Frischer Wind für ein bekanntes Thema – Klassifikation 4.0

AK Fernerkundung
Heidelberg, 4.-5.10.2018

Ruth Leska, GEOSYSTEMS GmbH

GEOSYSTEMS
THE GEOSPATIAL EXPERTS

HEXAGON
GEOSPATIAL

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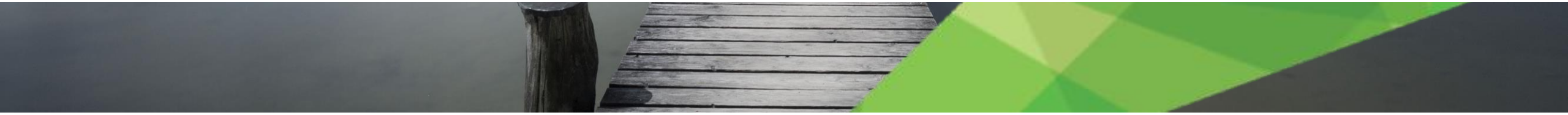
GEOSYSTEMS ist Ihr Partner für Geo-IT Lösungen und **Hexagon Geospatial Platinum Partner** mit herausragender Expertise in Geodatenmanagement, Smart M.Apps, GIS, Photogrammetrie und Fernerkundung.

Portfolio



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Hexagon Geospatial Portfolio

GEODATEN **AUSWERTEN UND VERTEILEN**

APPS **ERSTELLEN** & **VERKAUFEN**

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M.App Portfolio

A simpler way to see your world

M.App Portfolio® ist eine cloudbasierte Plattform, die es den Hexagon Geospatial Partnern ermöglicht, **Hexagon Smart M.Apps zu entwerfen**, **zu bauen** und **zu veröffentlichen**. Das M.App Portfolio untergliedert sich in die M.App Foundation, das M.App Studio und den M.App Exchange Marktplatz.

M.App Enterprise® ist eine On-Premise-Plattform, um für Ihre Organisation **geographische Apps zu erstellen**. M.App Enterprise speichert Ihre Bilddaten, Vektoren und Punktwolken, Ihre Workflows, Analysen und Abfragen, und all das ist über eine einfach zu bedienende Nutzeroberfläche zugänglich.

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GEOSYSTEMS Produkte

UAV-DATEN
Photogrammetrisch prozessieren

IMAGINE UAV

GeoApp.UAS

ATMOSPHÄRE
korrigieren & Dunst entfernen

ATCOR Workflow for IMAGINE

SENTINEL-DATEN
downloaden & prozessieren

Sentinel Made Simple

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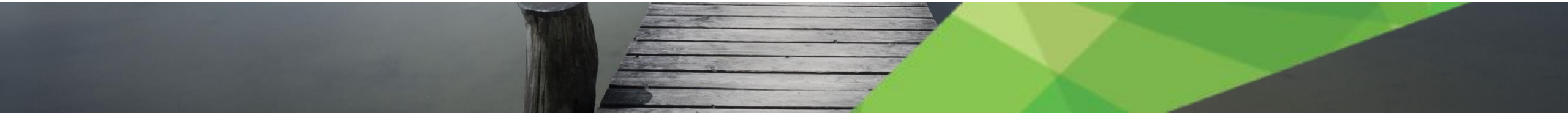
Give it to the machines and let them sort it out

Machine Learning und Deep Learning



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Ein großesThema der letzten Jahre

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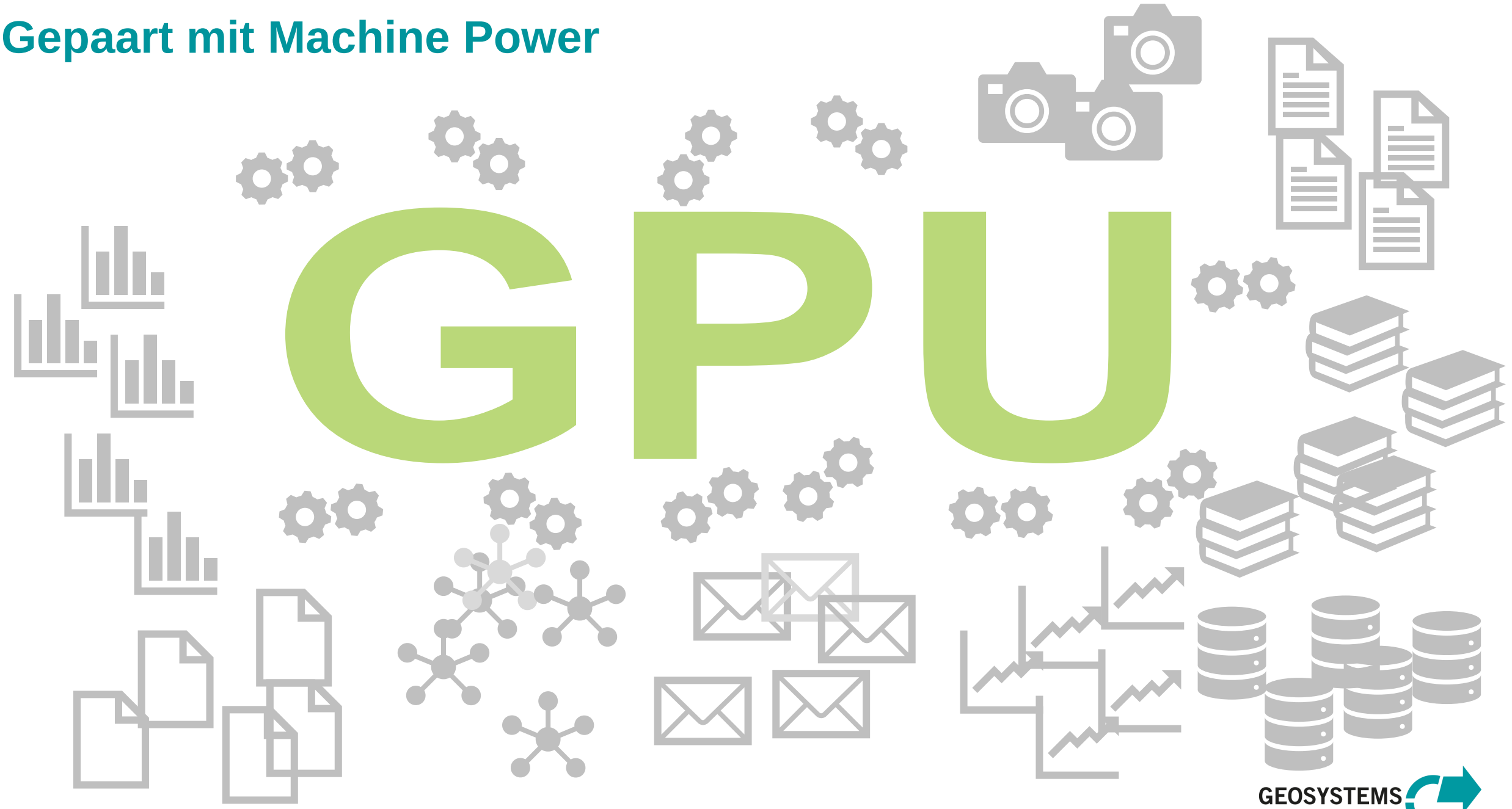
Gepaart mit Machine Power



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“Give it to the machines and let them sort it out”

MACHINE LEARNING

Machine Learning ist ein Ansatz, Daten anhand „unsichtbarer“ Muster zu erkennen – ohne zu wissen wie, wo und nach was zu suchen ist ….

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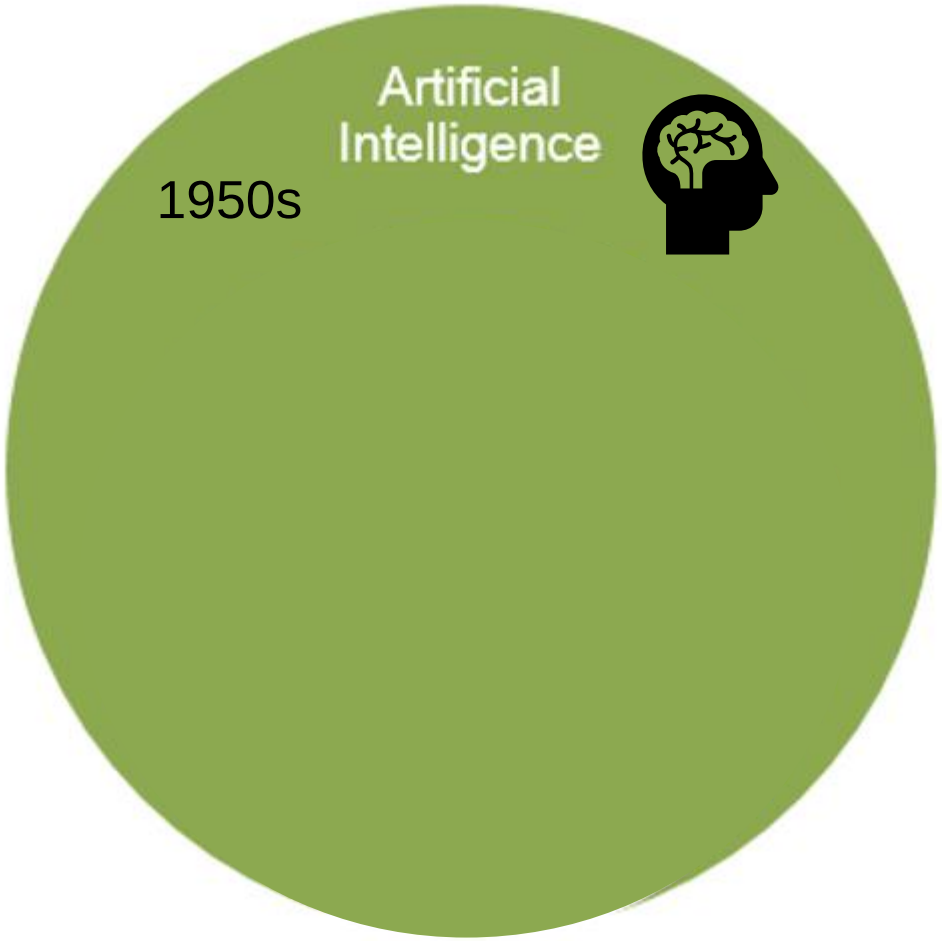
Künstliche Intelligenz



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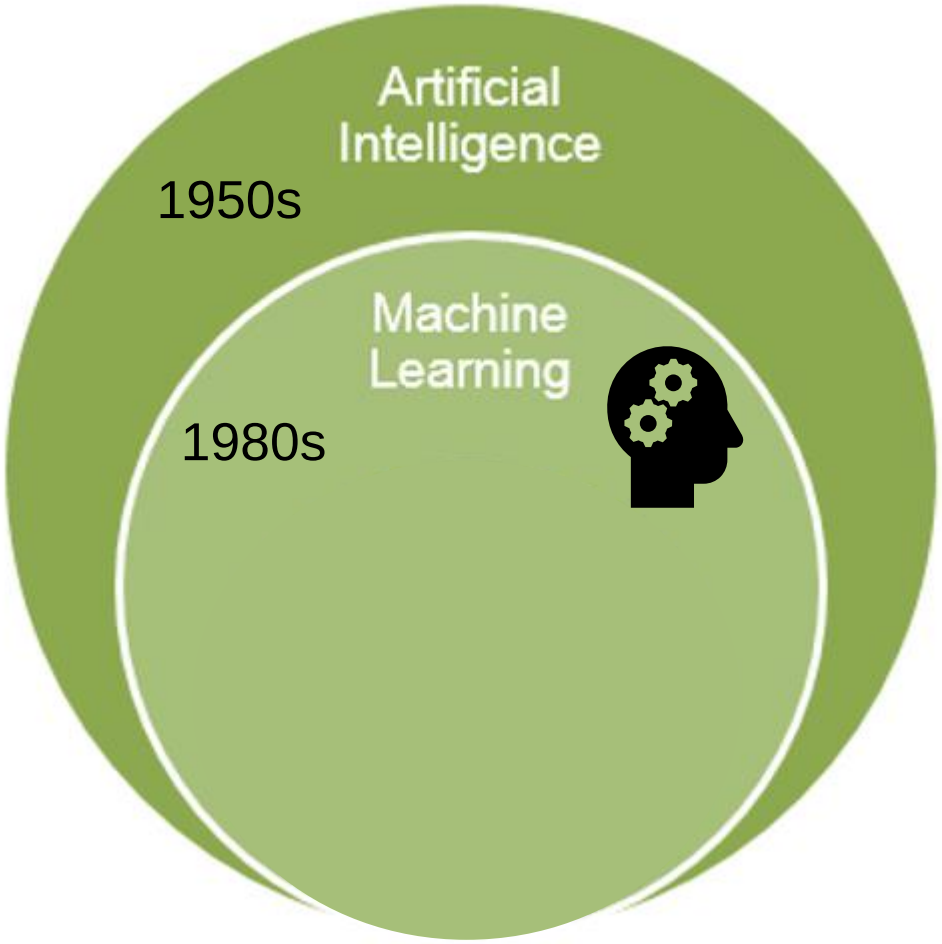
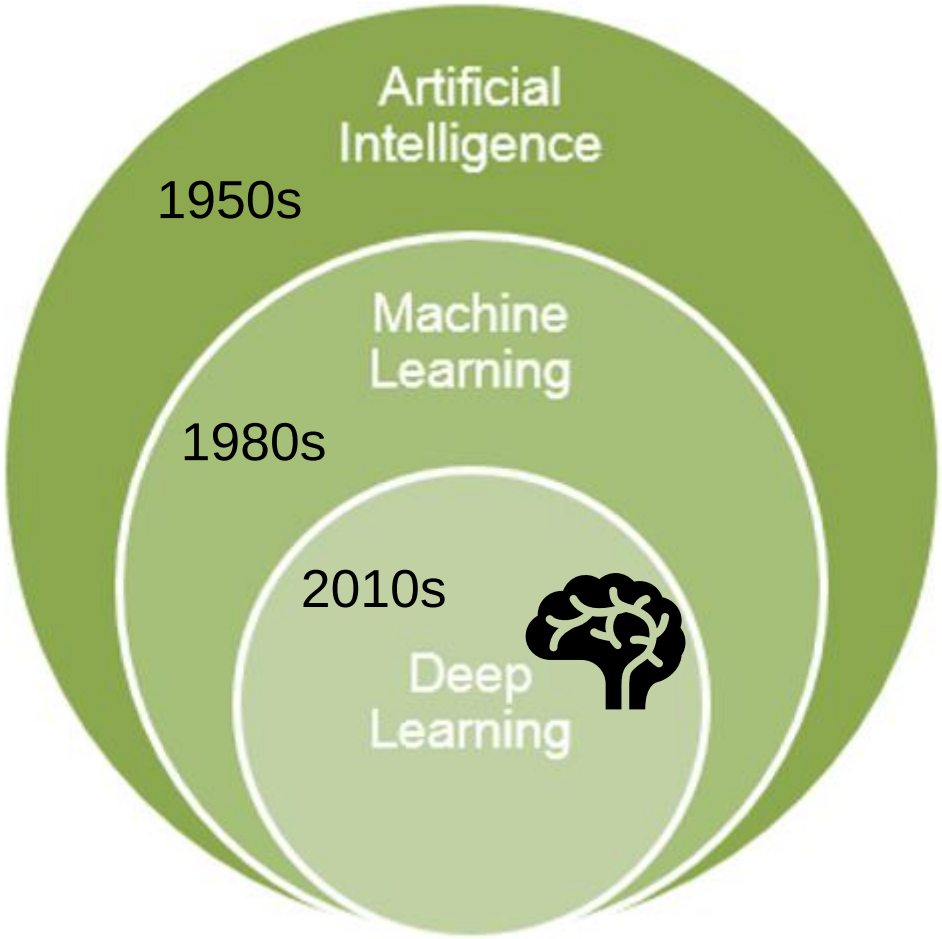
Machine Learning



K Means oder ISODATA
Bayesian Networks

Deep Learning



DNNs - Deep Neural Networks

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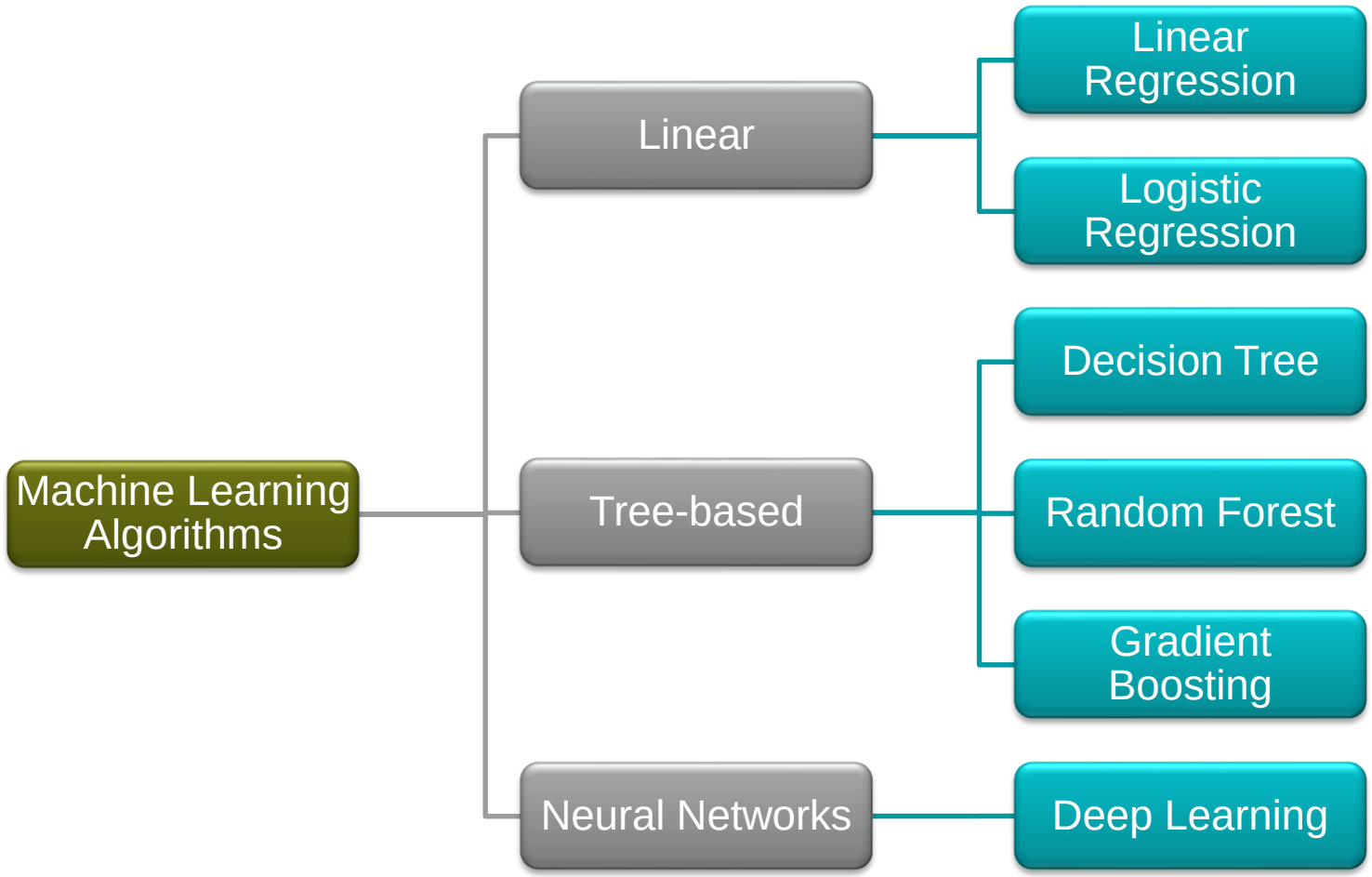
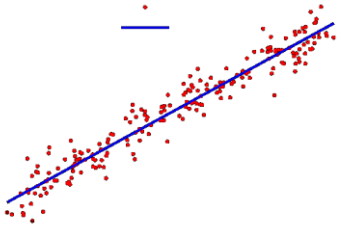
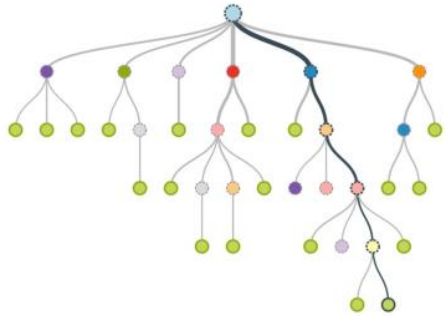
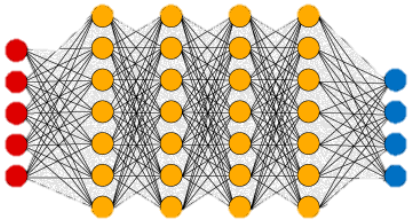
Machine Learning Algorithmen









