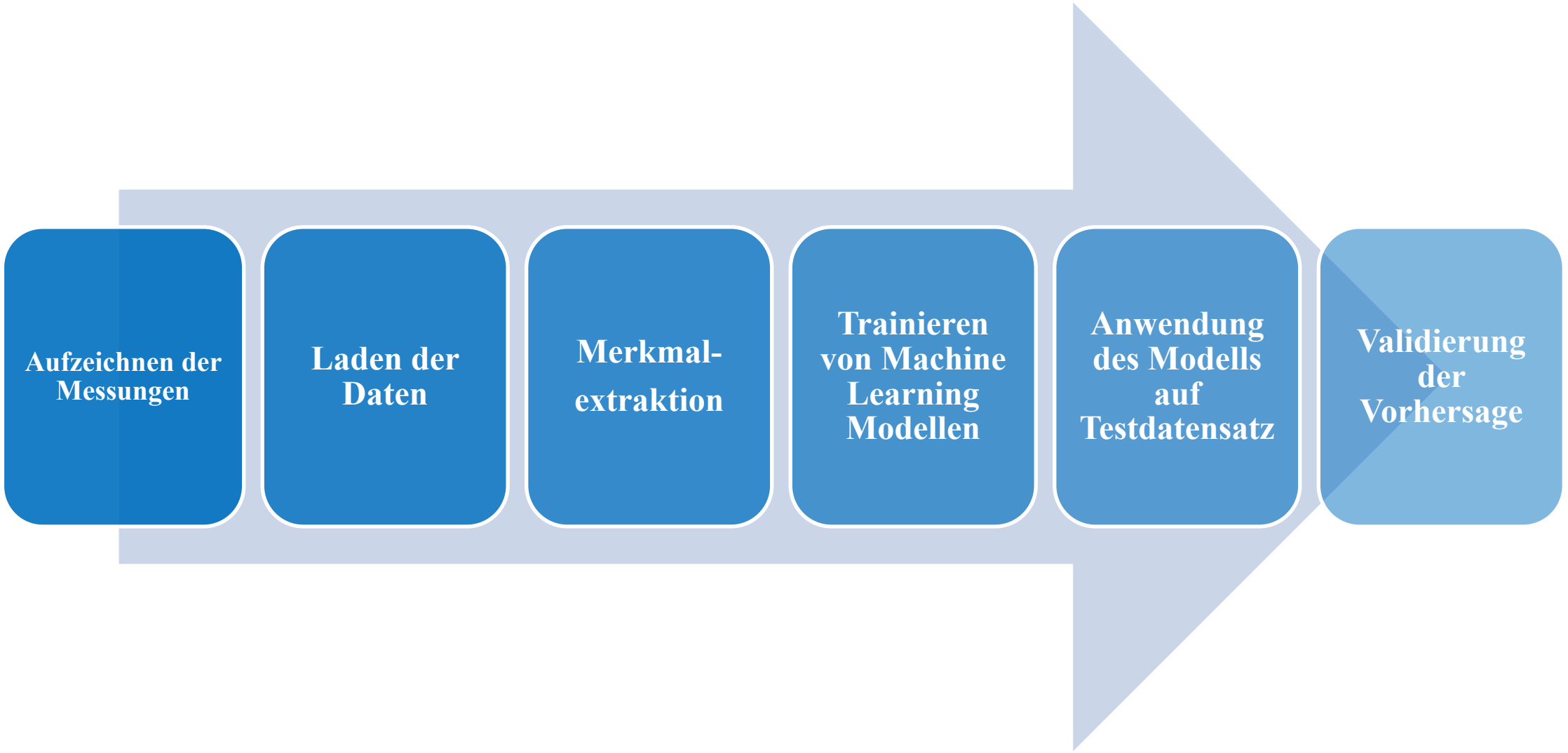
Große Anzahl an aufgezeichneten Fahrzeugmessungen (unlabeled) verfügbar

MACHINE LEARNING.

Verwendete Algorithmen.

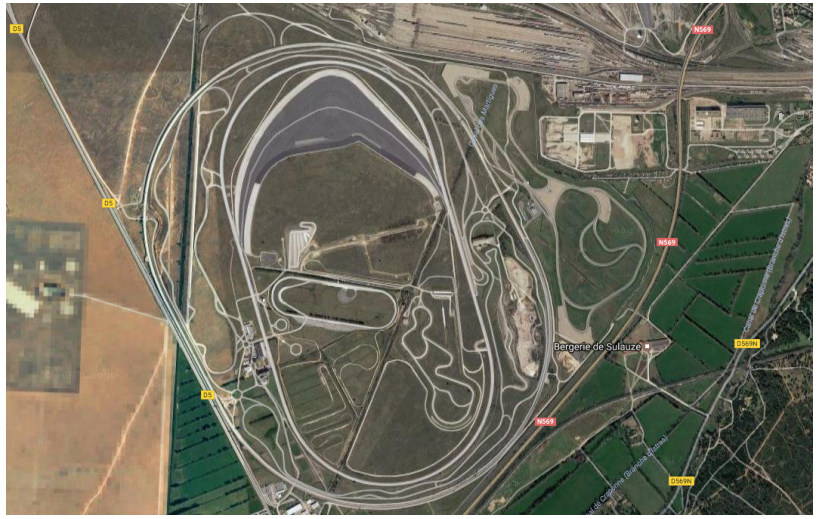


ABLAUF.


