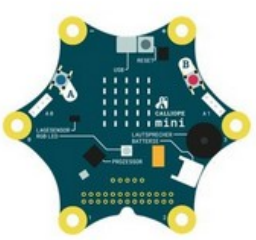
# KI@Calliope – Pipeline 1 Prototype 2
# Christian Schiller, 29.11.2019



**Wissen zu Künstlicher Intelligenz spielerisch in die Schulen bringen: Autonomes Fahren mit dem Calliope mini**

# Benötigte Software

- PuTTy (o.ä.)
  Data Capturing
- Python
  - Anaconda3 (empfohlen)
    Python Distribution&Environment manager
  - Jupyter Notebook
    IDE (Data Preparation)
  - Orange3
    IDE (Machine Learning)



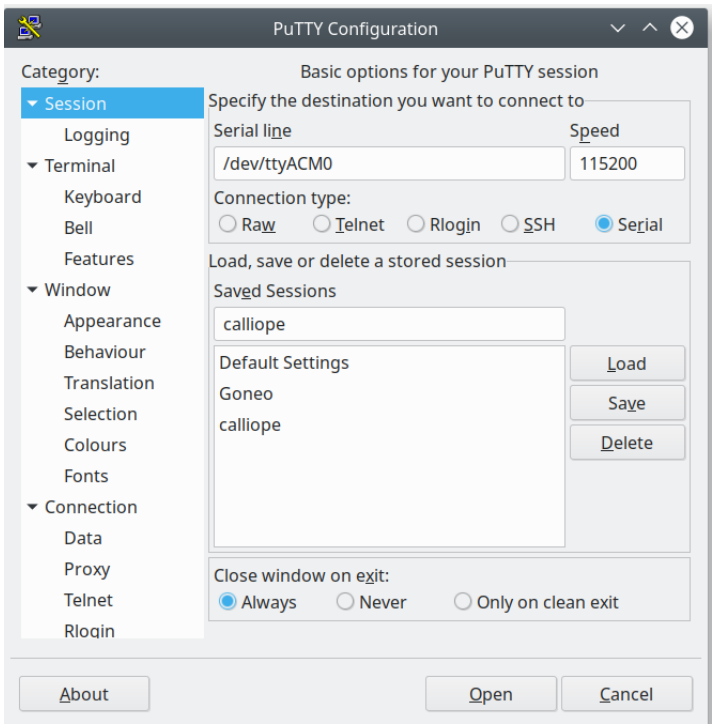

# Schritte - Überblick

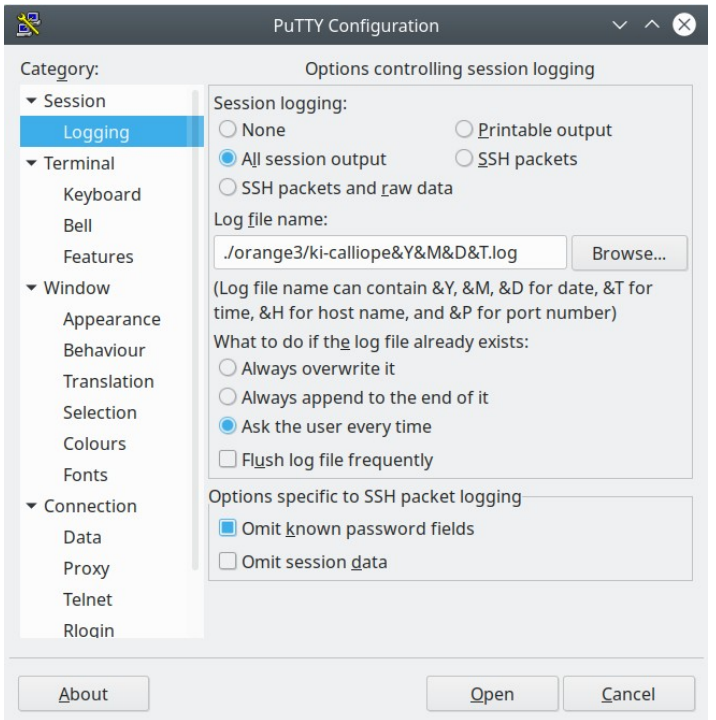
1) Trainingsdaten von einem Calliope Mini via USB mittels PuTTY loggen
   - Beispiel Logdatei = 10min Spielzeit des Autorennspiels:
     `car_race/orange3/putty-logs/carrace20191129002133.log` (Rohdaten)
     `car_race/orange3/10minutesplay.log` (Header entfernt)
2) Datenvorverarbeitung – Jupyter Notebook
   - Geloggte Trainingsdaten mittels eines Jupyter Notebooks in Machine-Learning-geeignetes Format überführen
   - Beispiel Ergebnis vorverarbeitete Daten basierend auf rohen Logdaten:
     `car_race/orange3/10minutesplay.csv`
3) Machine Learning – Orange3
   - Vorverarbeitete Daten in Orange3 Pipeline laden. Orange3 Workflow-Datei:
     `car_race/orange3/Pipeline1-Alpha.ows`
   - Beispiel Ergebnis trainiertes ML-Modell:
     `car_race/orange3/alpha-model.pkcls`
4) Evaluation
   - Trainiertes Modell in eine 1:1 Python-Nachimplementierung des Calliope-Rennspiels laden
   - Messen, wie lange das „autonome“ Auto durchhält.