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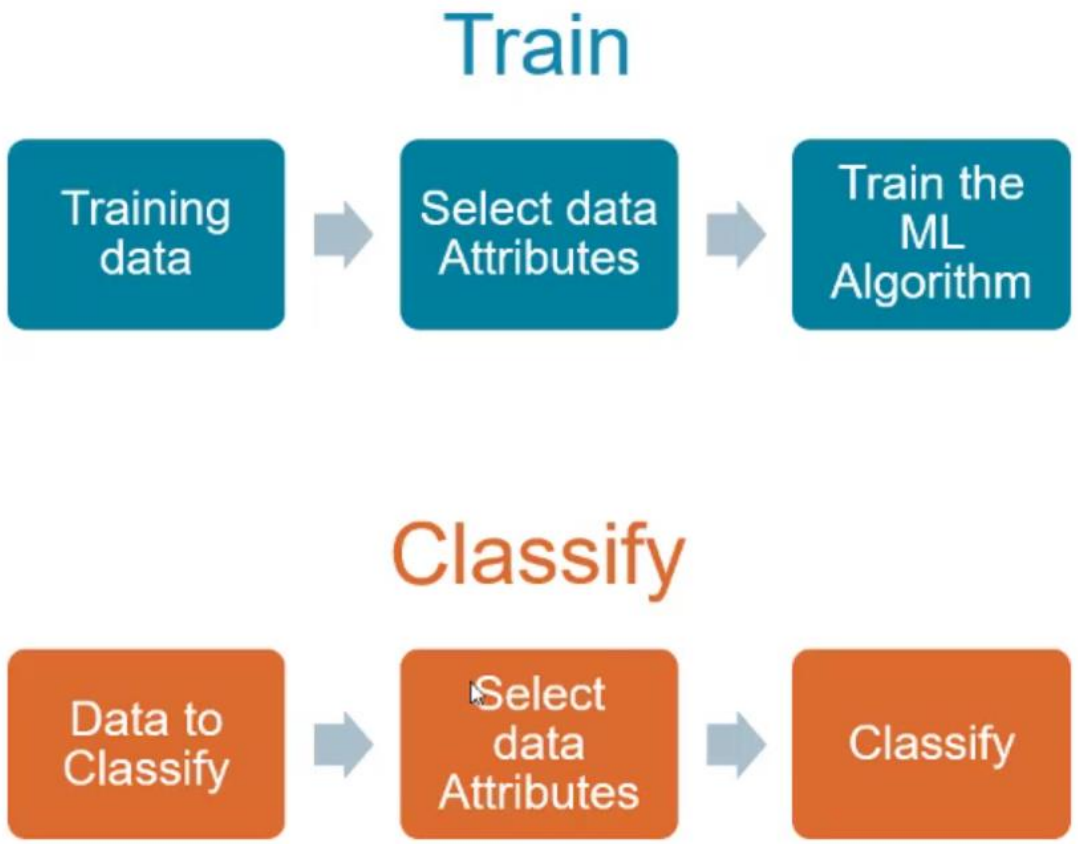
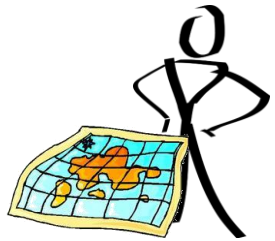
Wie funktioniert Machine Learning?



Machine Learning packages

Machine Learning in der Geospatial Welt?



Die meisten Machine Learning Bibliotheken sind nicht für die Geospatial-Welt gemacht.

Komplexe Machine Learning Ansätze sind noch in der Forschung und brauchen einen Experten.

Eigene Abläufe und Lösungen entwickeln ist nicht einfach.

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Machine learning-Bedarf in der Geospatial Welt

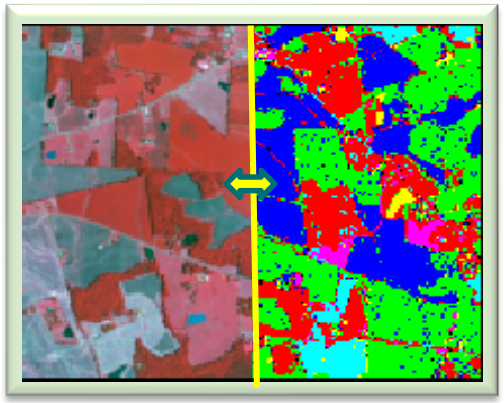

Image Classification

Change Detection

Feature Extraction

Prediction

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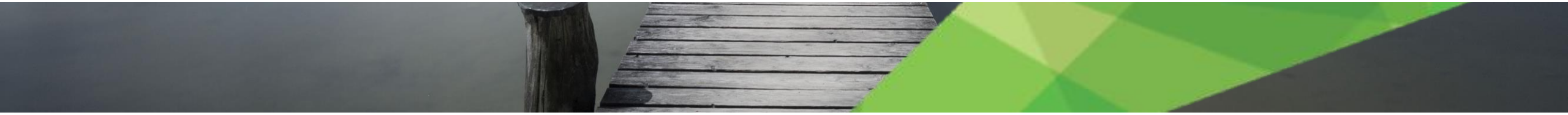
Machine Learning mit dem Spatial Modeler



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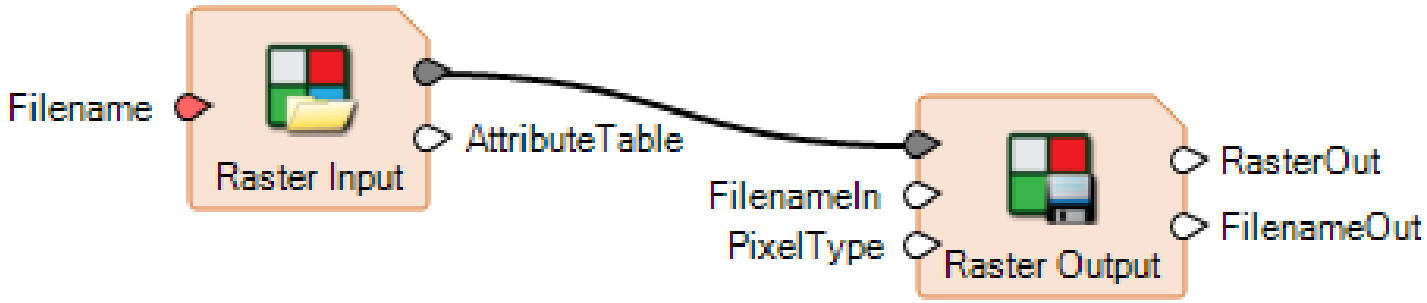
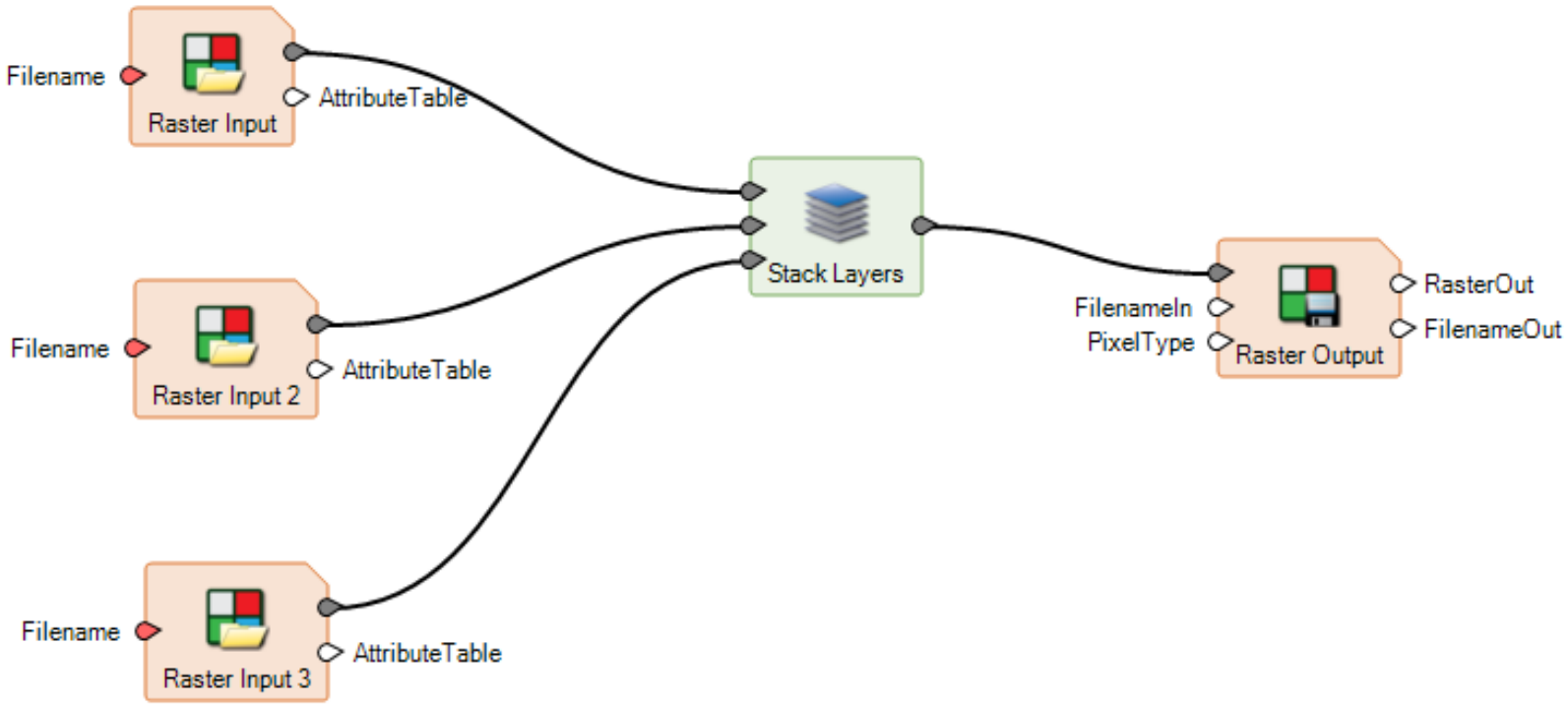
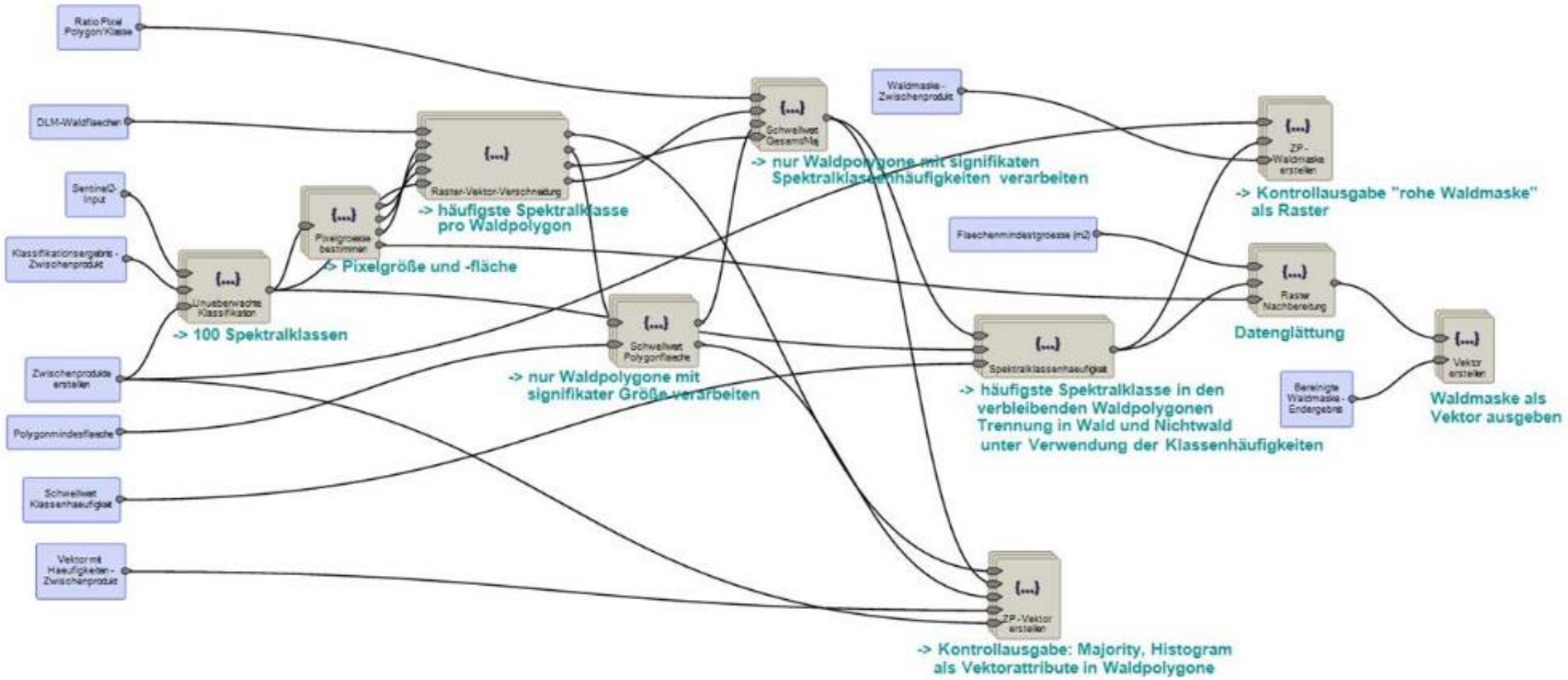
Einfachstes Spatial Model



Layer Stack im Spatial Model



Komplexes Spatial Model



F. Spitzer, GEOSYSTEMS GmbH 2017

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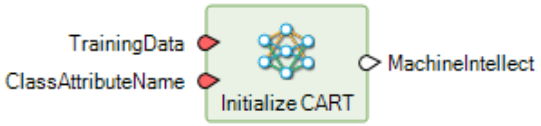
Wo findet sich der Spatial Modeler?