Aufzeichnen der Messungen
Laden der Daten
Merkmal-extraktion
Trainieren von Machine Learning Modellen
Anwendung des Modells auf Testdatensatz
Validierung der Vorhersage

GENERIERUNG DER MESSDATEN. STRECKE

Trainieren eines Modells



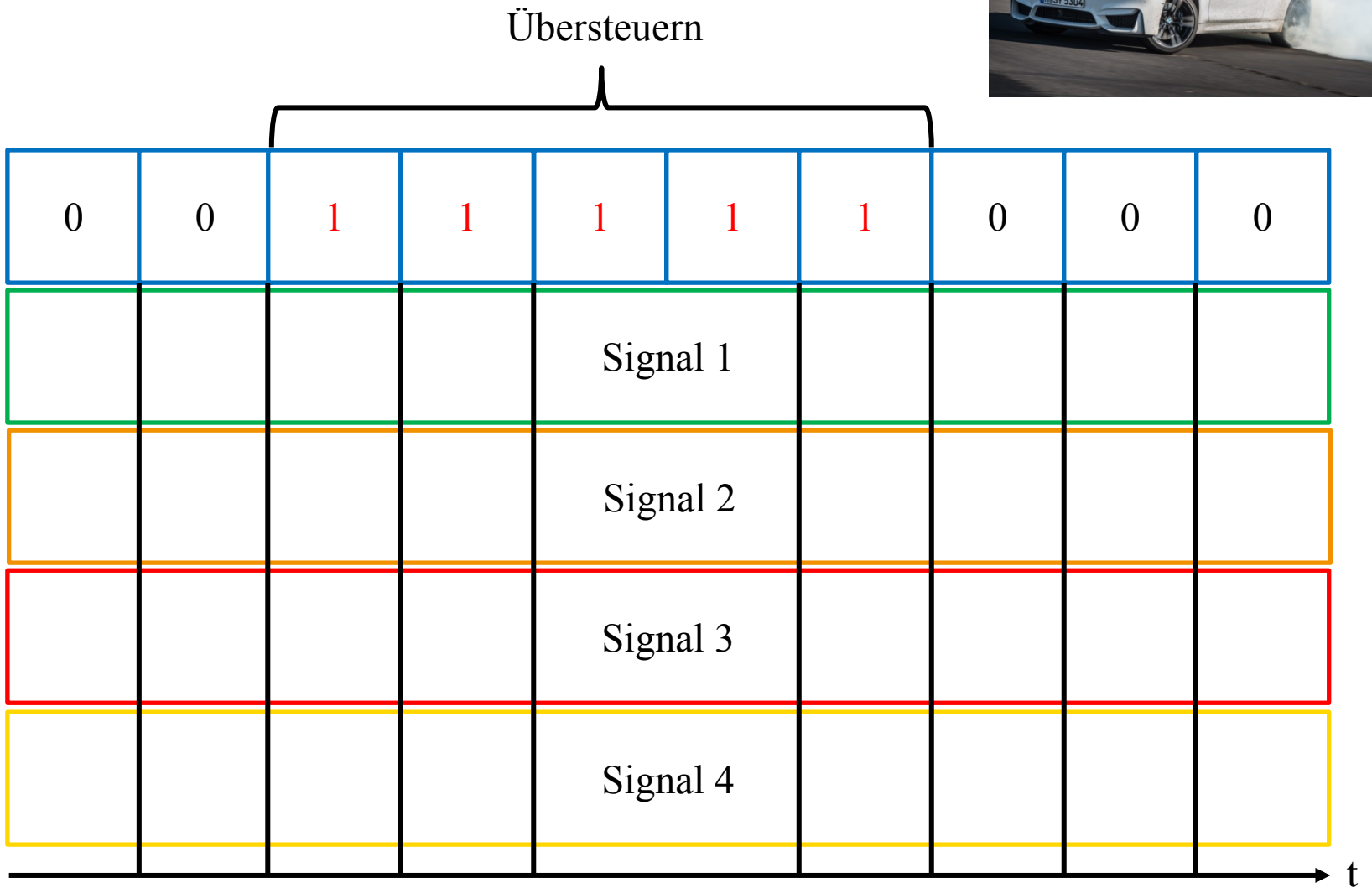
Trainingsdatenset:
- Handlingskurs Miramas
- 259.000 Datenpunkte
≙ 43 Minuten

Testen des erstellten Modells

Testdatenset:
- Handlingskurs Aschheim
- 150.000 Datenpunkte
≙ 25 Minuten

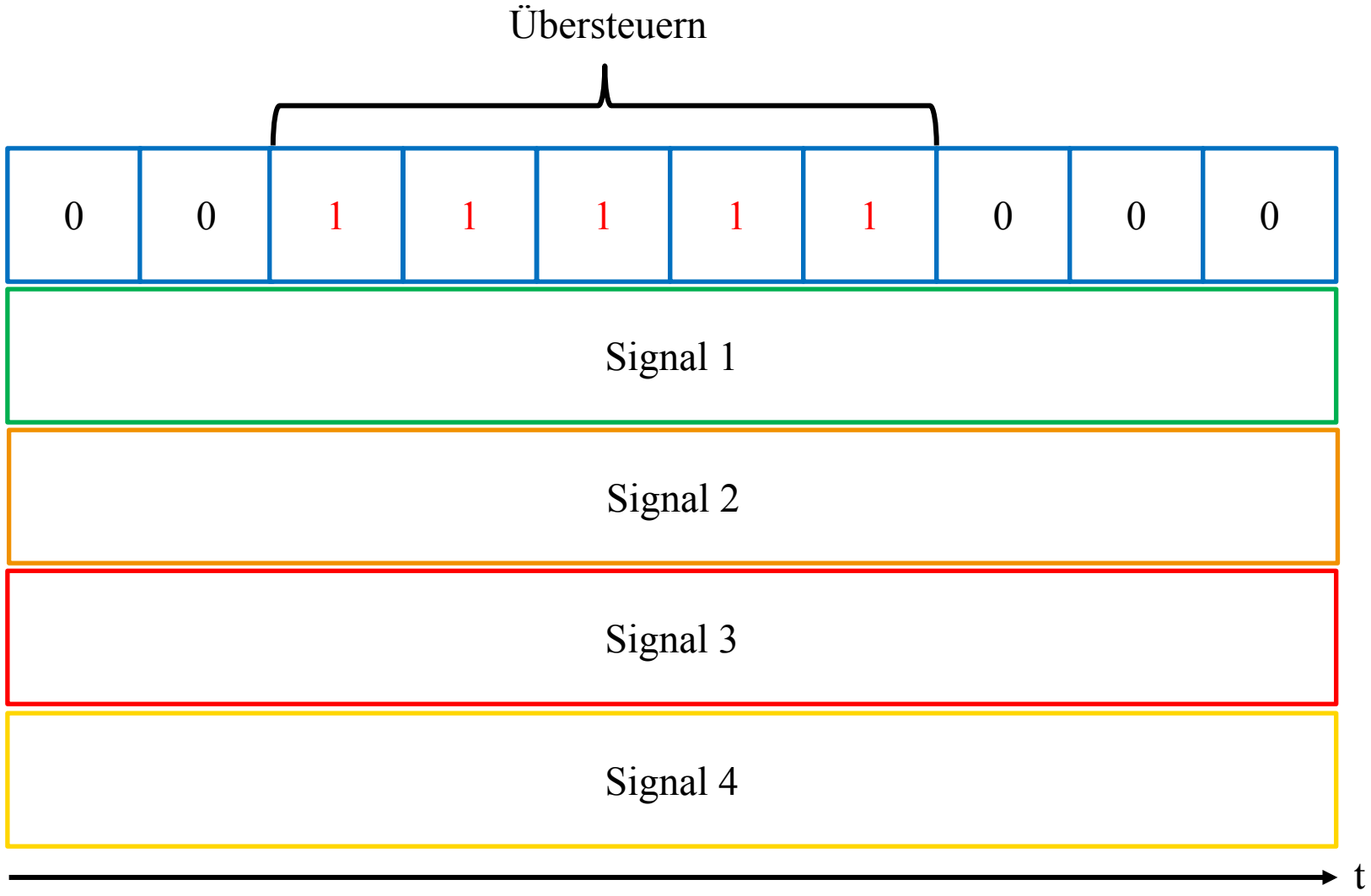
GENERIERUNG DER MESSDATEN.