} noch nicht implementiert

# Trainingsdaten von einem Calliope Mini via USB mittels PuTTY loggen

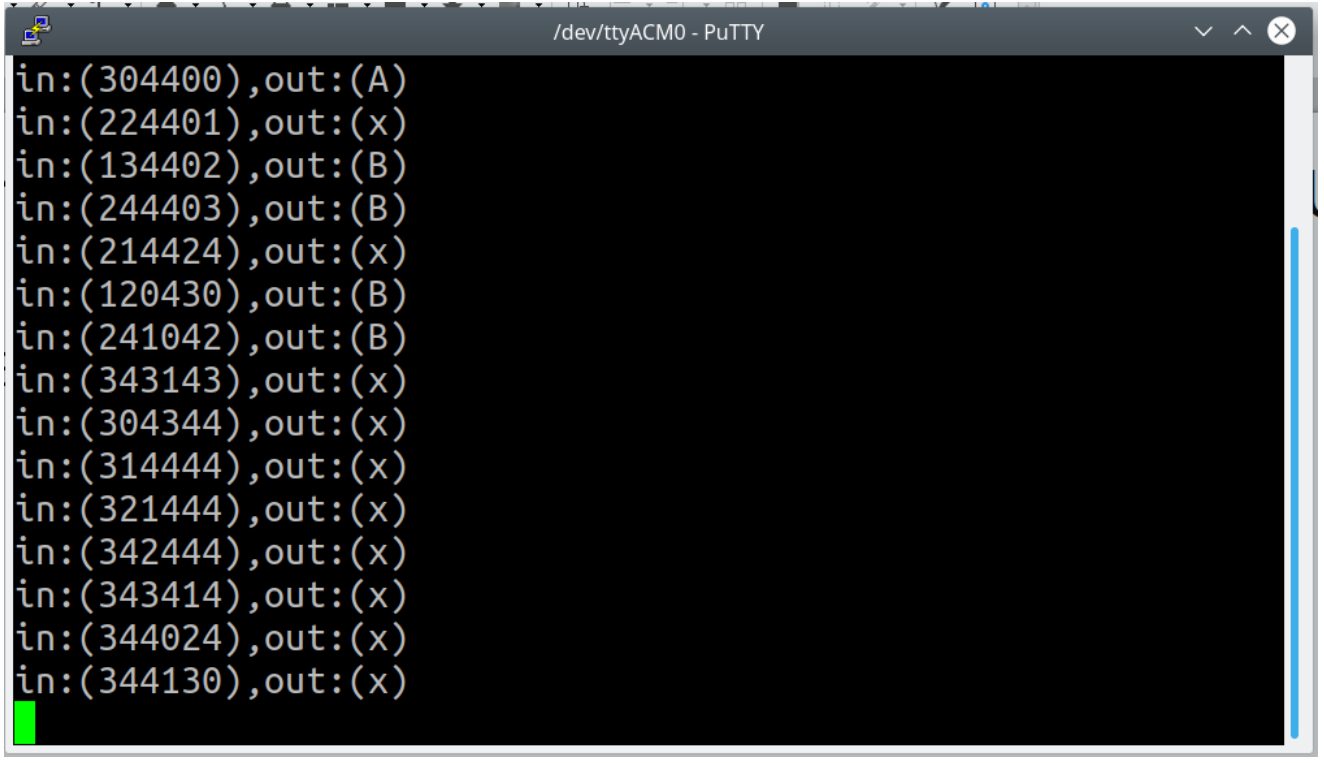
- Example configuration on Ubuntu 18.04LTS:
  Session and logging settings