- IMAGINE Professional
- IMAGINE Essentials (Ausführen von Modellen)
- GeoMedia Professional
- ERDAS APOLLO Professional
- M.App Studio
- M.App Enterprise

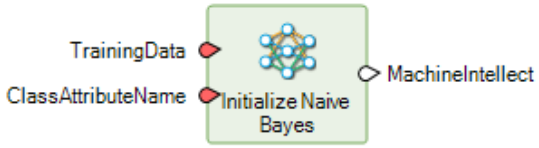
Verwendete OpenSource-Bibliotheken

Caffe

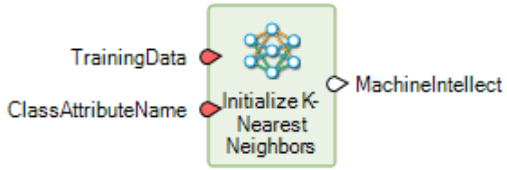
Machine Learning Operatoren im Spatial Modeler



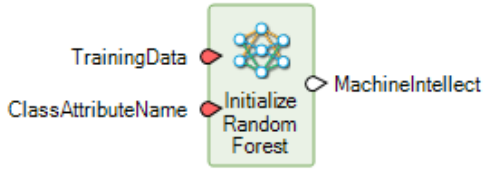
Classification and Regression Trees



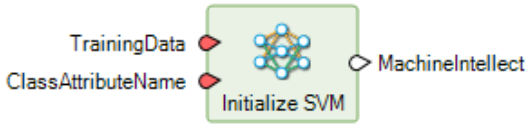
Naive Bayes



K-Nearest Neighbors



Random Forests



Support Vector Machines

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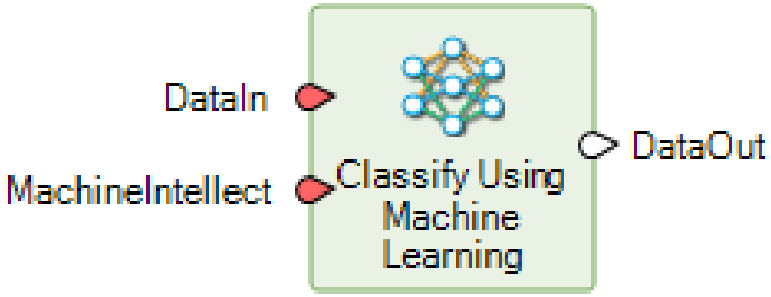
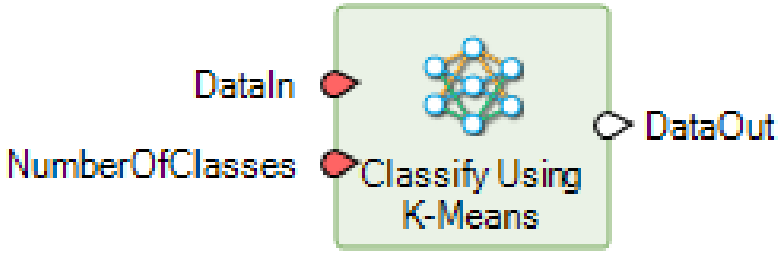
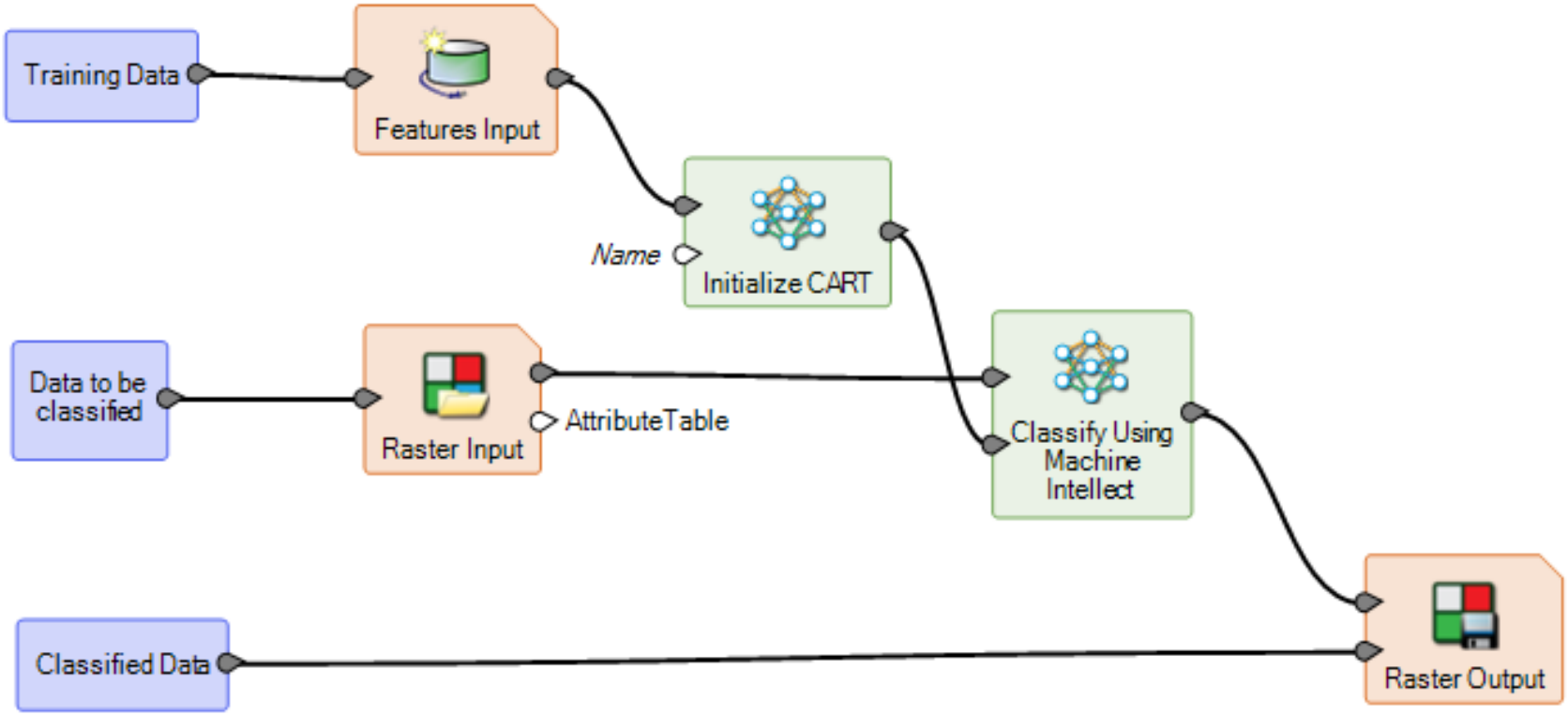
Classify Using….





Unsupervised Classifier

Beispiel-Model für den CART-Algorithmus



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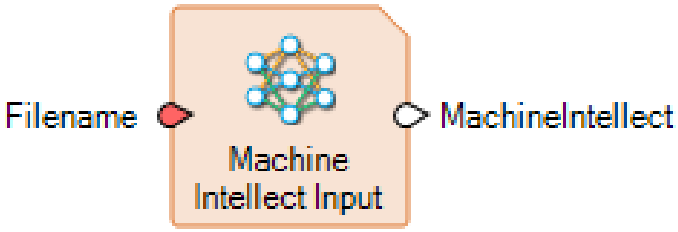
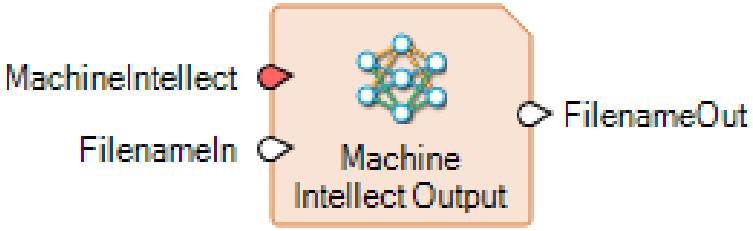
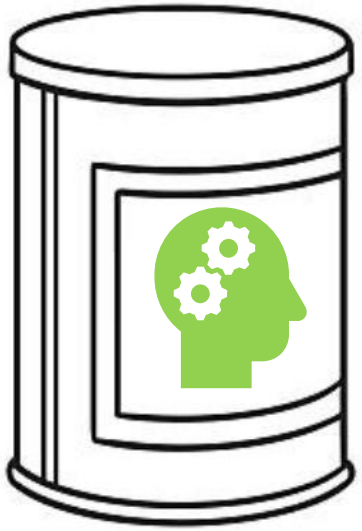
Machine Intellect

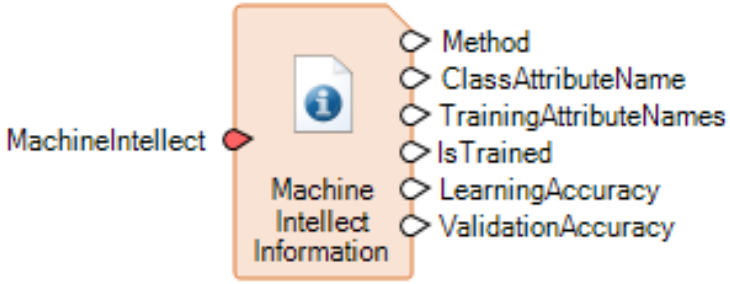


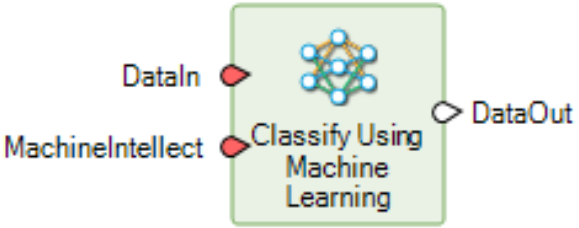


Gut beschriften!



Machine Intellect





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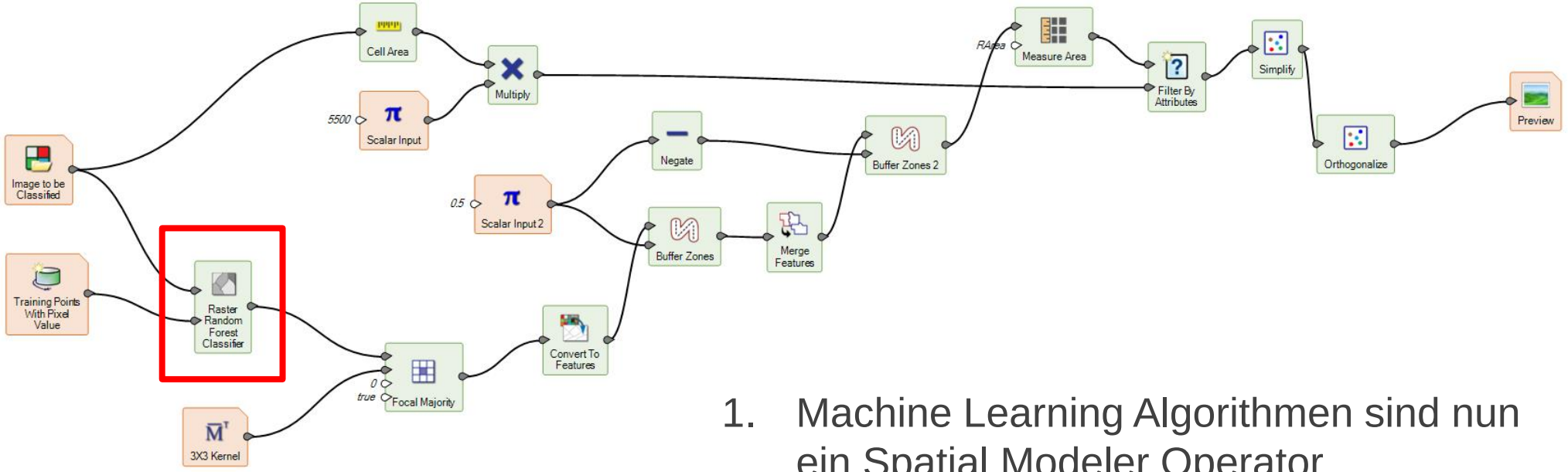
Machine Learning mit dem Hexagon Geospatial Spatial Modeler



1. Machine Learning Algorithmen sind nun ein Spatial Modeler Operator.
2. Kombination von Machine Learning mit den Operatoren des Spatial Modelers.
3. Einbauen/Integrieren von Machine Learning Algorithmen mit vorhandenen Workflows.

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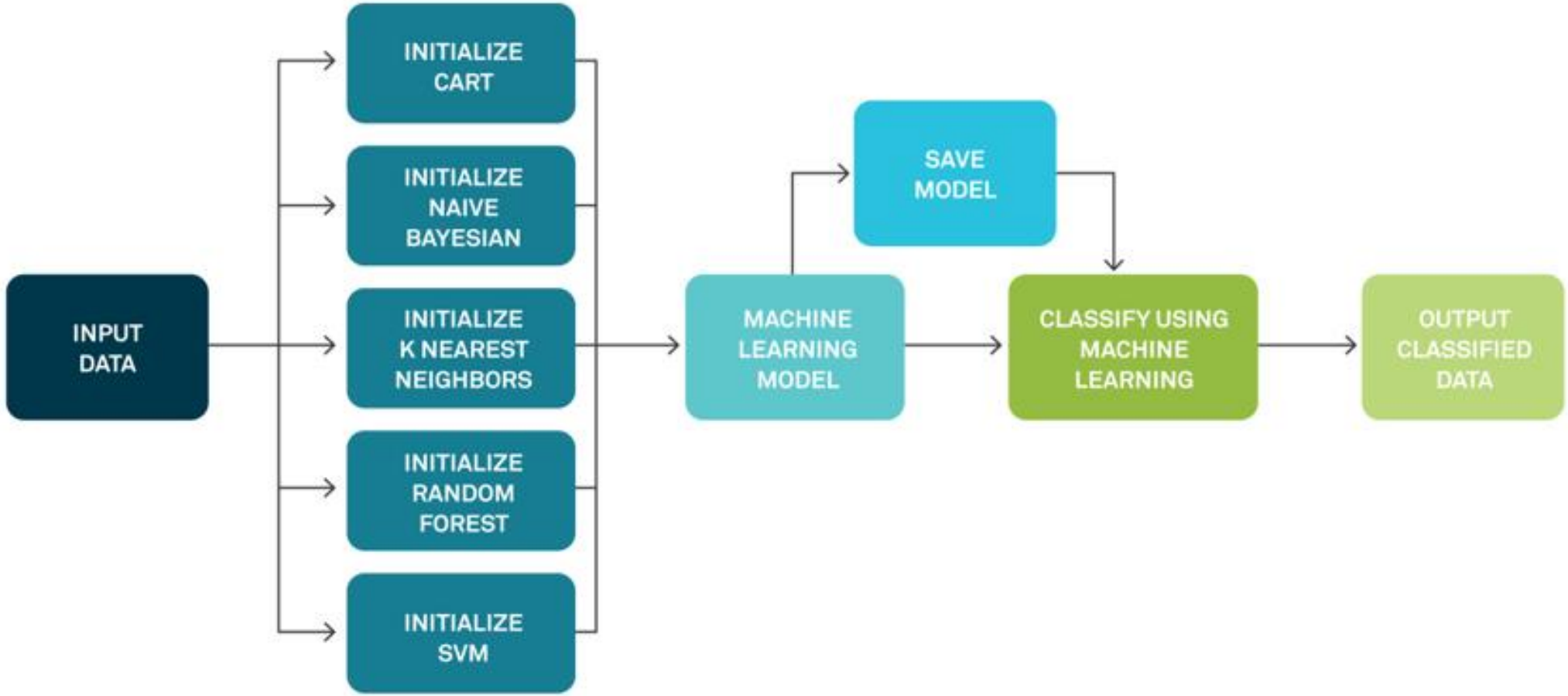
Ablaufschema Machine Learning in IMAGINE



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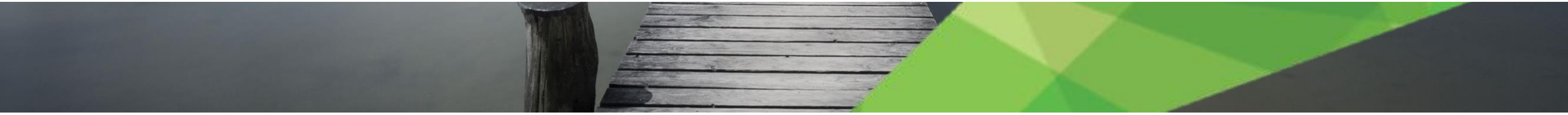
Phasen eines Machine Learning Projekts

- Vorbereitung der Trainingsdaten
- Auswahl des Machine Learning Modells
- Modell trainieren
- Testen und Validieren
- Anwenden

Machine Learning Beispiel - Vektorklassifikation



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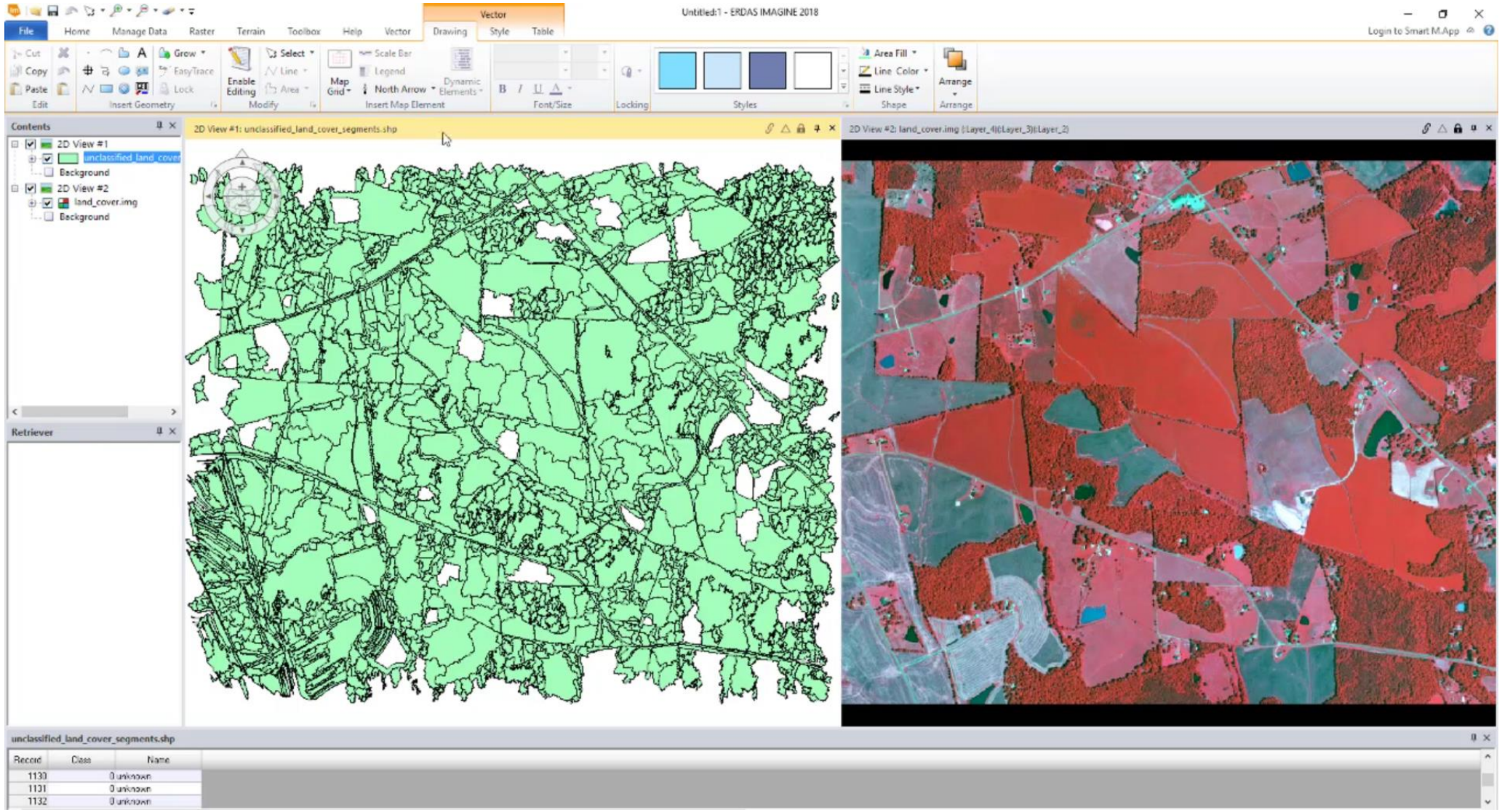
Zu klassifizierende Vektoren und Rasterdatensatz für das Training