Einfügen eines Trigger-Signals.



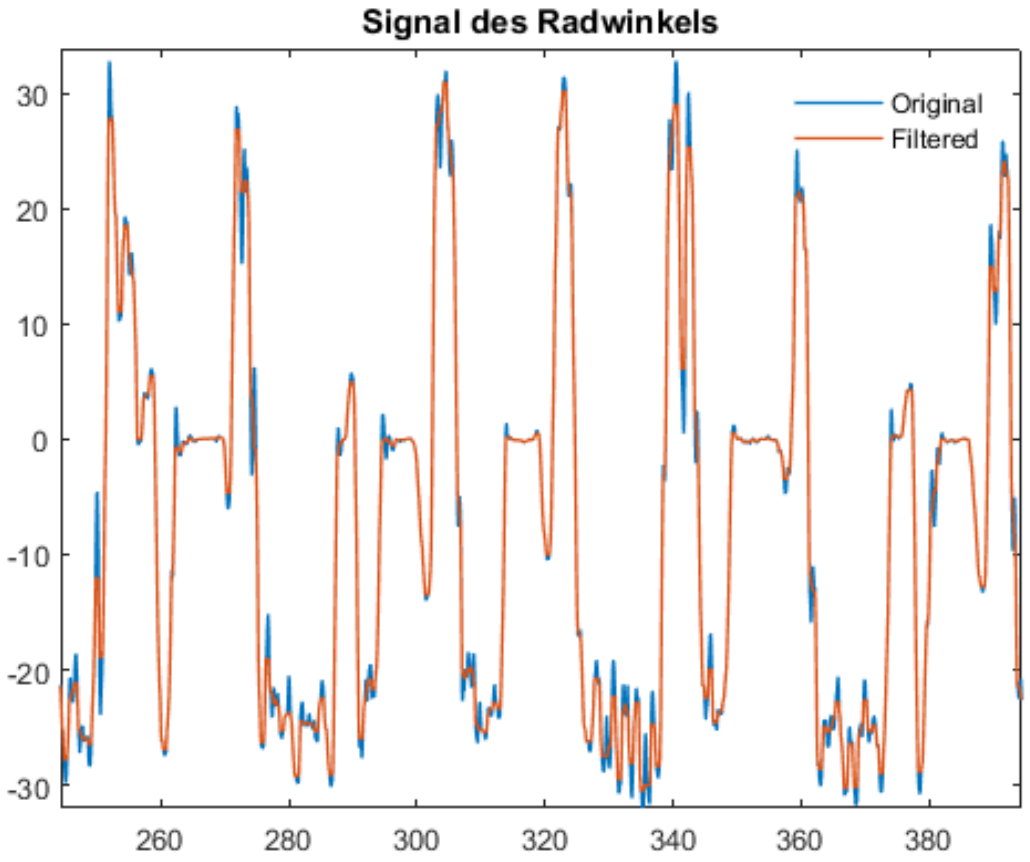
GENERIERUNG DER MESSDATEN.

Einfügen eines Trigger-Signals.



MERKMALEXTRAKTION.

Filter.