# Trainingsdaten von einem Calliope Mini via USB mittels PuTTY loggen

- Example of logging during playing the car_race game



# Datenvorverarbeitung Jupyter Notebook

- Run Jupyter notebook `car_race/orange3/00 Preprocess data.ipynb`
- Set input logfile name
- Set output file name
- Example output CSV file:

10minutesplay.csv

```
PlayerPos,Car1Pos,Car2Pos,Car3Pos,Car4Pos,Car5Pos,Action
2,0,0,0,0,0,x
2,0,0,0,0,0,x
2,0,0,0,0,0,x
2,1,0,0,2,0,x
2,2,1,0,3,0,x
2,4,2,0,4,0,x
2,4,3,1,4,1,B
3,4,4,3,0,3,x
3,4,4,4,1,4,x
3,4,4,4,2,4,A
2,4,4,4,4,1,x
2,4,4,4,4,2,A
1,4,4,4,4,3,B
2,1,1,4,0,4,x
2,3,2,0,1,4,x
```

jupyter 00 Preprocess data Last Checkpoint: vor 16 Stunden (autosaved)

File Edit View Insert Cell Kernel Widgets Help

## Load raw data

In [3]:
```
import os
```

In [39]:
```
def load_data(path):
    """
    Load Dataset from File
    """
    input_file = os.path.join(path)
    with open(input_file, "r") as f:
        data = f.read()

    return data
```

In [45]:
```
raw_data = load_data('./10minutesplay.log')
```

## Preprocess raw data

In [41]:
```
import pandas as pd
```

In [49]:
```
preprocessed_data = None
preprocessed_data = pd.DataFrame(columns=['PlayerPos','Car1Pos','Car2Pos','Car3Pos','Car4Pos','Car5Pos','Acti
```

In [51]:
```
for i in raw_data.split('\n'):
    PlayerPos = i[4:5]
    Car1Pos = i[5:6]
    Car2Pos = i[6:7]
    Car3Pos = i[7:8]
    Car4Pos = i[8:9]
    Car5Pos = i[9:10]
    Action = i[17:18]
    preprocessed_data = preprocessed_data.append({'PlayerPos': PlayerPos,
                                'Car1Pos': Car1Pos,
                                'Car2Pos': Car2Pos,
                                'Car3Pos': Car3Pos,
                                'Car4Pos': Car4Pos,
                                'Car5Pos': Car5Pos,
                                'Action': Action},
                               ignore_index=True)
```