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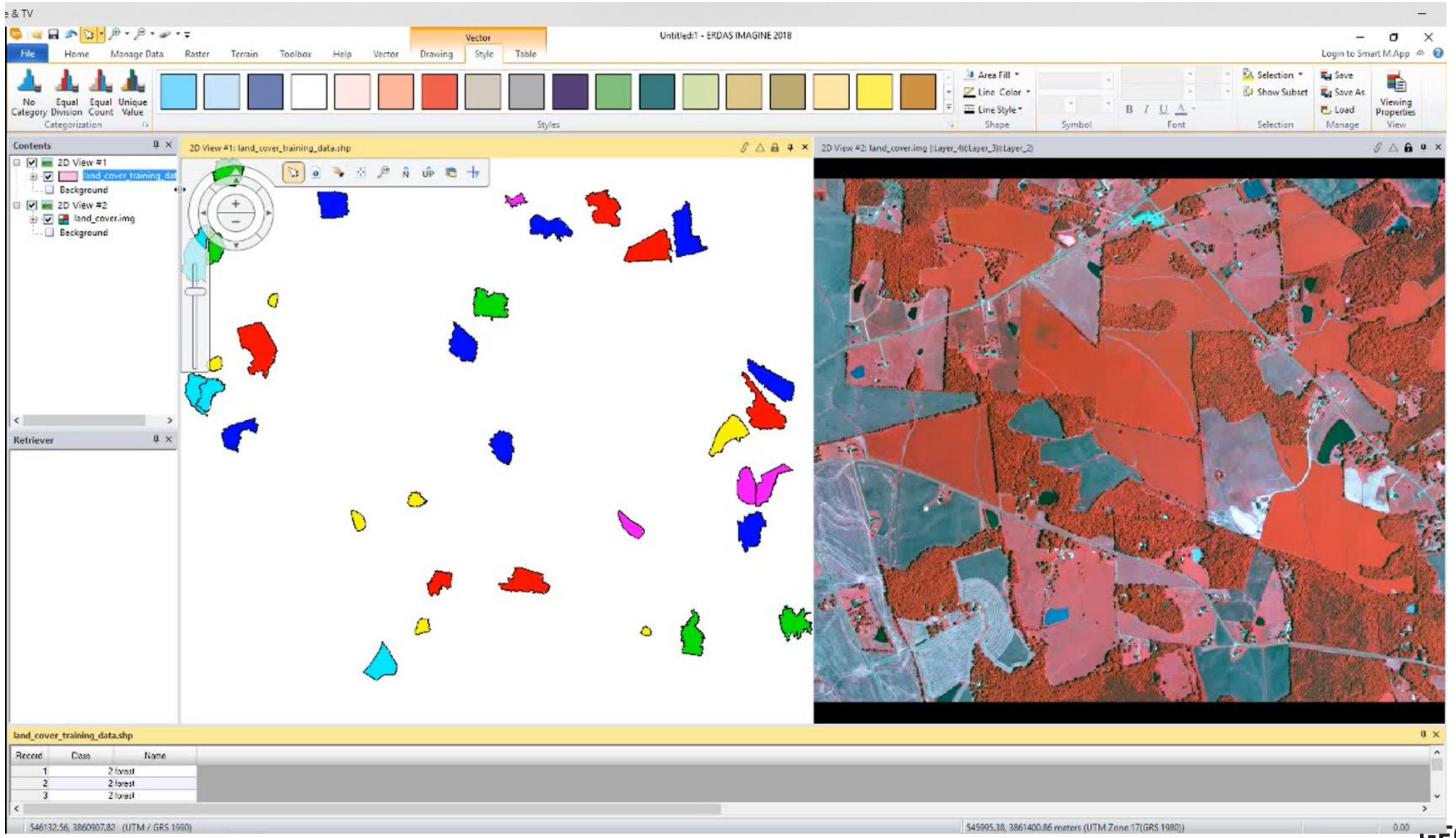
Vektor-Trainingsgebiete



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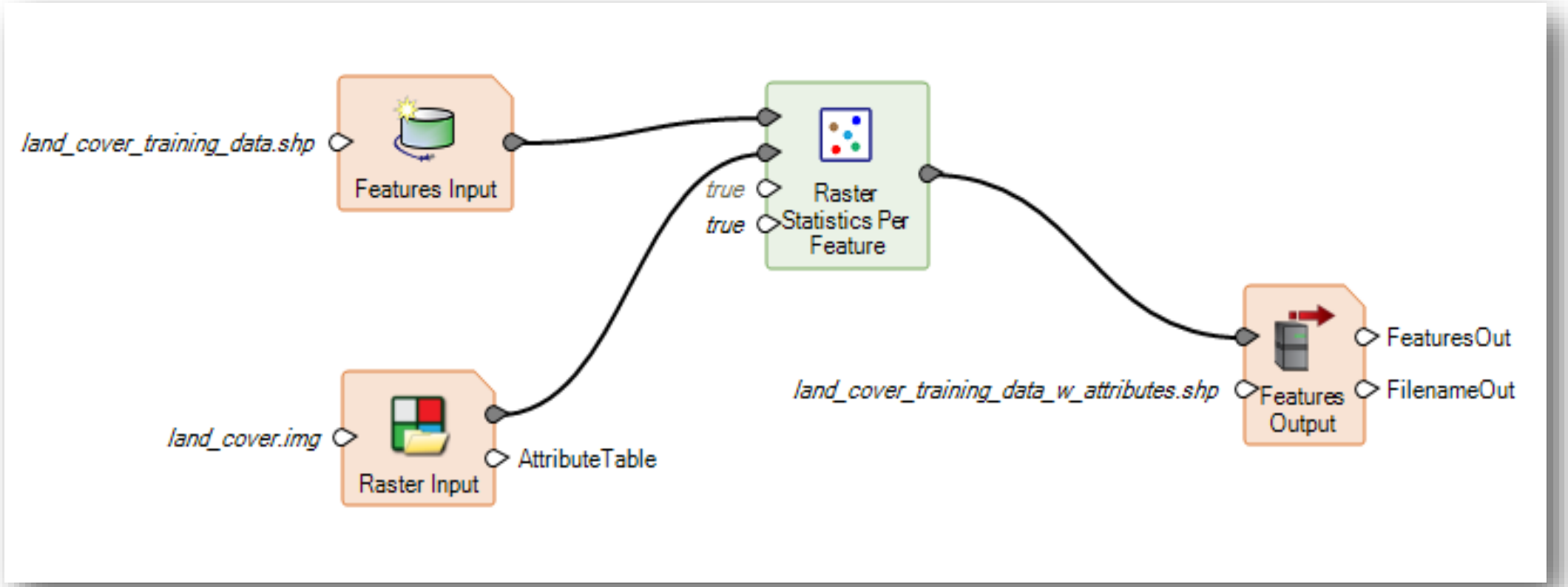
Trainingsdaten aufbereiten – Statistik als neues Attribut



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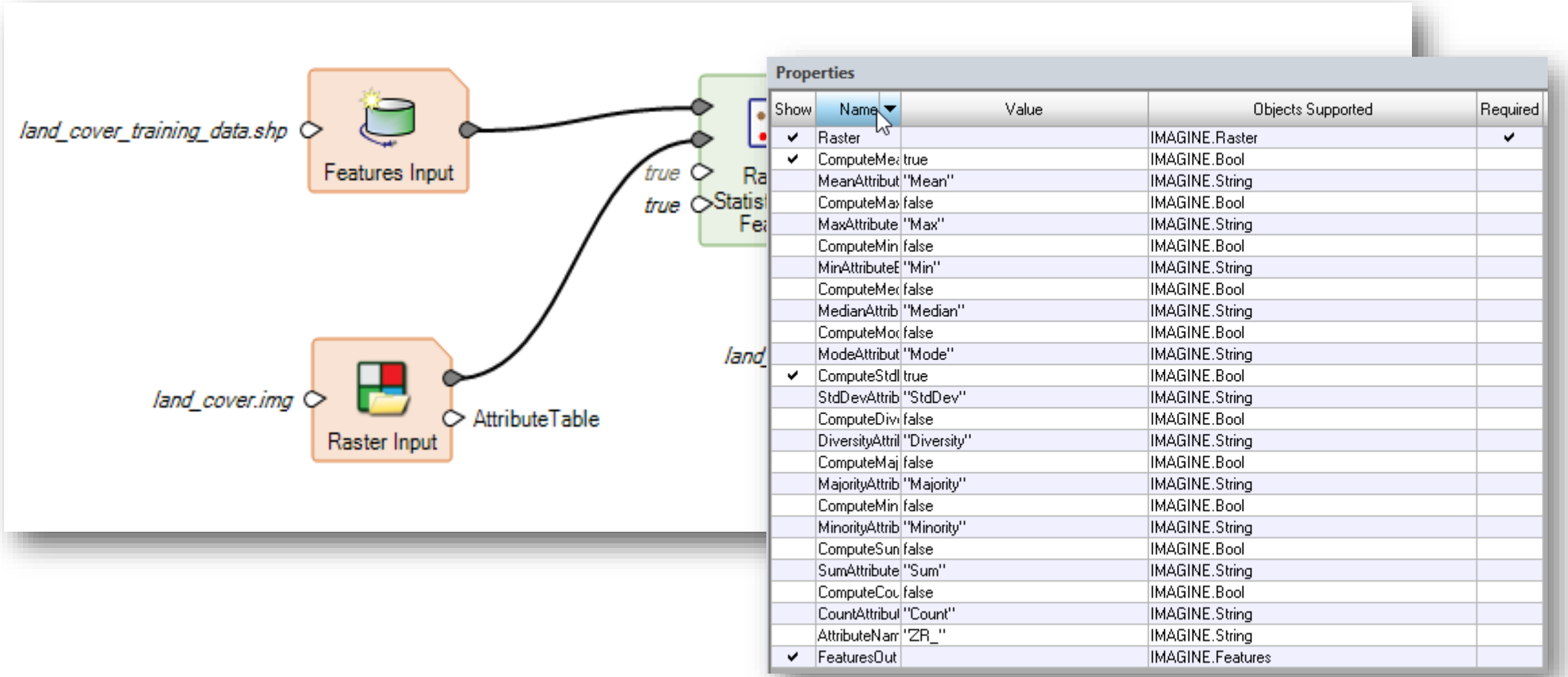
Trainingsdaten aufbereiten – Mean + StdDev



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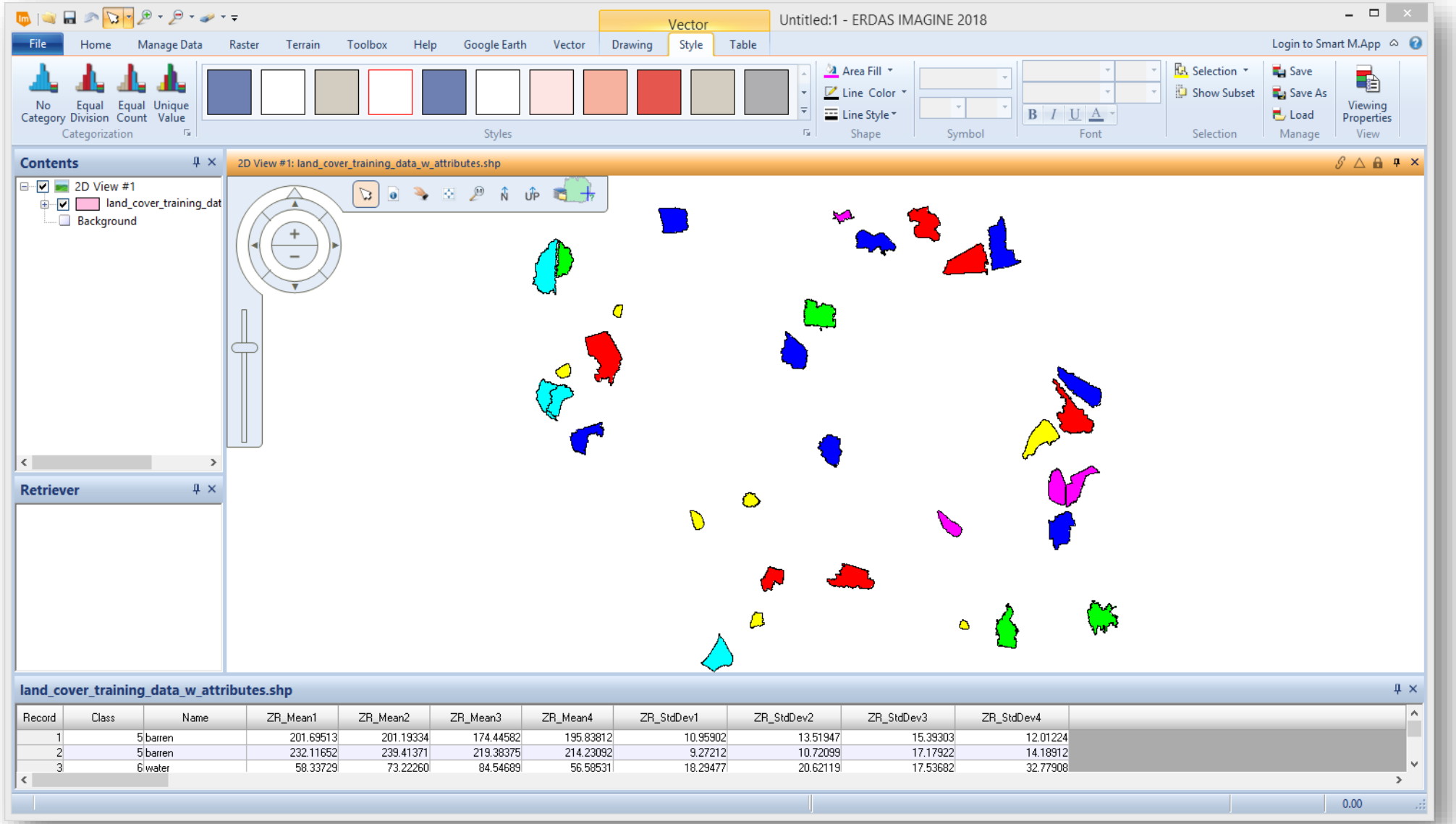
Trainingsdaten aufbereiten – Mean + StdDev



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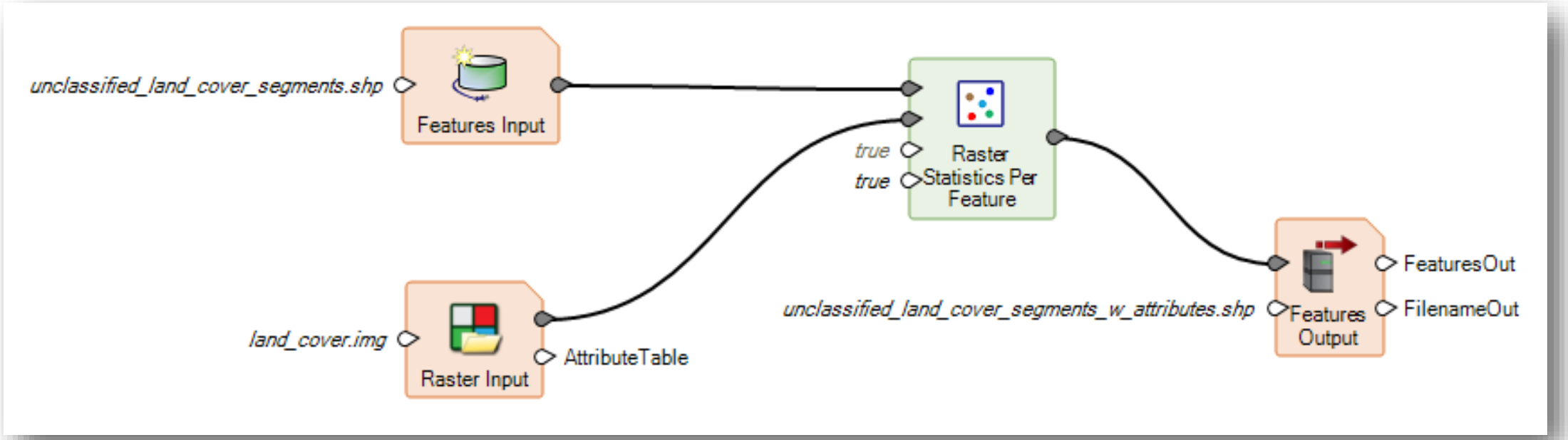
Eingangsdaten aufbereiten – Mean + StdDev



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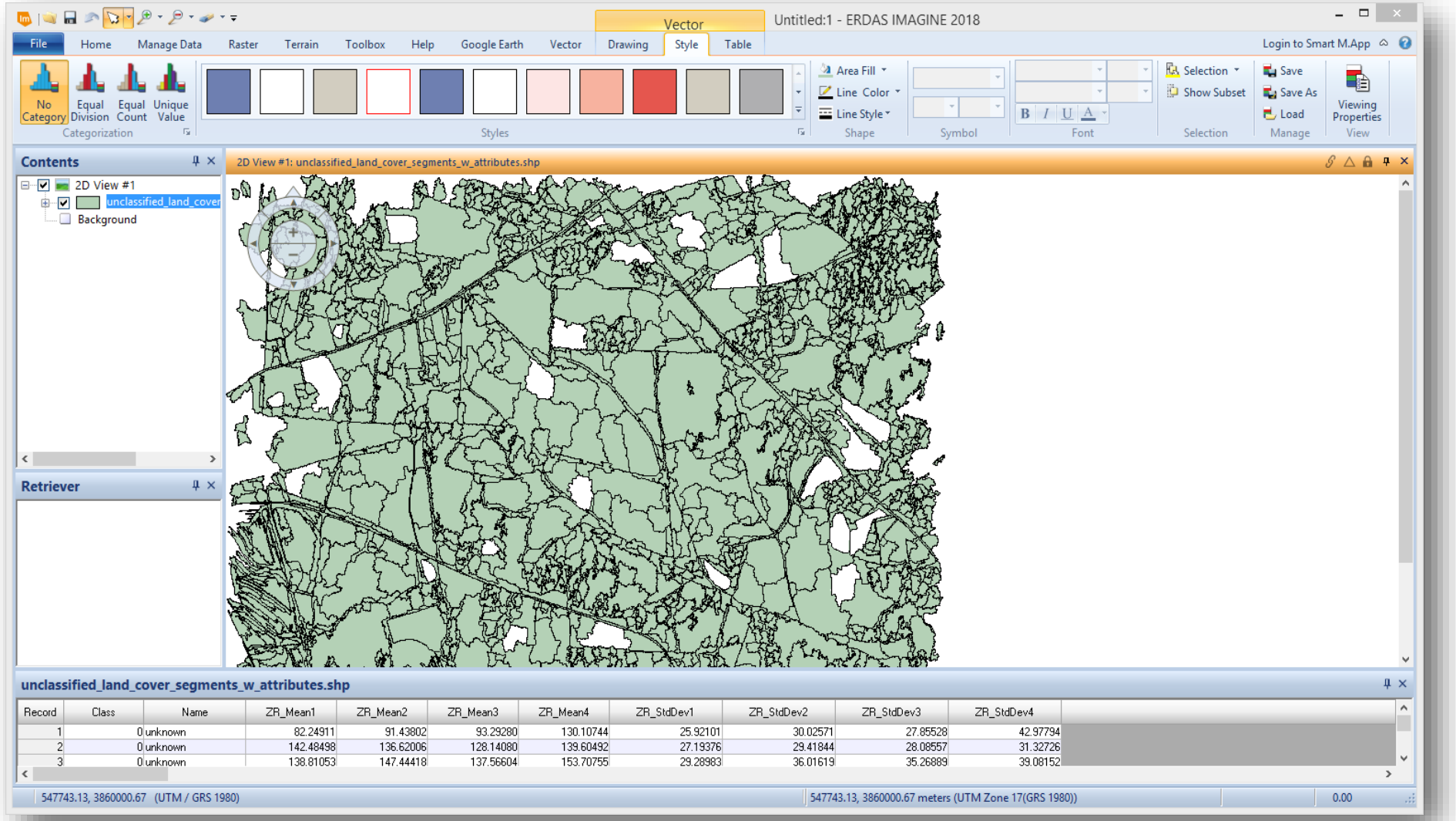
Eingangsdaten aufbereiten – Mean + StdDev wurden berechnet