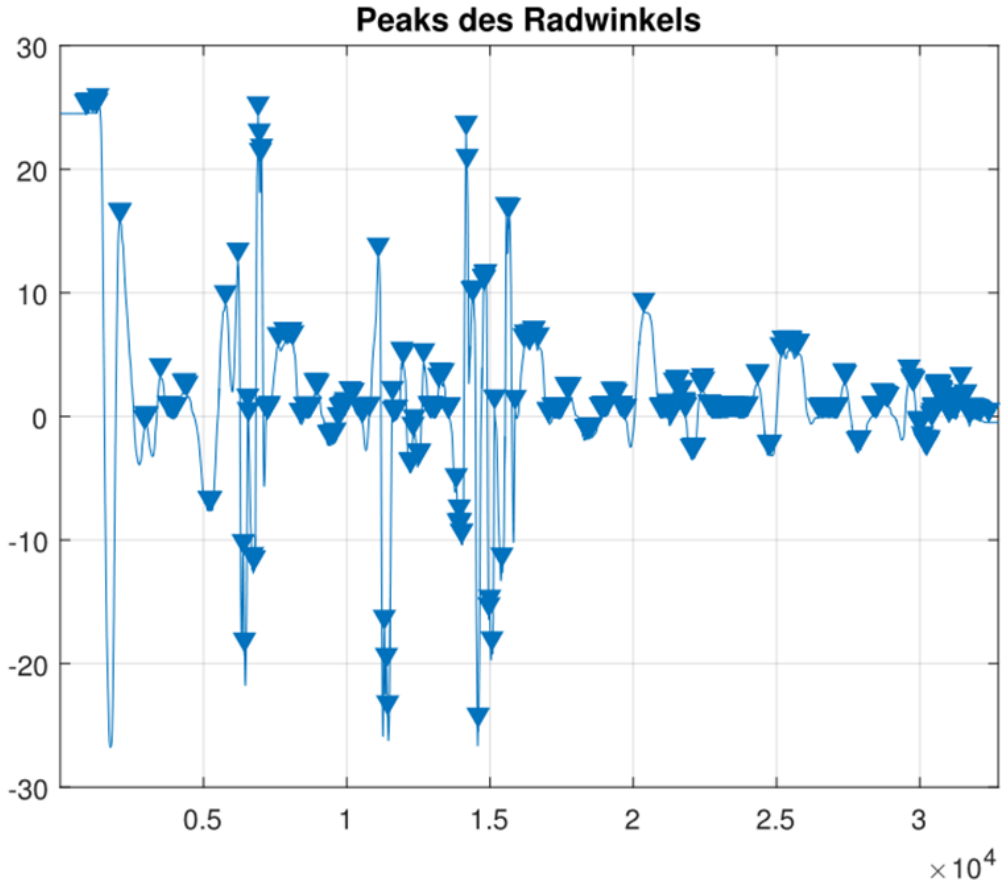


Rauschen des Signals unterdrücken

Trainings- und Testdatenset müssen
mit dem gleichen Filter gefiltert werden

MERKMALEXTRAKTION.

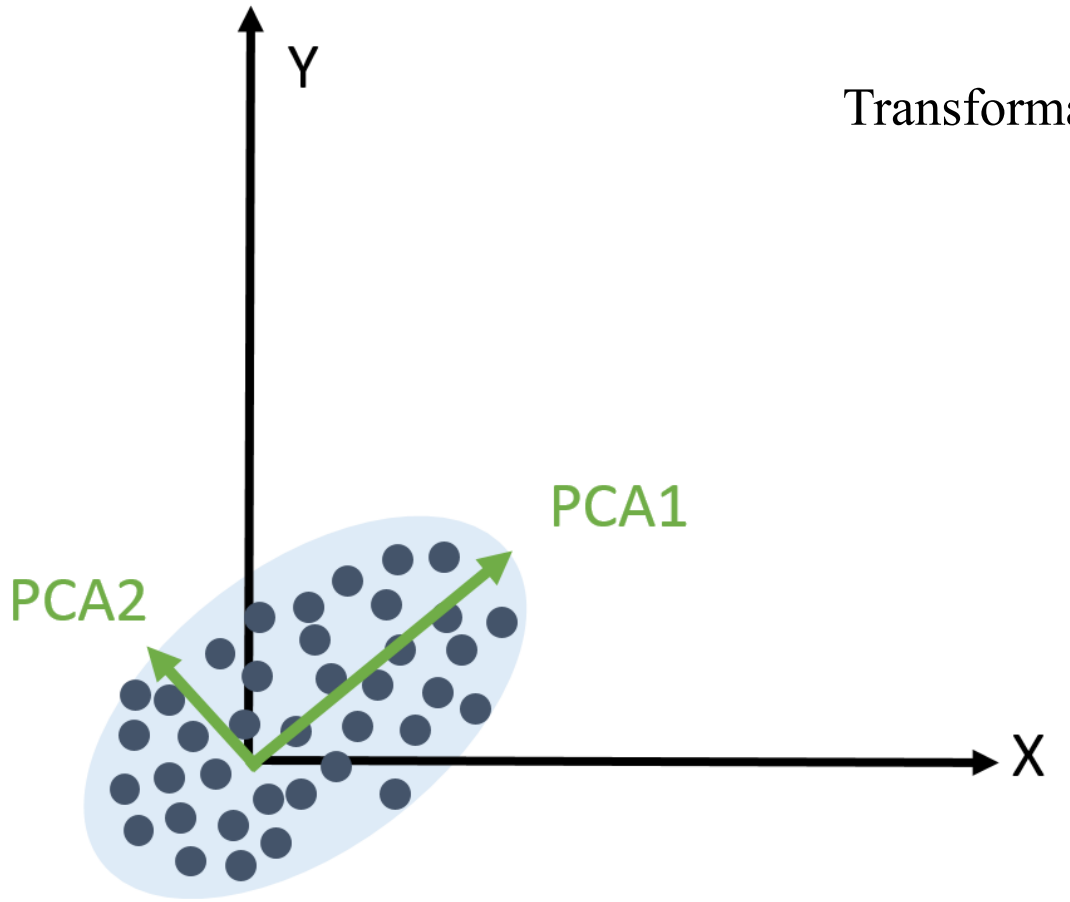
Peak Analysis.



- Anwendung der Funktion FindPeaks
- Mindestdistanz zwischen den Peaks

MERKMALEXTRAKTION.