In [52]:
```
preprocessed_data.head()
```

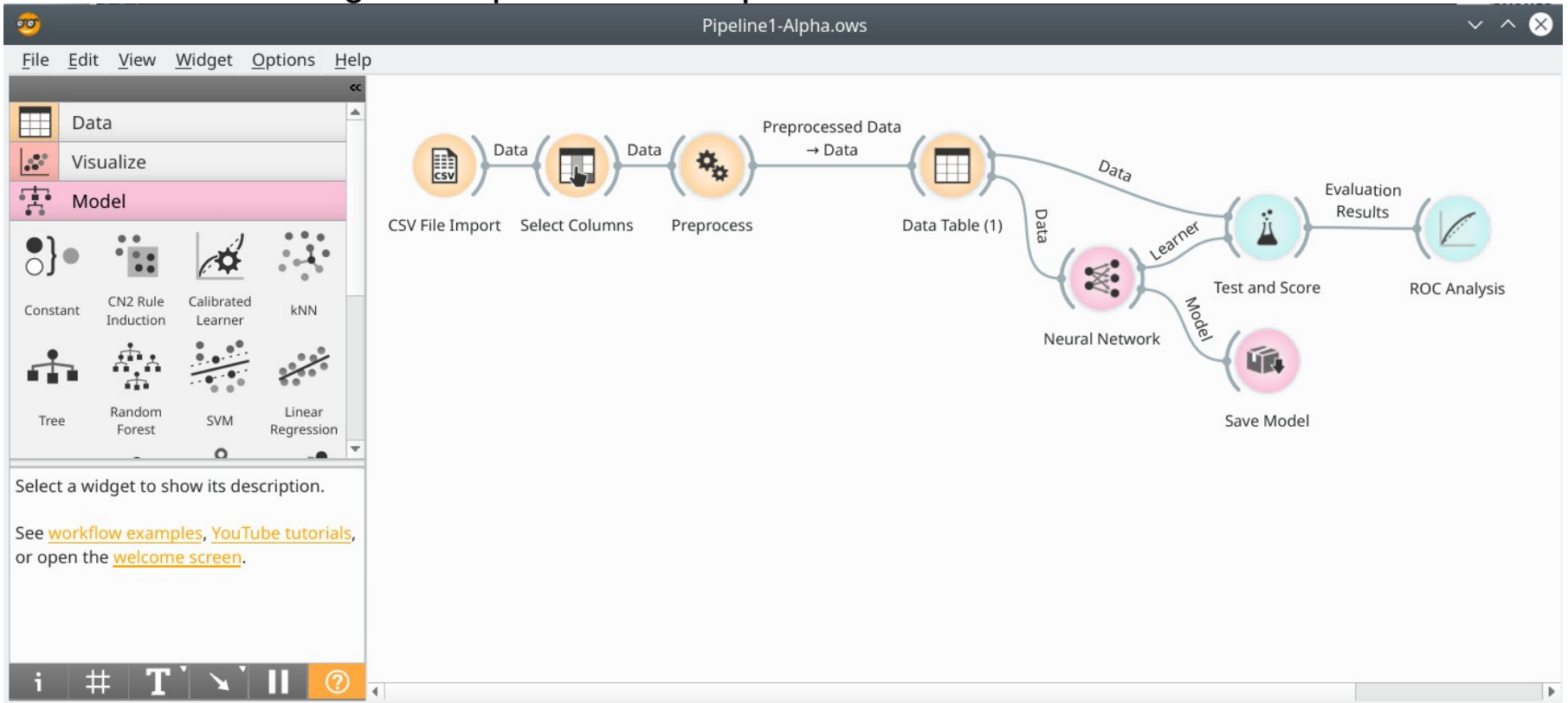
Out[52]:

| | PlayerPos | Car1Pos | Car2Pos | Car3Pos | Car4Pos | Car5Pos | Action |
|---|---|---|---|---|---|---|---|
| 0 | 2 | 0 | 0 | 0 | 0 | 0 | x |
| 1 | 2 | 0 | 0 | 0 | 0 | 0 | x |
| 2 | 2 | 0 | 0 | 0 | 0 | 0 | x |
| 3 | 2 | 1 | 0 | 0 | 2 | 0 | x |
| 4 | 2 | 2 | 1 | 0 | 3 | 0 | x |

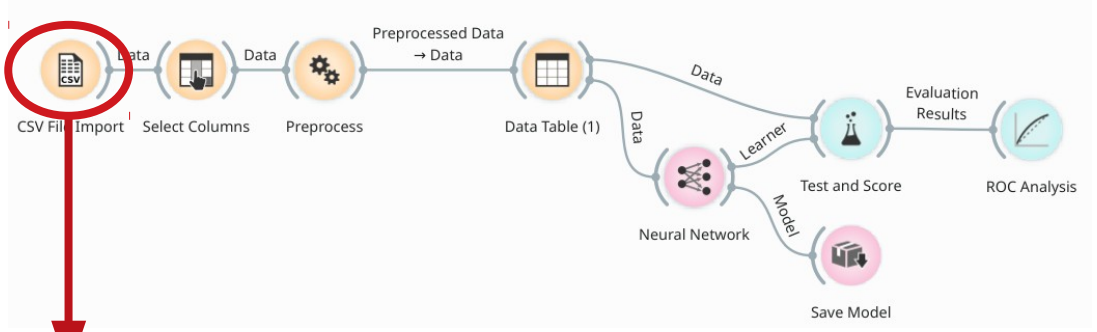
In [53]:
```
preprocessed_data.to_csv('10minutesplay.csv', encoding='utf-8', index=False)
```