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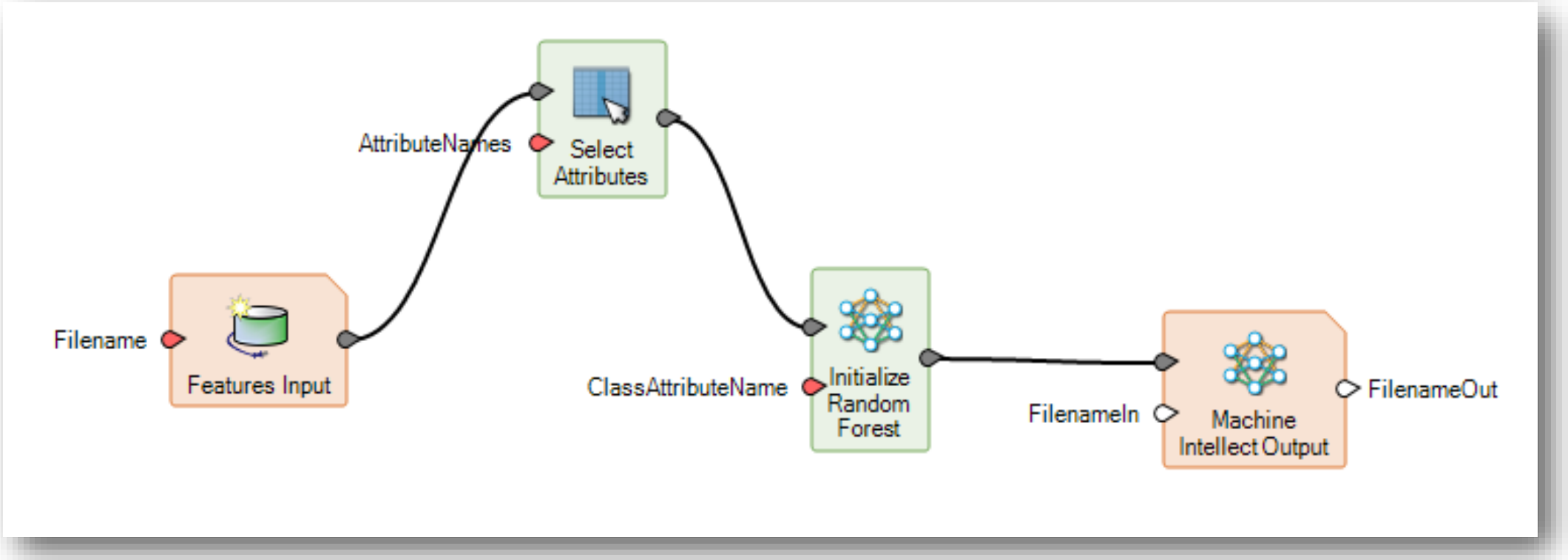
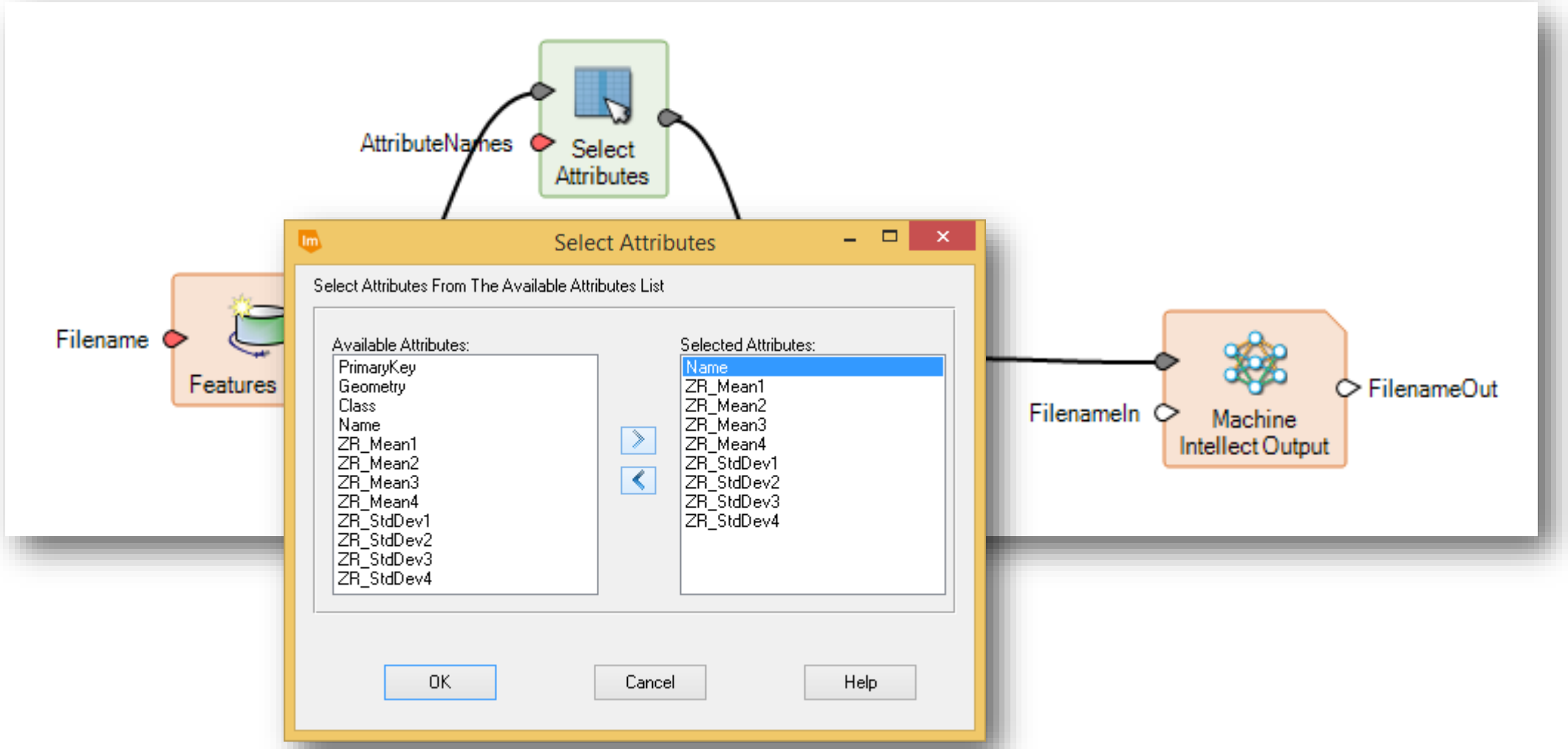
Random Forest Algorithmus trainieren – Initialize



Random Forest Algorithmus trainieren – Select Attributes



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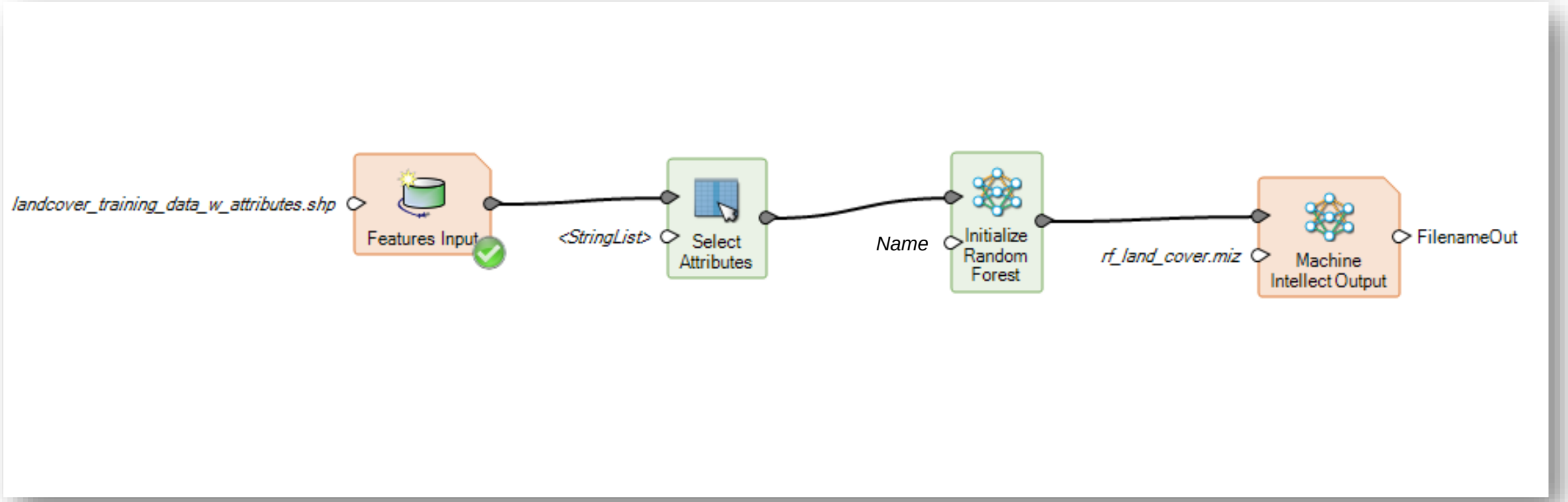
Random Forest Algorithmus – Ausgabe des Machine Intellect



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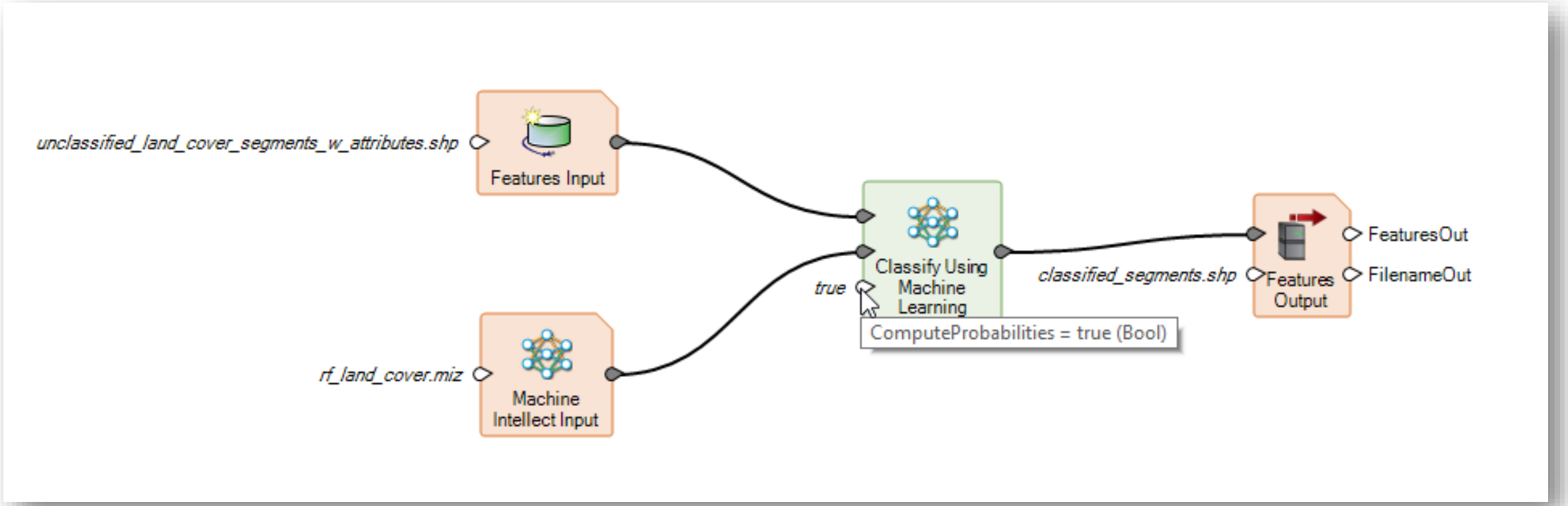
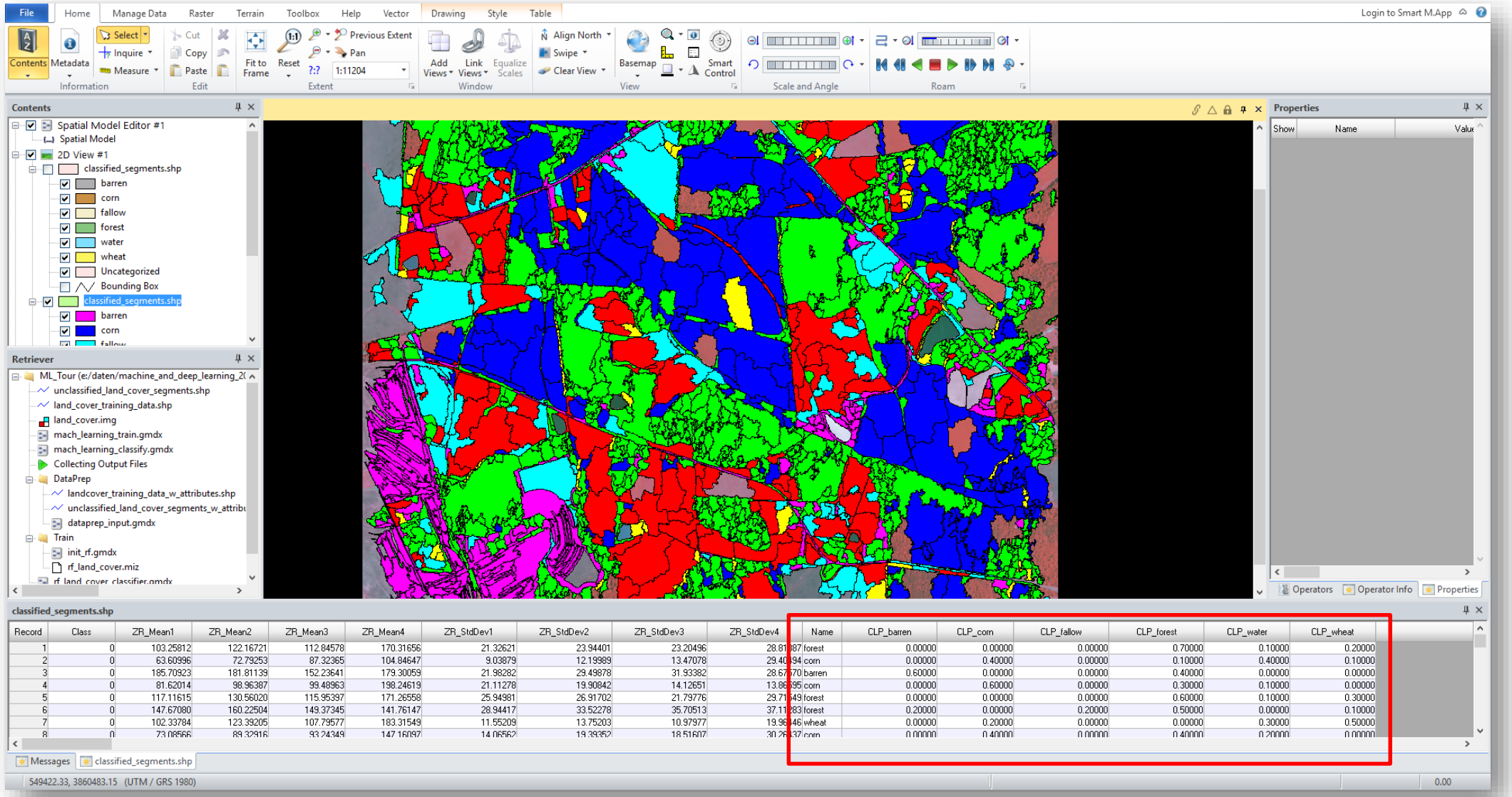
Mit trainiertem Machine Intellect klassifizieren



Ergebnisanalyse



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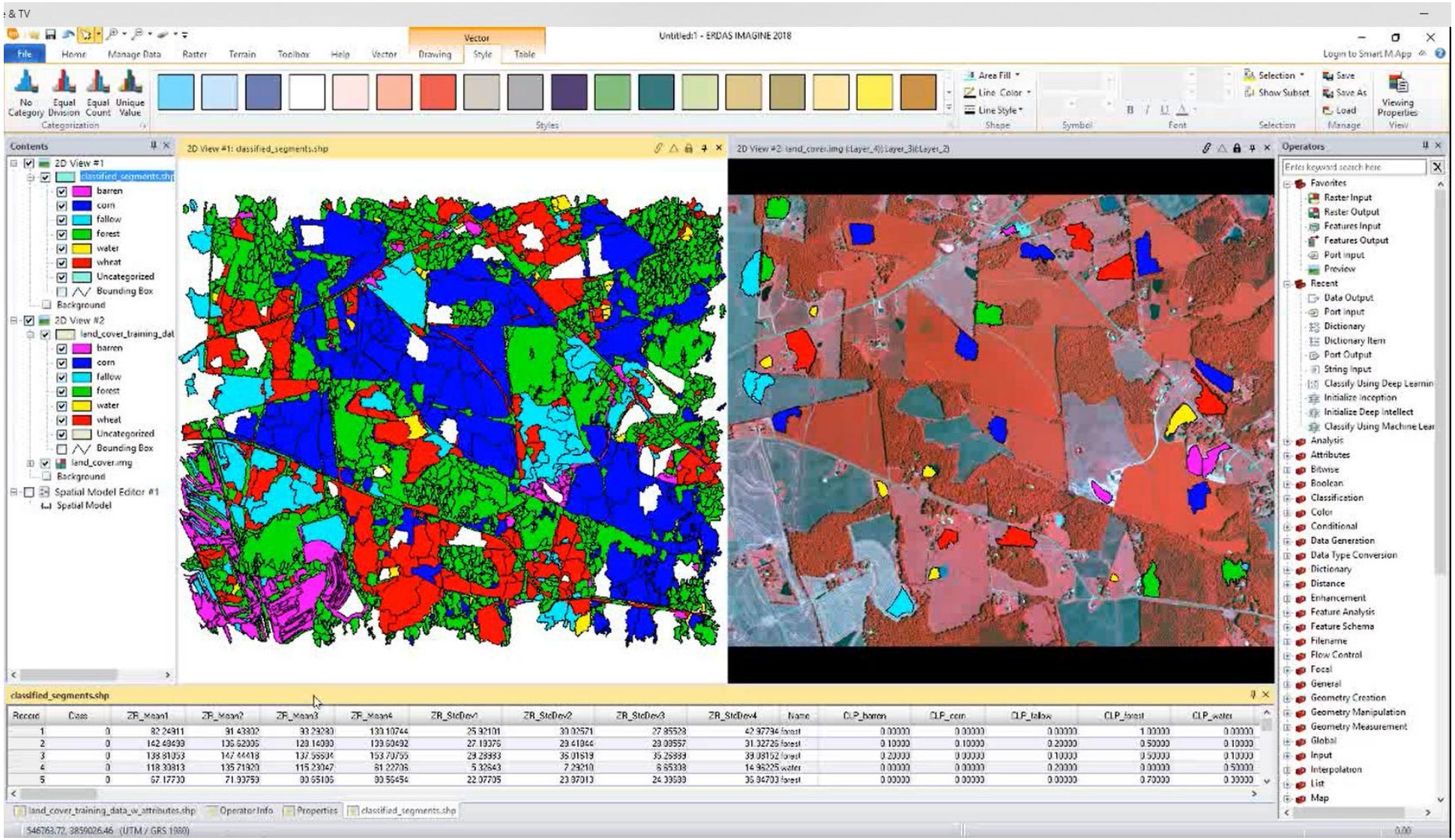
Ergebnis



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Herausforderungen

- Overfitting – Modell zu komplex

  Modell funktioniert gut auf Trainingsdaten,
  läßt sich aber nicht gut generalisieren.