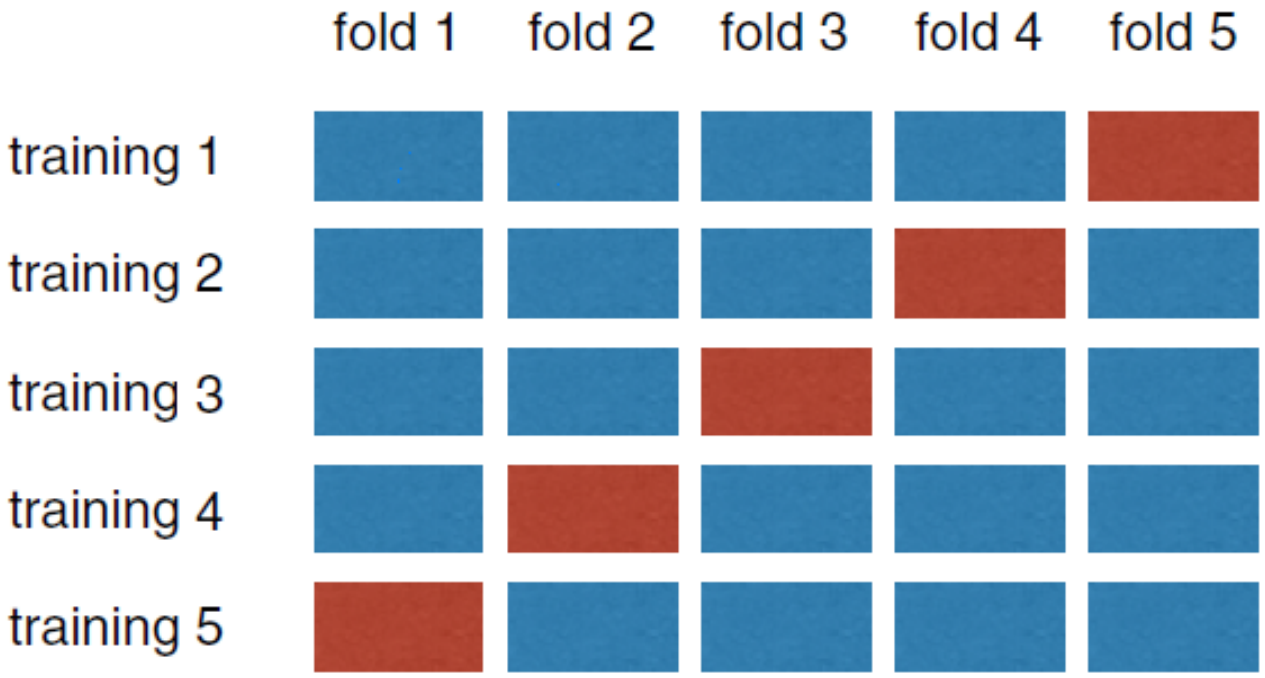
Principal Component Analysis (PCA).



Transformation in der Richtungen der Principal Components

MODELLAUSWAHL.

K-Fold Crossvalidierung.



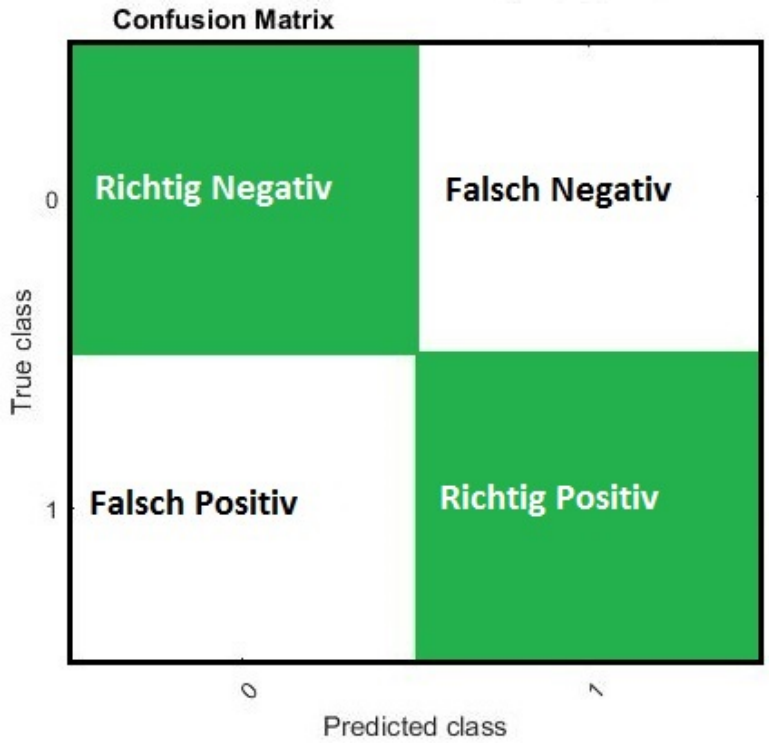
Blau = Trainingsdatenset
Rot = Testdatenset

Ergebnis:
Durchschnittlicher Fehler

Quelle: Machine Learning for Evolution Strategies, Kramer, 2016, S.39

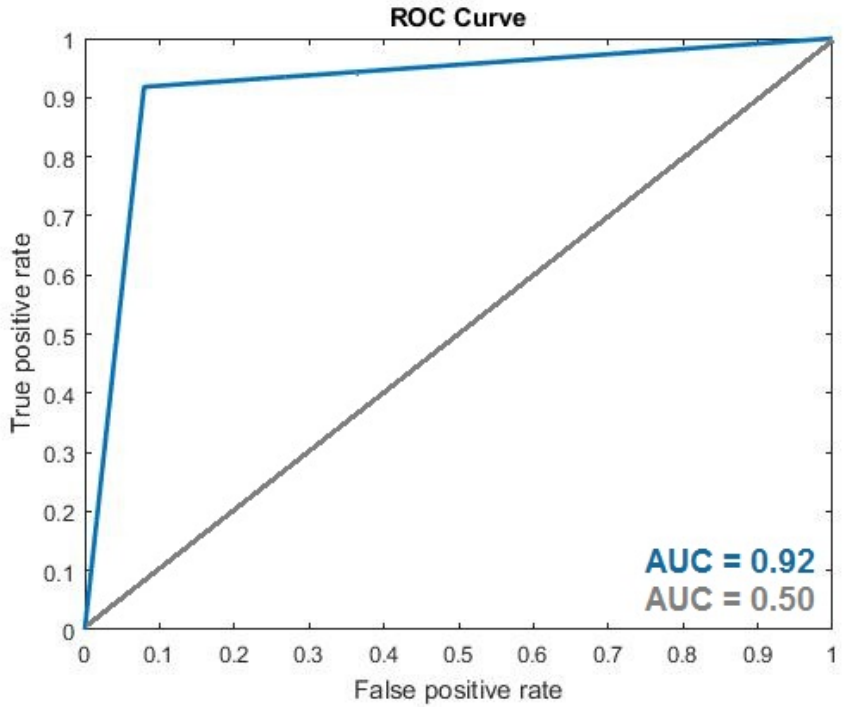
MODELLAUSWAHL.

Konfusionsmatrix.