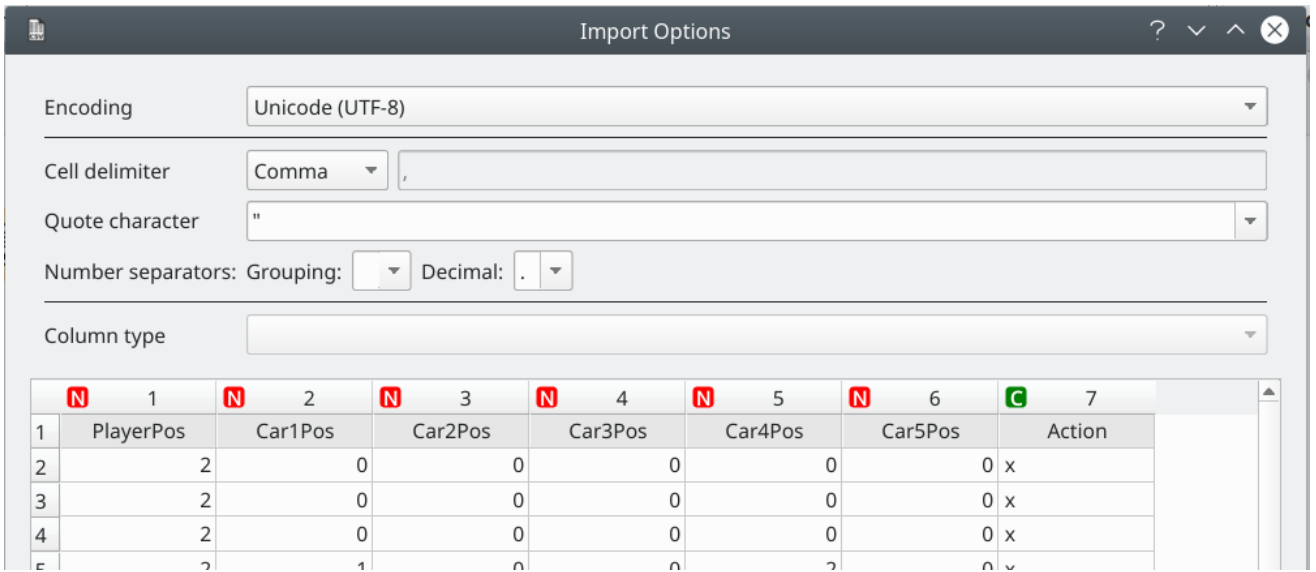
# Machine Learning – Orange3

- Open Orange3 Workflow `car_race/orange3/Pipeline1-Alpha.ows`



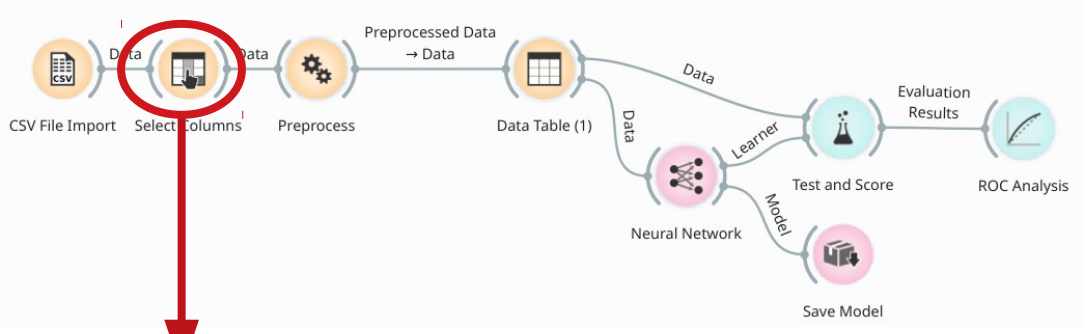
# Machine Learning – Orange3

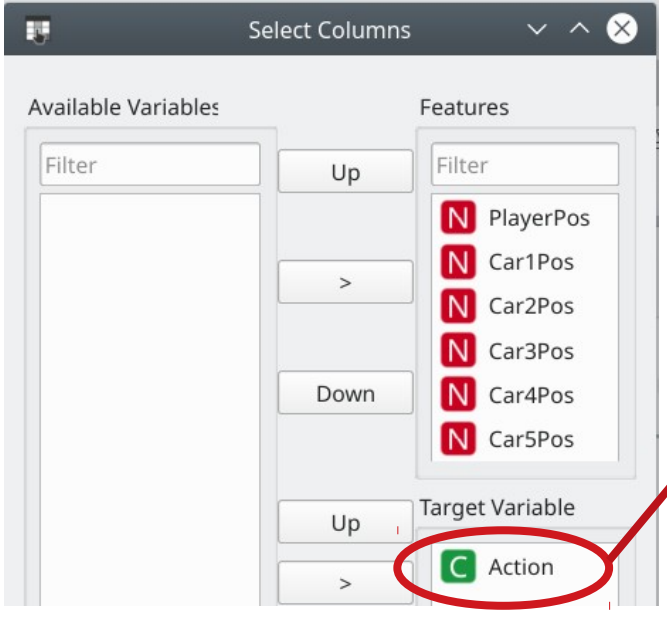



| | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|
| | PlayerPos | Car1Pos | Car2Pos | Car3Pos | Car4Pos | Car5Pos | Action |