  - Modell vereinfachen (weniger Parameter oder einfacheres Modell)
  - Reduktion der Eingangsinformation (weniger Attibute)
  - Mehr Trainingsdaten

Herausforderungen des Modells

- Overfitting – Modell zu komplex

  Modell funktioniert gut auf Trainingsdaten,
  läßt sich aber nicht gut generalisieren.

  - Modell vereinfachen (weniger Parameter oder einfacheres Modell)
  - Reduktion der Eingangsinformation (weniger Attibute)
  - Mehr Trainingsdaten

- Underfitting – Modell zu einfach

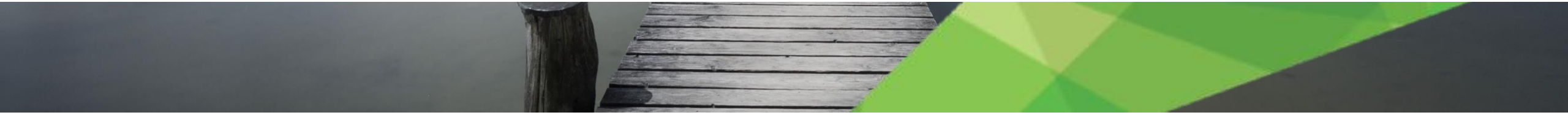
  Modell funktioniert auch auf Trainingsdaten nicht gut.

  - Einschränkungen untersuchen und verringern
  - Komplexeres Modell mit mehr Parametern wählen
  - Bessere Trainingsdaten verwenden

Herausforderungen der Trainingsdaten

- Ausreichend hohe Quantität
- Repräsentiv
- Gute Qualität
- Ausreichend viel relevante Attribute
- Wenig irrelevante Attribute

Machine Learning Beispiel - Rasterklassifikation



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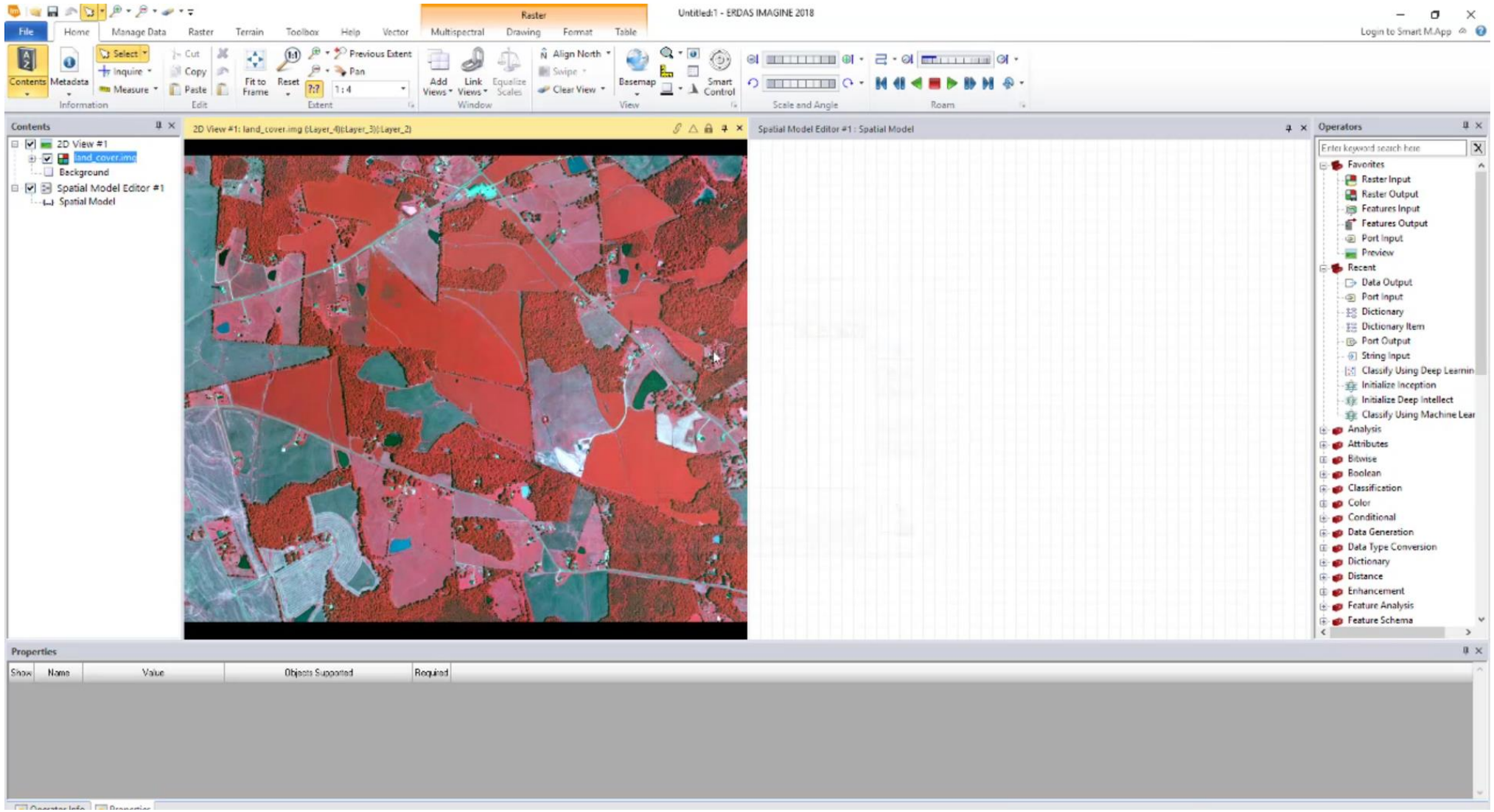
Zu klassifizierendes Rasterbild



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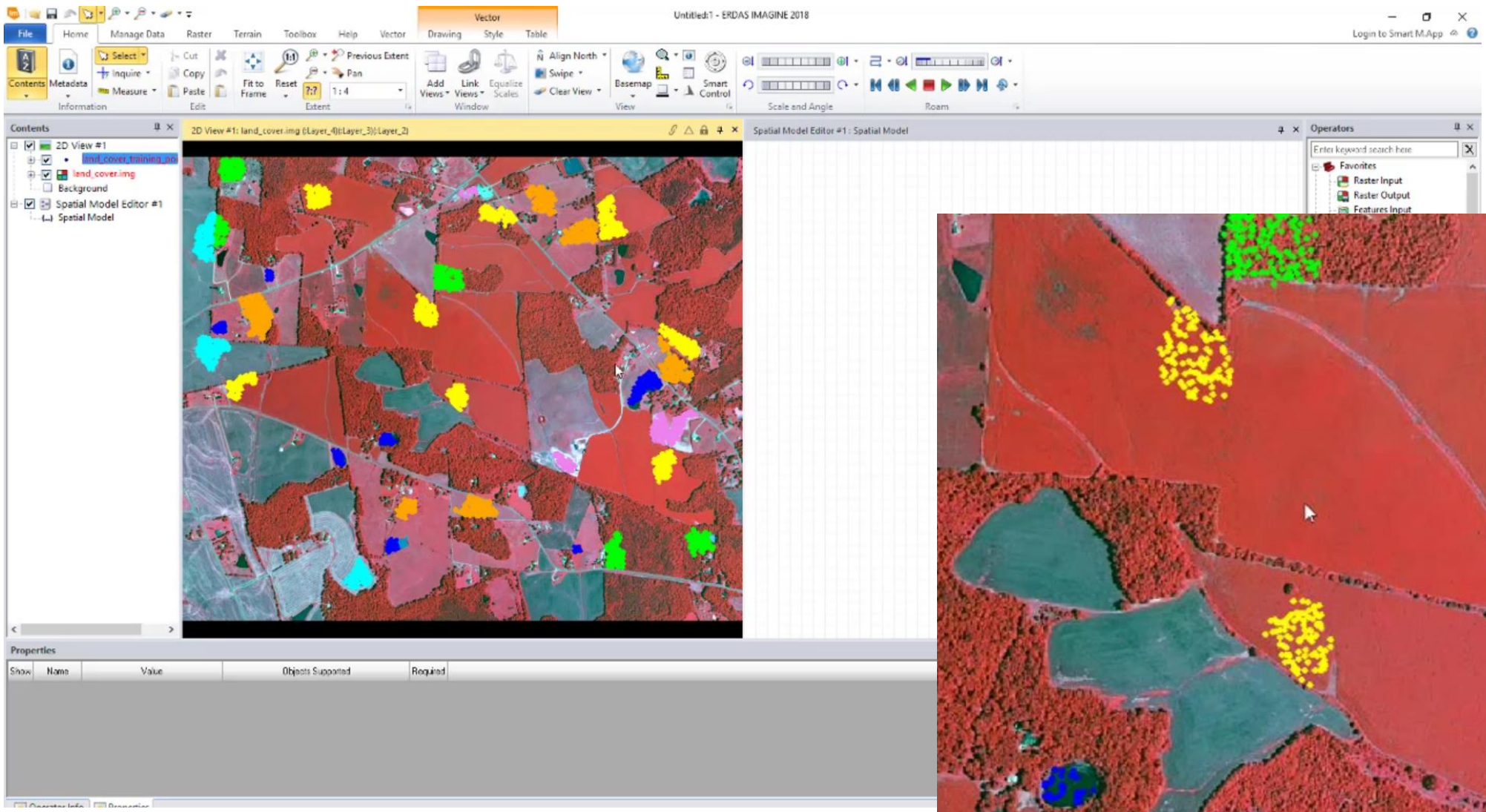
Rasterbild mit Trainingsdaten (Punkt-Vektoren)



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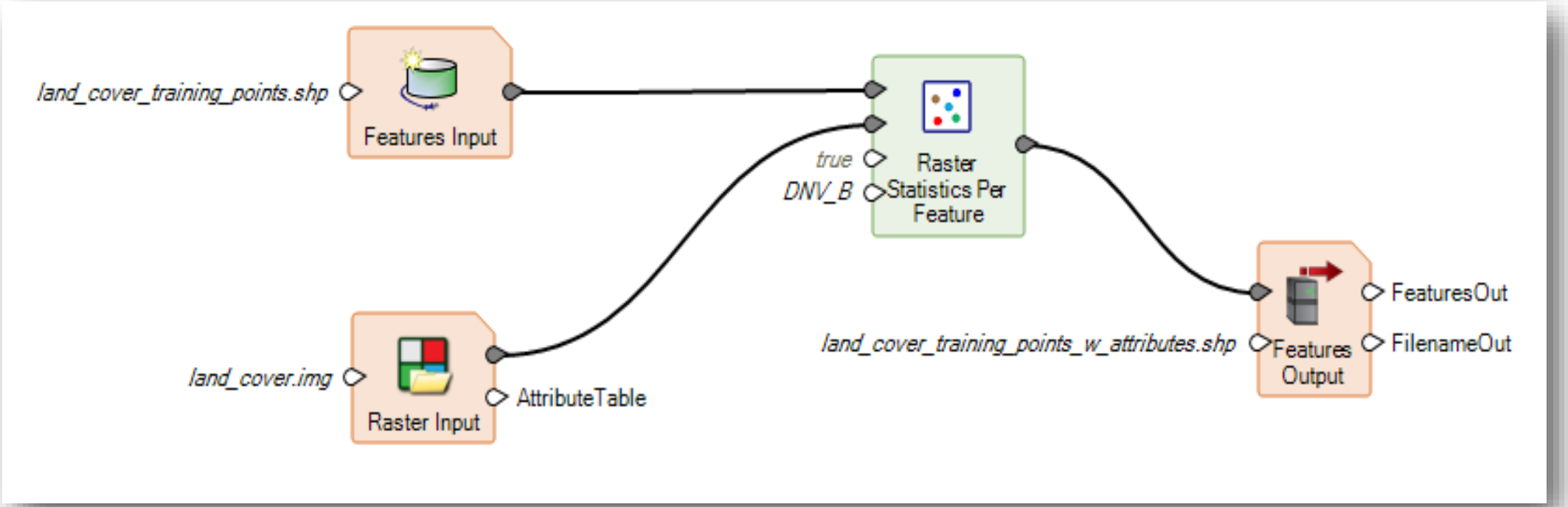
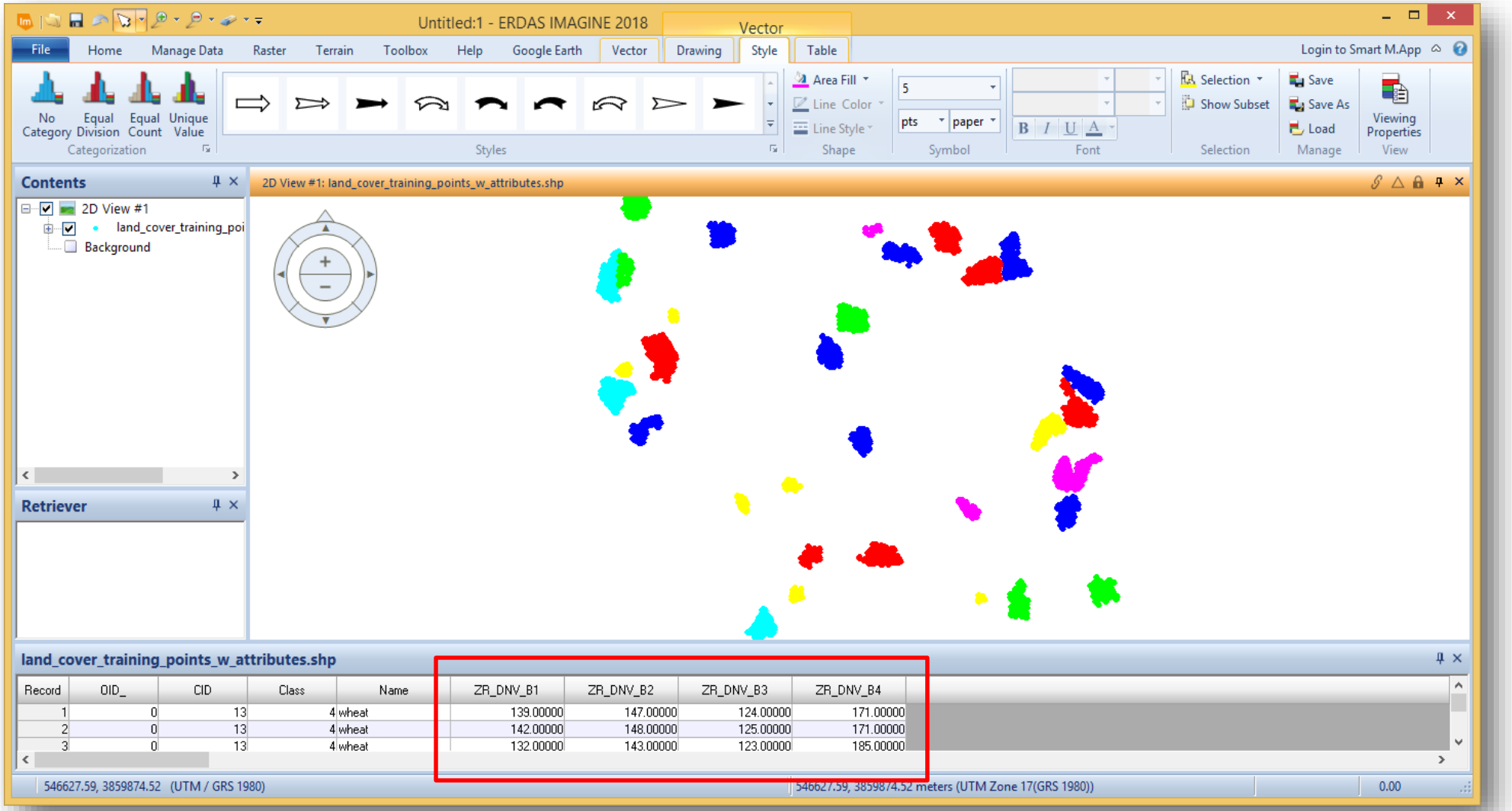
Trainingsdaten aufbereiten – DN als neues Attribut