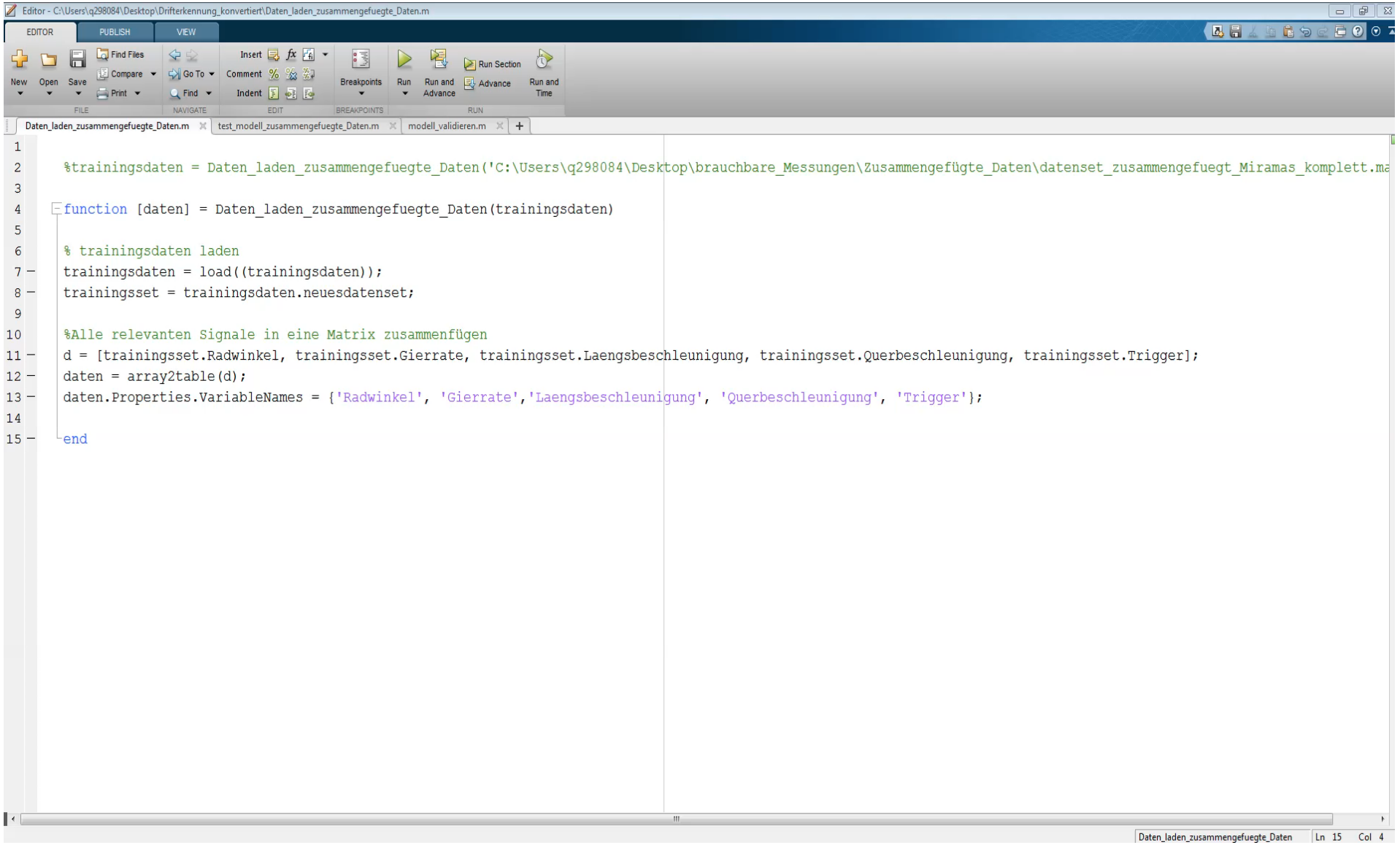
Ziel:
100 % auf der grünen Diagonale

Receiver-Operating-Characteristic-Kurve.



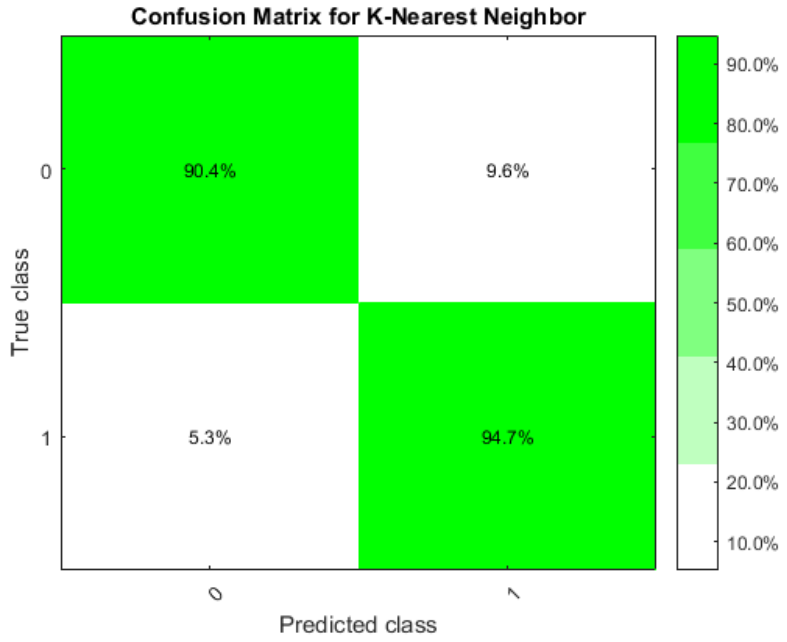
Ziel:
AUC = 1

VIDEO: VORGEHENSWEISE.