Trainingsdaten aufbereiten – DN Value per Band



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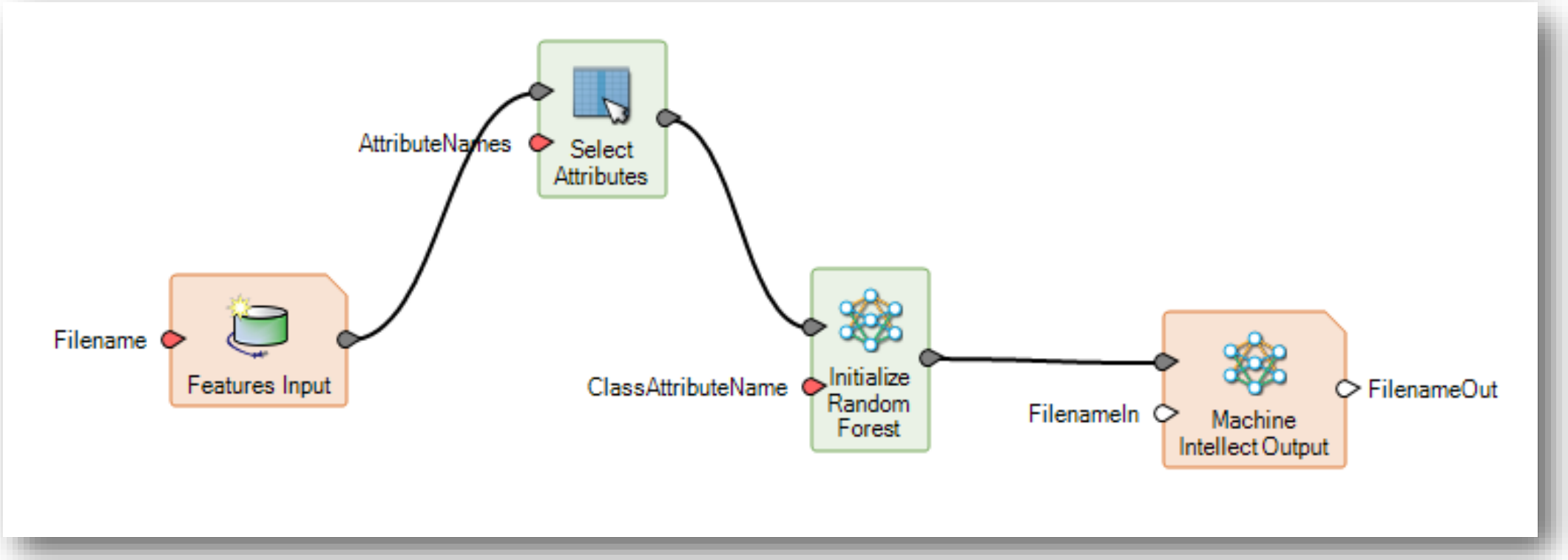
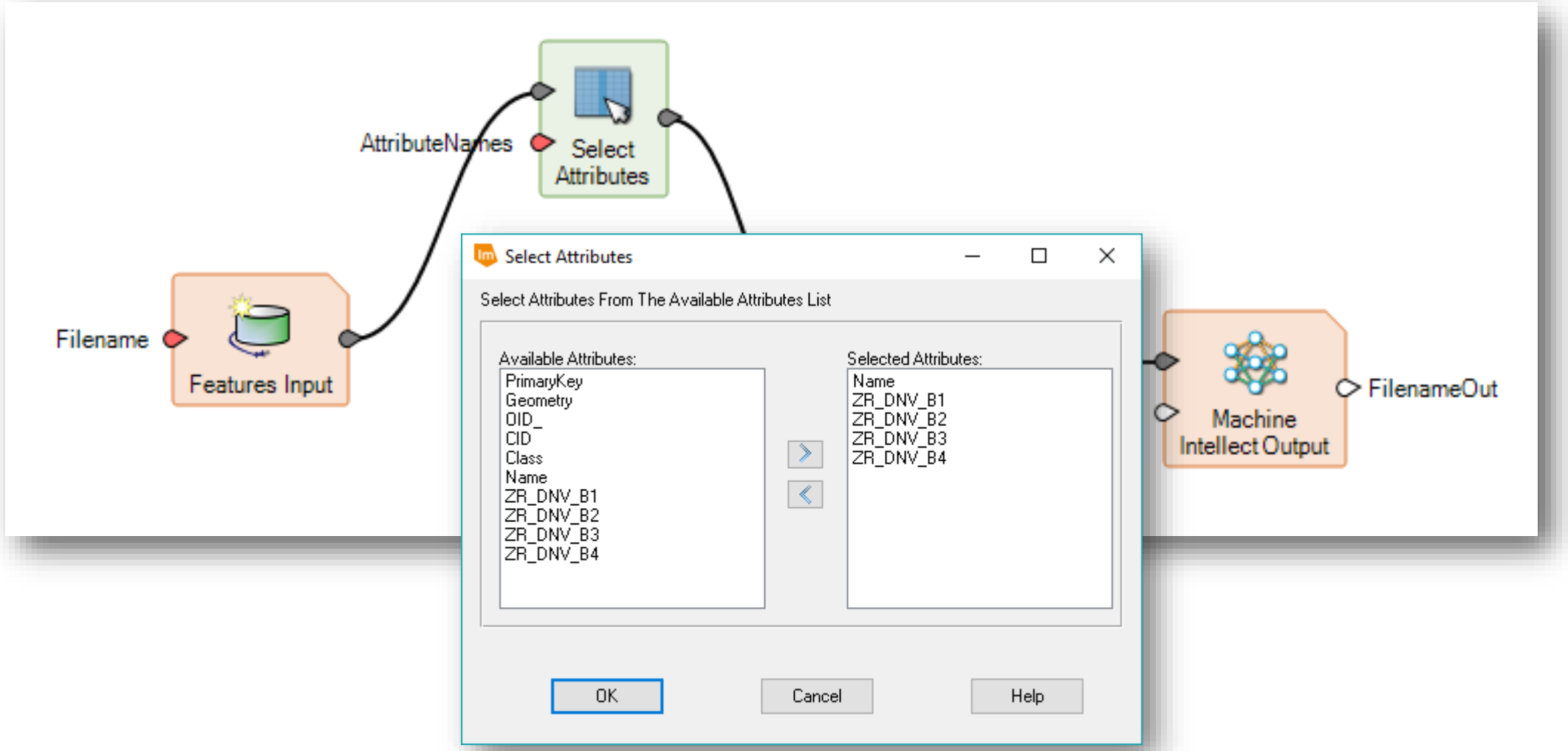
Random Forest Algorithmus trainieren – Initialize



4. Random Forest Algorithmus trainieren – Initialize



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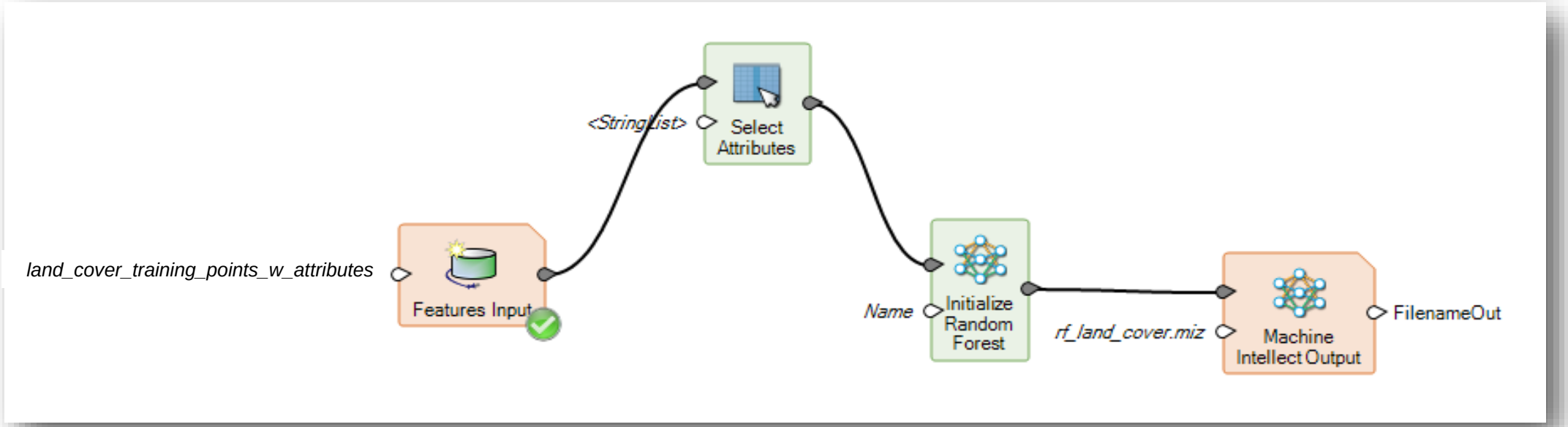
Random Forest Algorithmus – Machine Intellect ausgeben



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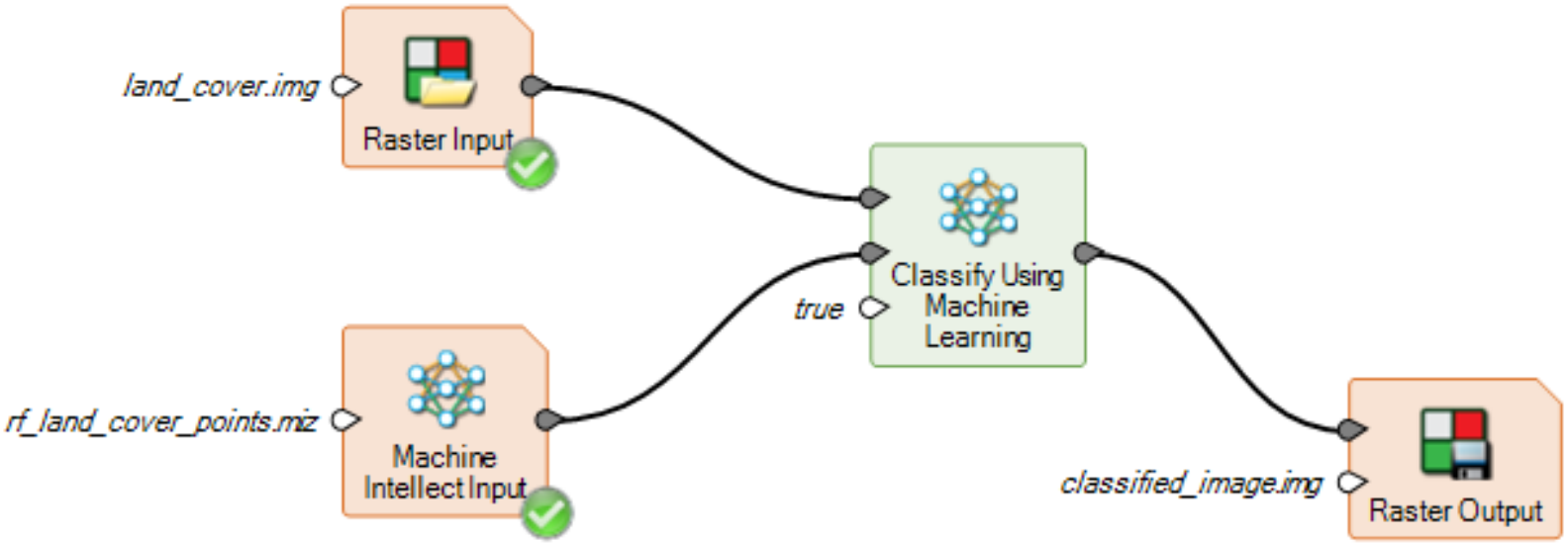
Mit trainiertem Machine Intellect klassifizieren



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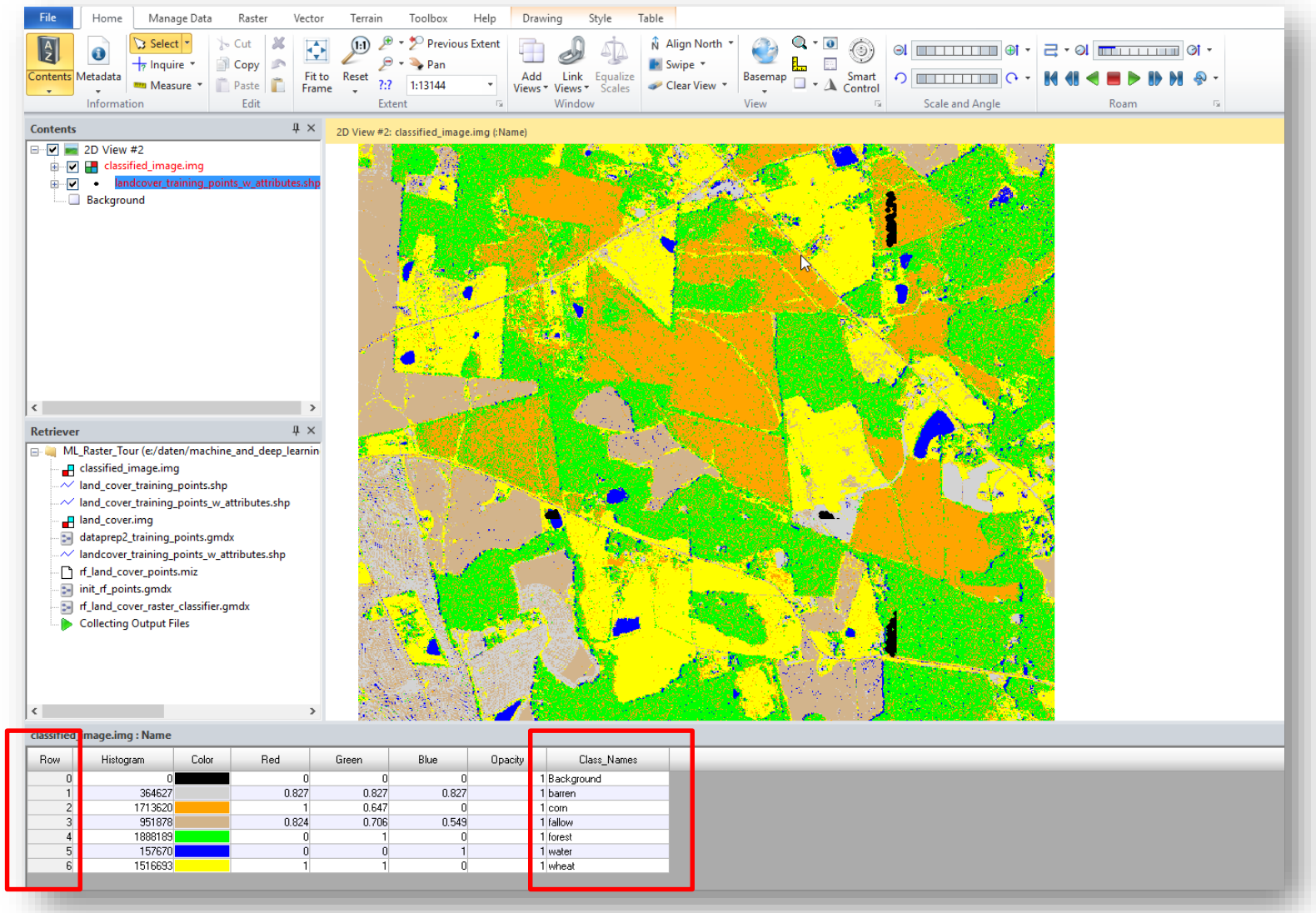
Ergebnisanalyse



Row	Histogram	Color	Red	Green	Blue	Opacity	Class_Names
0	0		0	0	0	1	Background
1	364627		0.827	0.827	0.827	1	barren
2	1713620		1	0.647	0	1	corn
3	951878		0.824	0.706	0.549	1	fallow
4	1888189		0	1	0	1	forest
5	157670		0	0	1	1	water
6	1516693		1	1	0	1	wheat

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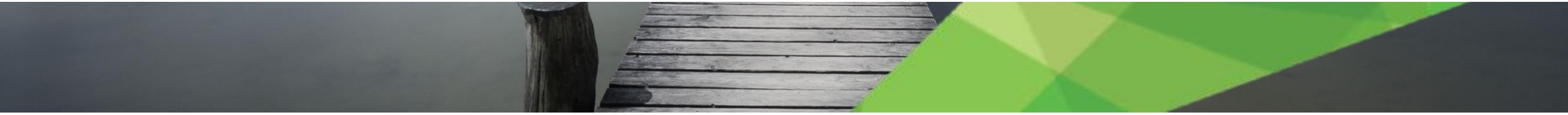
Deep Learning



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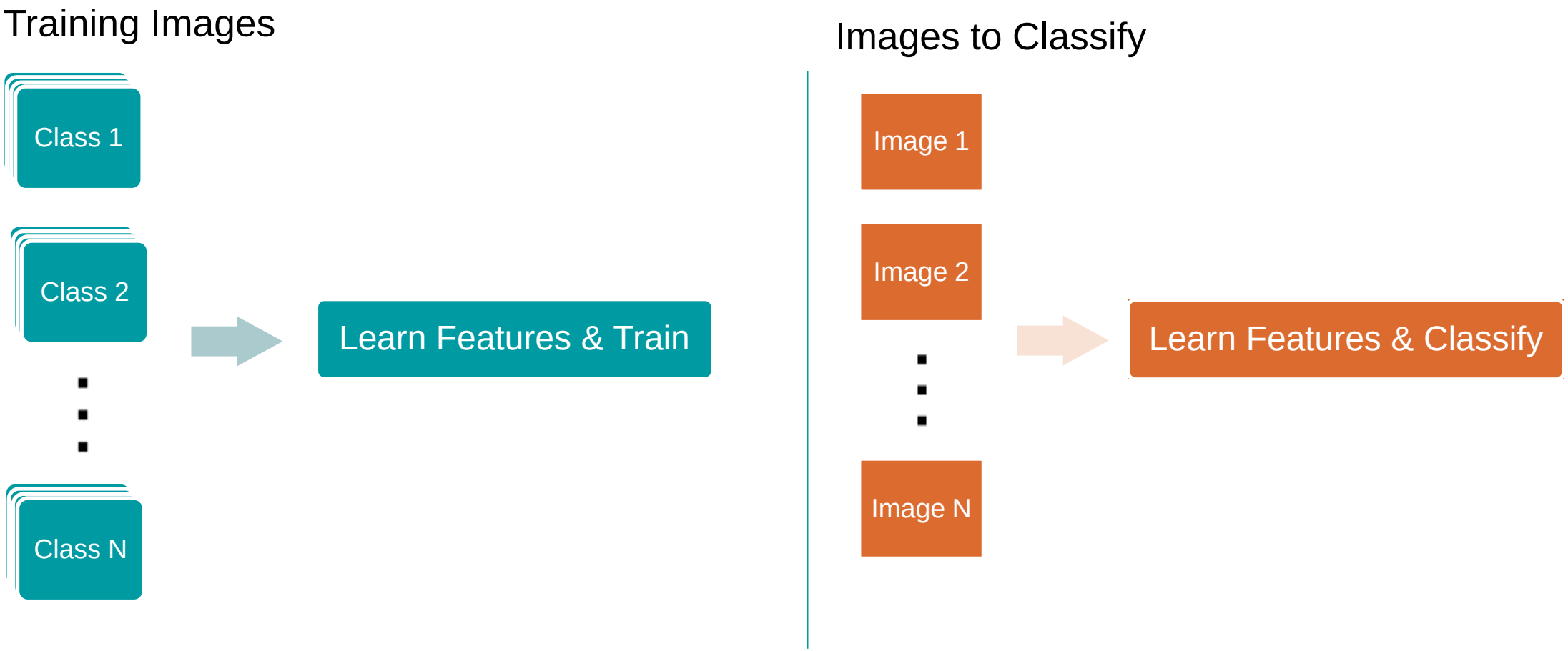
Deep Learning