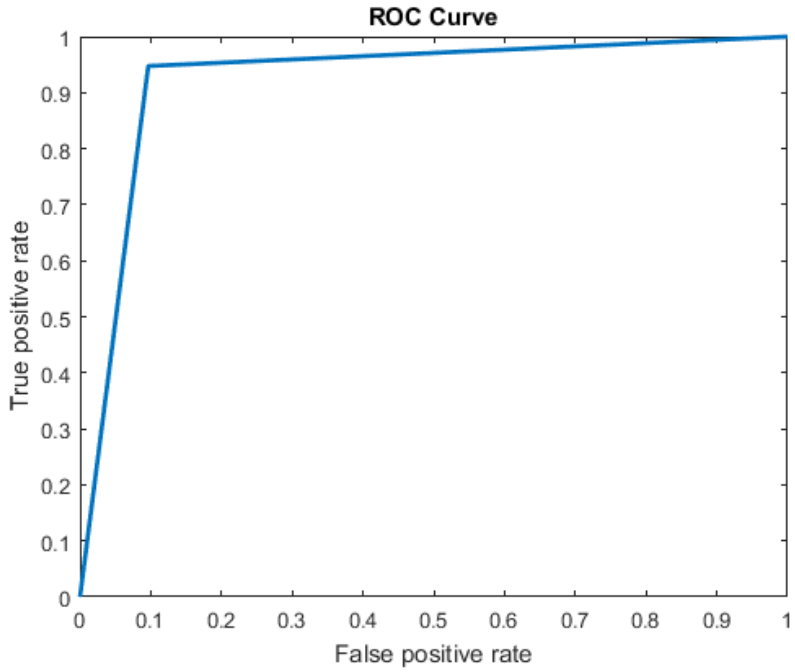
ERGEBNISSE.

Konfusionsmatrix: K-Nearest Neighbor & PCA Feature Extraktion



Performance of model :

	Predicted 0	Predicted 1
Actual 0	90.35% (82943)	9.65% (8856)
Actual 1	5.26% (3162)	94.74% (57004)



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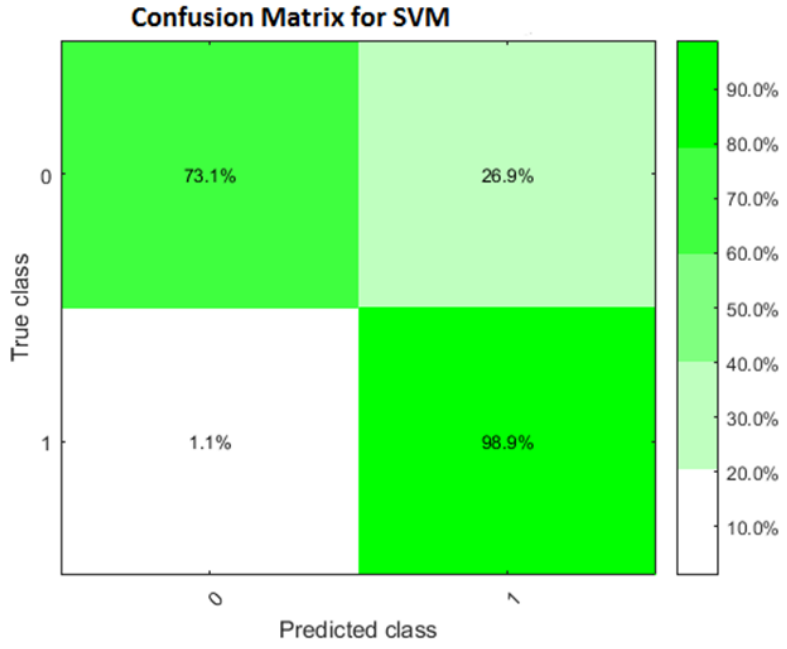
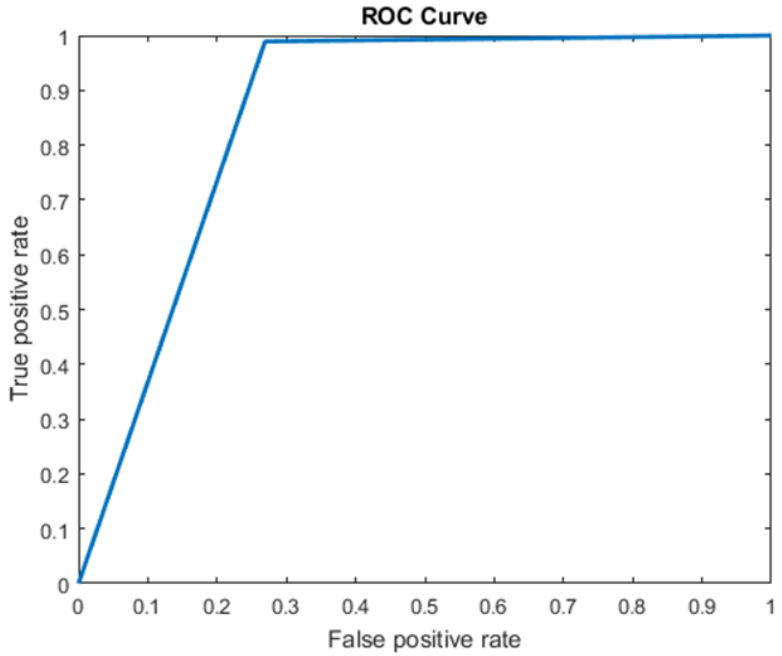
Konfusionsmatrix: Support Vector Machine



Performance of model :

	Predicted 0	Predicted 1
Actual 0	73.07% (67078)	26.93% (24721)
Actual 1	1.08% (650)	98.92% (59516)



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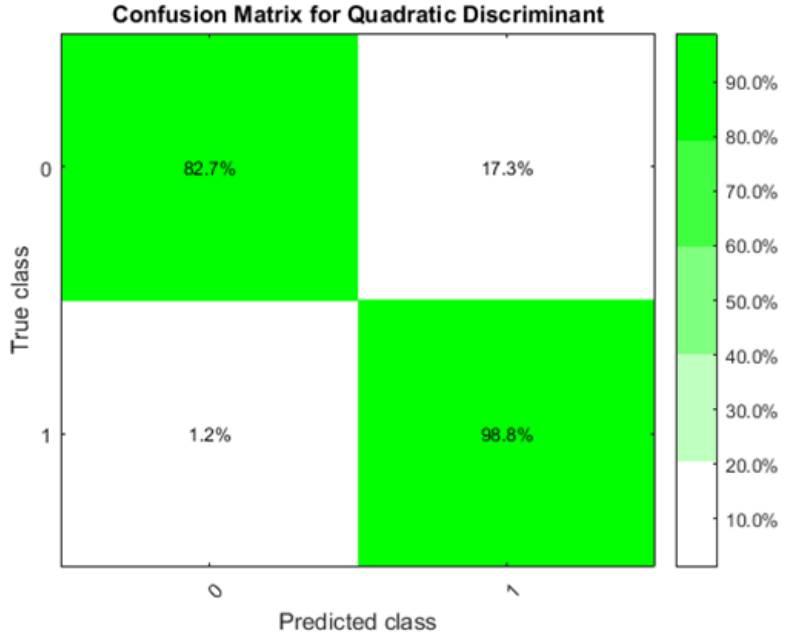
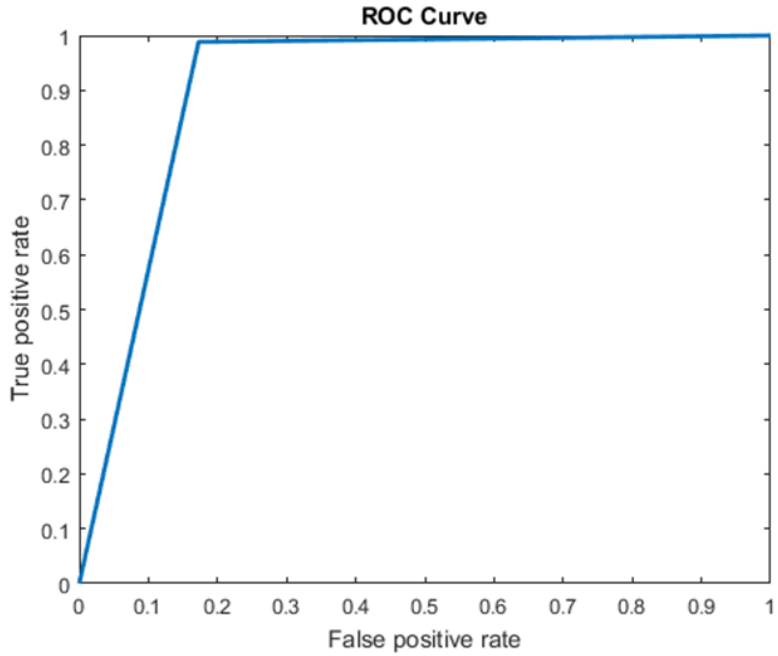
Konfusionsmatrix: Quadratic Discriminant analysis model



Performance of model :

	Predicted 0	Predicted 1
Actual 0	82.73% (75946)	17.27% (15853)
Actual 1	1.17% (701)	98.83% (59465)



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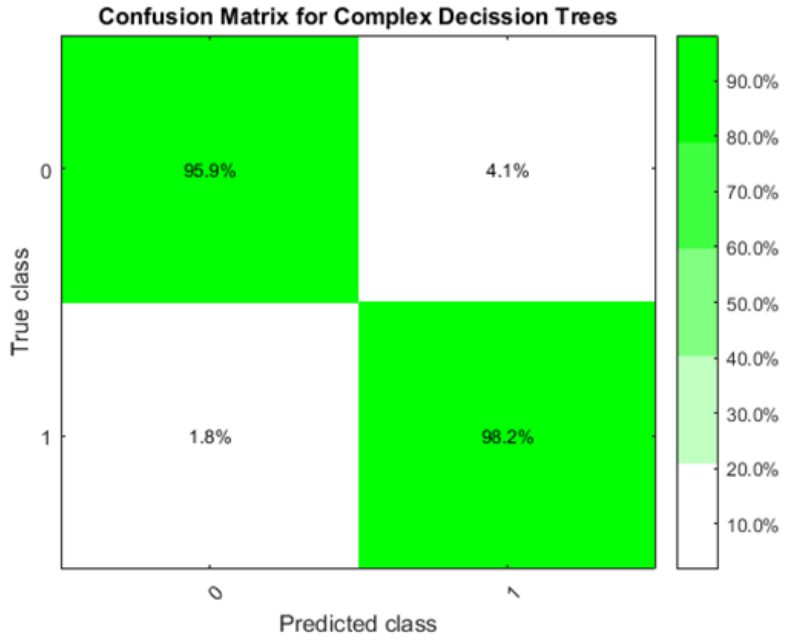
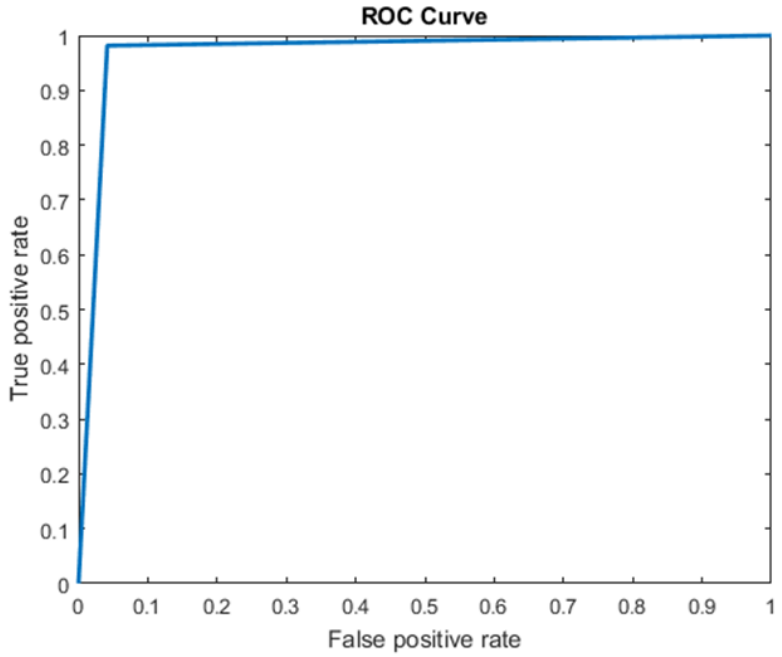
Konfusionsmatrix: Complex Decision Trees



Performance of model :

	Predicted 0	Predicted 1
Actual 0	95.86% (87996)	4.14% (3803)
Actual 1	1.84% (1109)	98.16% (59057)



HERAUSFORDERUNGEN.

Lernvorgang muss immer wieder vom Anfang der Messungen vollzogen werden,

kein „Deltalernen“

Suche nach dem besten „Machine Learning“ Algorithmus

Sicherheitskritische Software erfordert hohe Zuverlässigkeit