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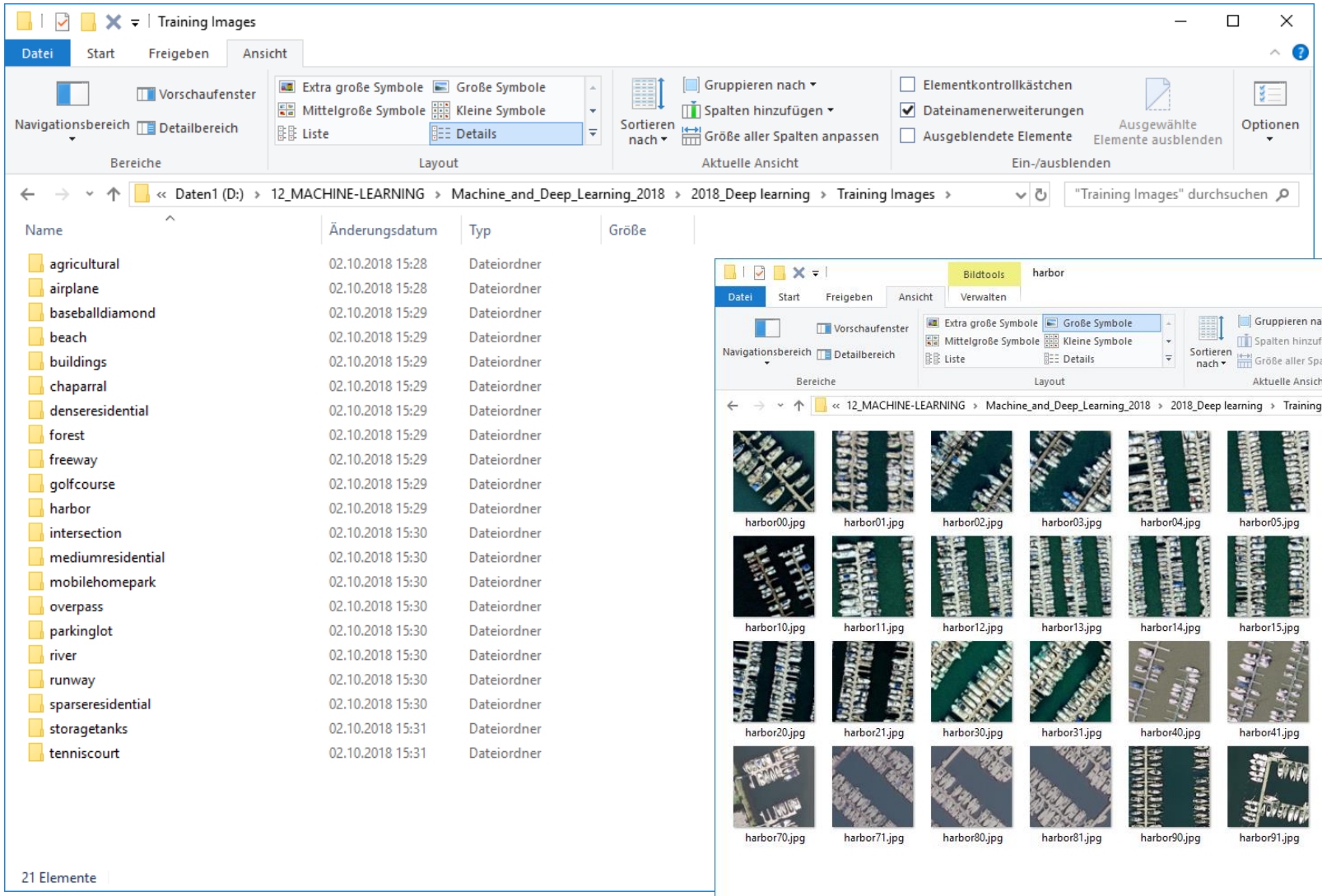
Umfangreiche Trainingsbilder werden benötigt



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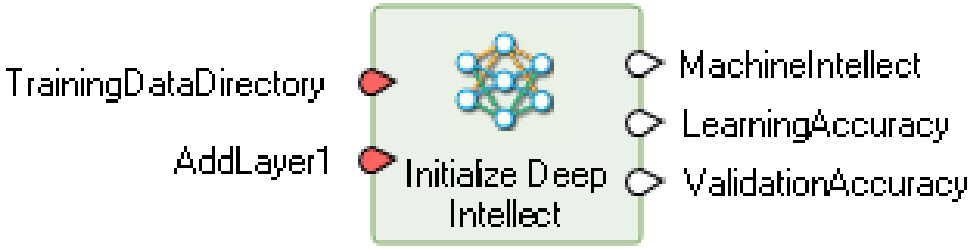
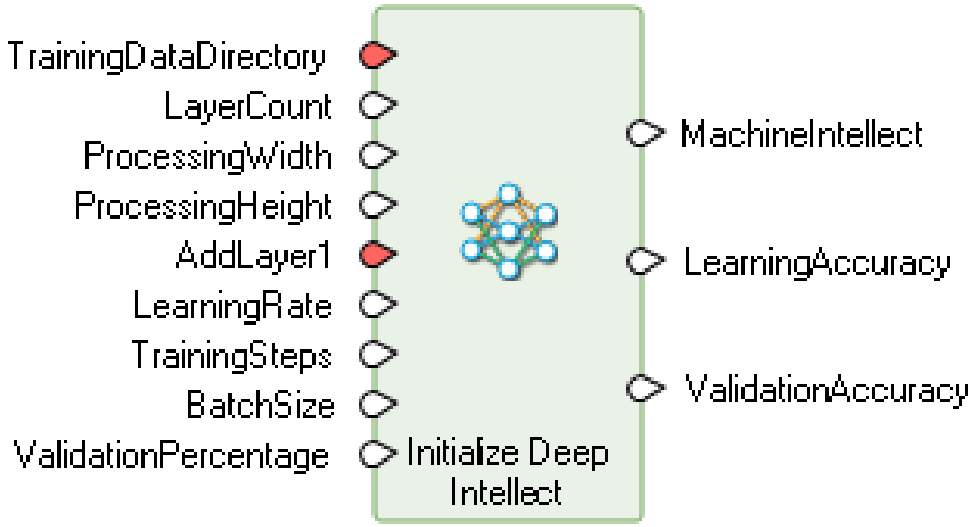
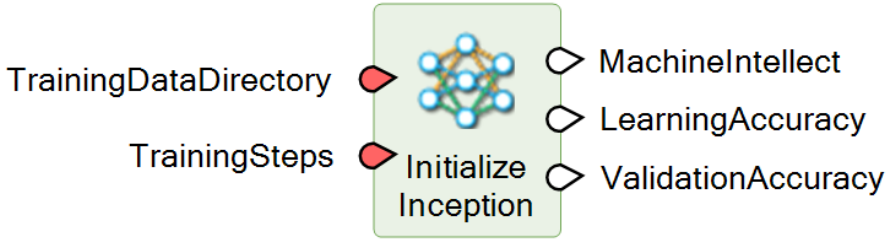
Initialize Deep Intellect







Trained by Google

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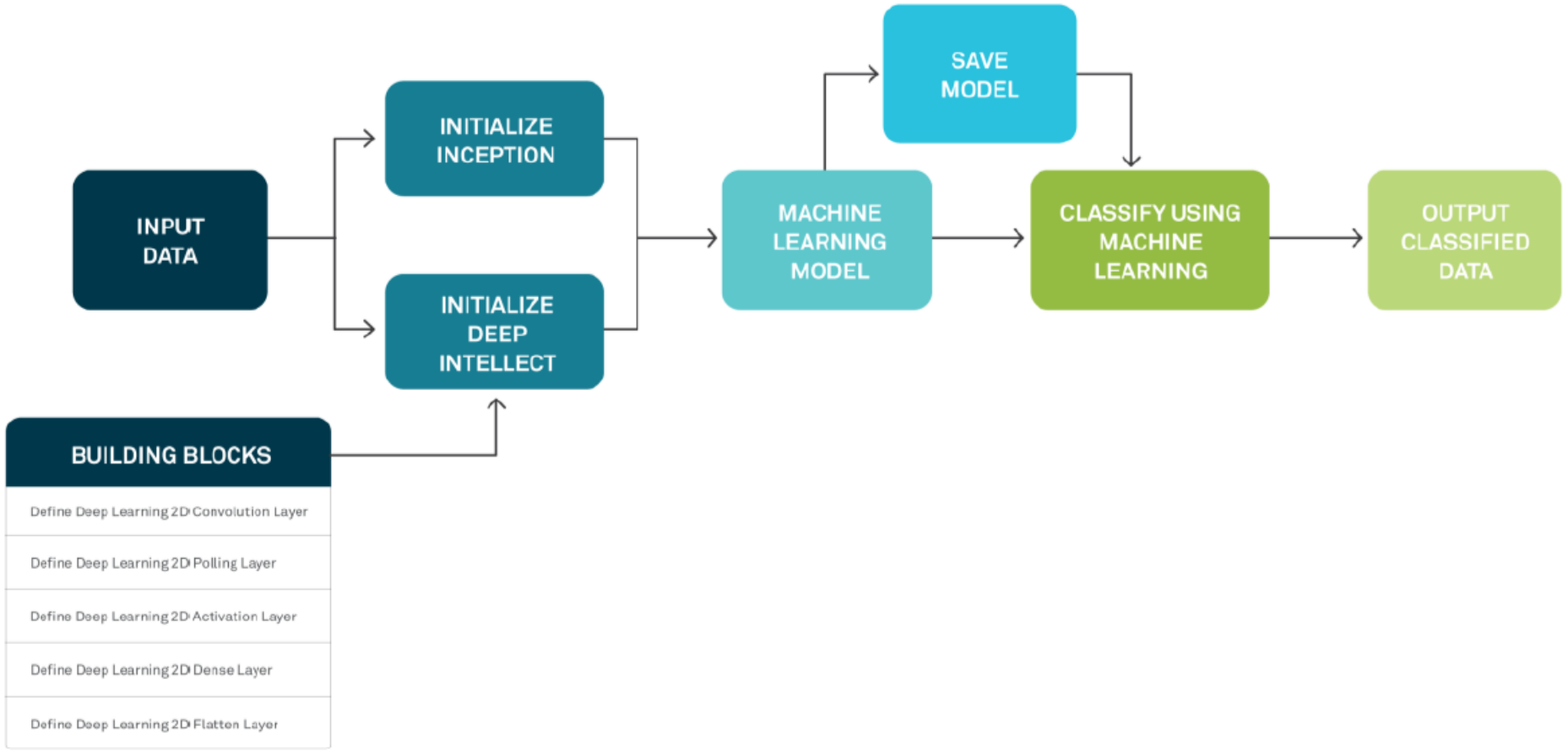
Ablaufschema Deep Learning in IMAGINE



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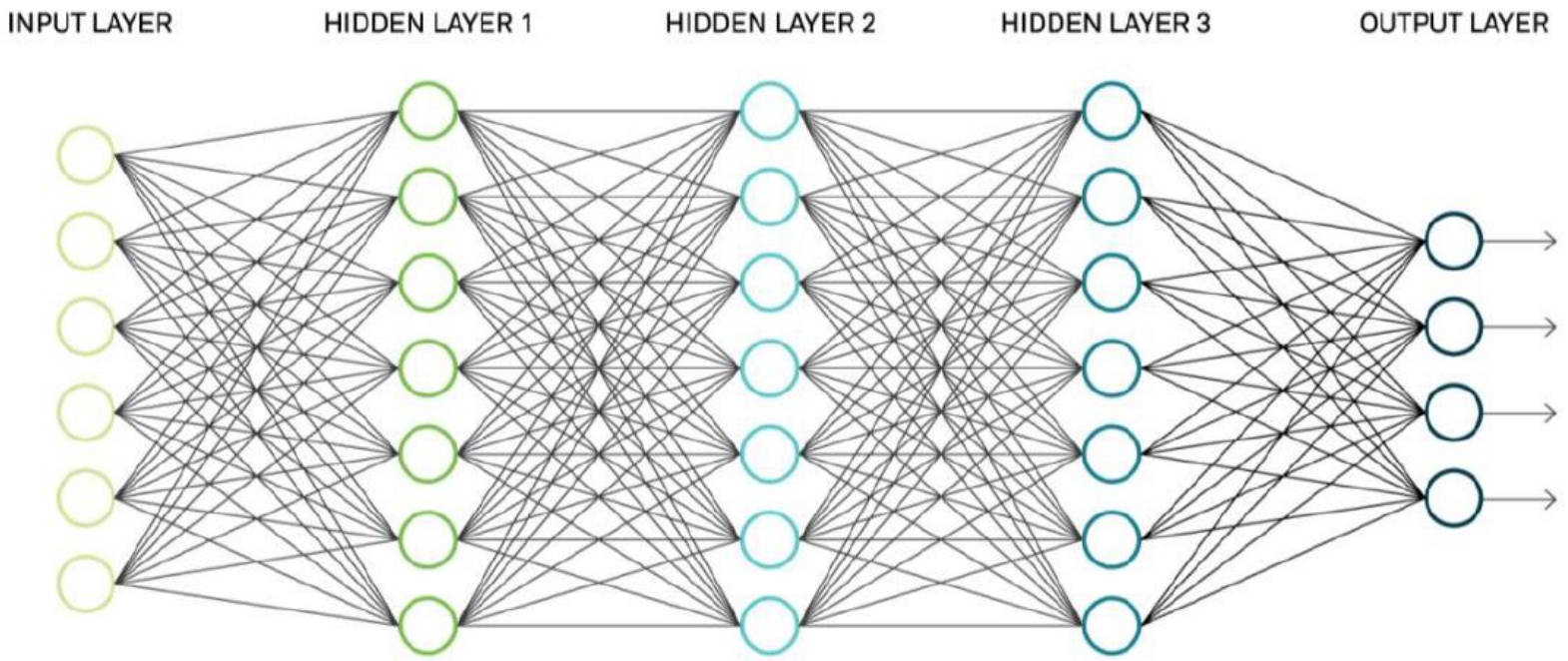
Deep Neural Networks

- Input layer – This is an input to the network. No computation is done in this layer.
- Hidden layers – All the computations are performed here. The input data is transformed through a series of operations.
- Output layer – Represents probability scores



A neural network with three hidden layers

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CNN – Convolutional Neural Networks

Convolutional Neural Networks (CNN) sind gut geeignet für bildrelevante Aufgaben

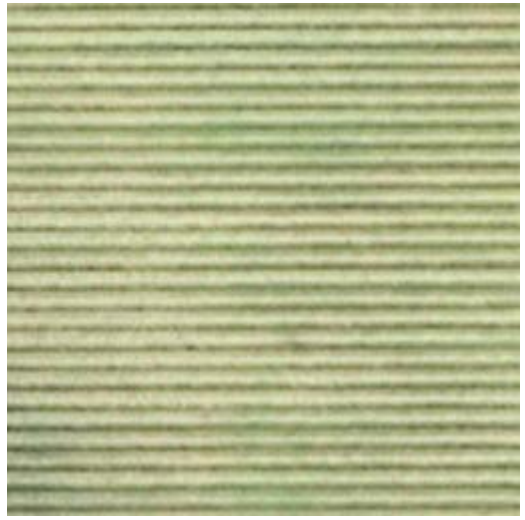
Der **Input Layer** wird durch die bereitgestellten Bilddaten abgebildet.

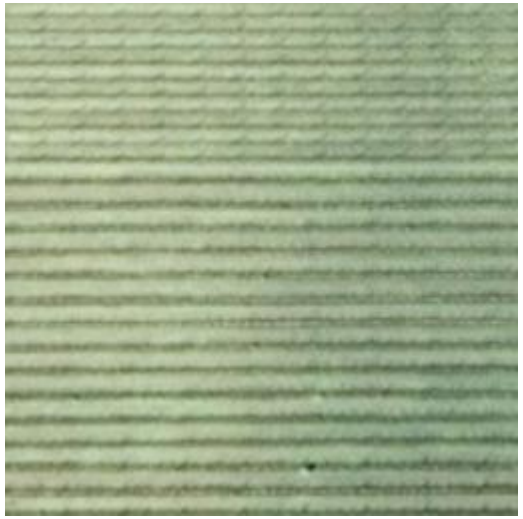
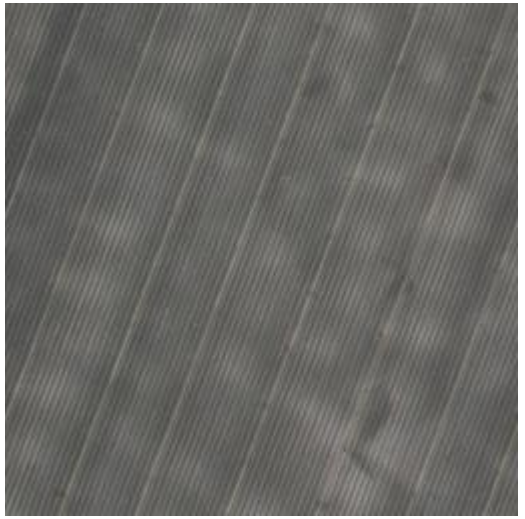
Hidden Layers wenden eine Reihe von Filtern auf das Bild an, um Features zu extrahieren und zu lernen, welche davon für die Klassifikation verwendet werden sollen.

Die Werte im **Output Layer** repräsentieren die Wahrscheinlichkeit eines Bildes zu einer Klasse zu gehören.

Trainingsdaten Acker



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Testmosaik zum Klassifizieren

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Deep Learning results

- 2120 images classified
  - Size: 8960 rows, 15360 columns
  - Divided into 2120 grids
  - 1941 classified correctly
  - 91.56% accuracy

Land Cover Type	Omissions	Commissions
agricultural	6	1
airplane	6	3
baseballdiamond	5	4
beach	1	0
buildings	15	19
chaparral	1	0
denseresidential	26	32
forest	1	0
freeway	8	7
golfcourse	5	6
harbor	1	2
intersection	5	17
mediumresidential	29	12
mobilehomepark	11	23
overpass	2	11
parkinglot	2	3
river	5	6
runway	11	4
sparseresidential	12	5
storagetanks	14	7
tenniscourt	14	18

Machine Learning vs. Deep Learning

	Machine Learning	Deep Learning
Training Dataset	Small	Large
Choose your own training attributes	Yes	No
Training time	Short	Long
CPU/ GPU/ Mem	Standard	Big

Fazit

- Machine Learning können alle => Open Source Bibliotheken stehen zur Verfügung
- ABER: Hexagon Geospatial macht das Machine Learning einfach
- Machine Learning-Operatoren können in Prozessketten eingebunden und gebatcht werden
- IMAGINE bietet die Werkzeuge, Trainingsdaten und zu klassifizierende Daten geeignet aufzubereiten.
- IMAGINE bietet die Werkzeuge, Daten nach der Klassifikation zu bearbeiten (Funktionale Attribute)
- Der Spatial Modeler wird kontinuierlich weiterentwickelt.
- Entwicklungen auf dem Sektor des Machine Learning werden von Hexagon Geospatial verfolgt und ggfs. implementiert
- Weitere Bibliotheken können über Python adressiert werden (Python-Anbindung des Spatial Modelers)

Mehr dazu auf dem UGM 2018 !

06. - 07. November 2018, Germering bei München

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Vielen Dank für Ihre Aufmerksamkeit!