| 2 | 2 | 0 | 0 | 0 | 0 | 0 | x |
| 3 | 2 | 0 | 0 | 0 | 0 | 0 | x |
| 4 | 2 | 0 | 0 | 0 | 0 | 0 | x |
| 5 | 2 | 1 | 0 | 0 | 2 | 0 | x |

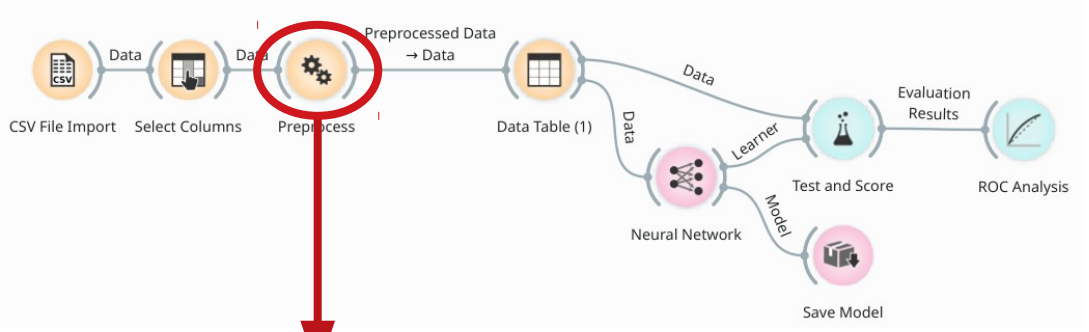
# Machine Learning – Orange3

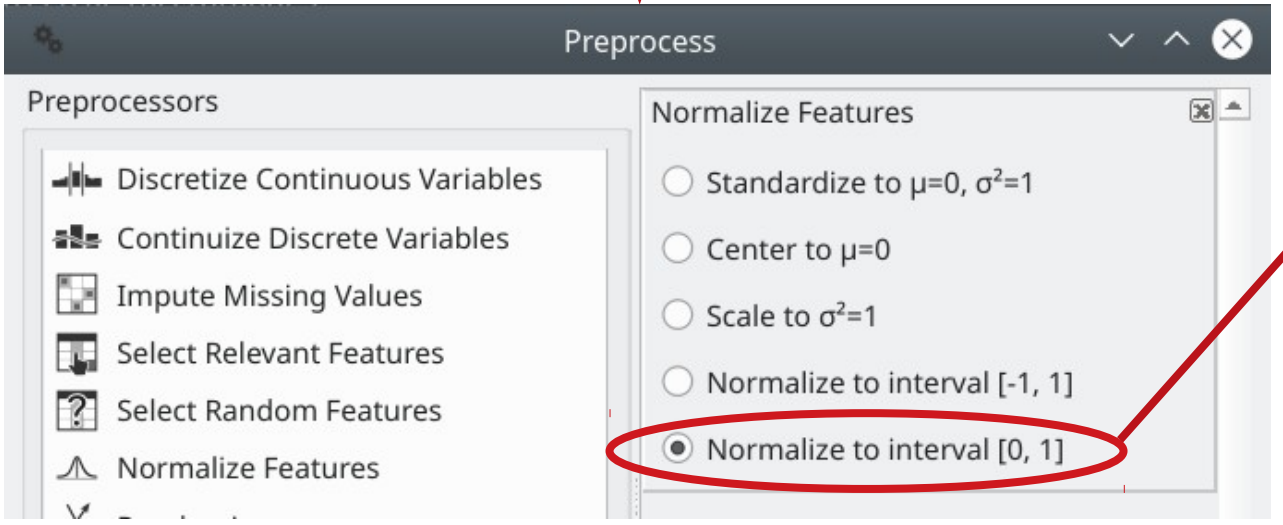



Wir wollen lernen zu steuern,
also ist das die Target Variable.
X = nichts zun
A = links lenken
B = rechts lenken

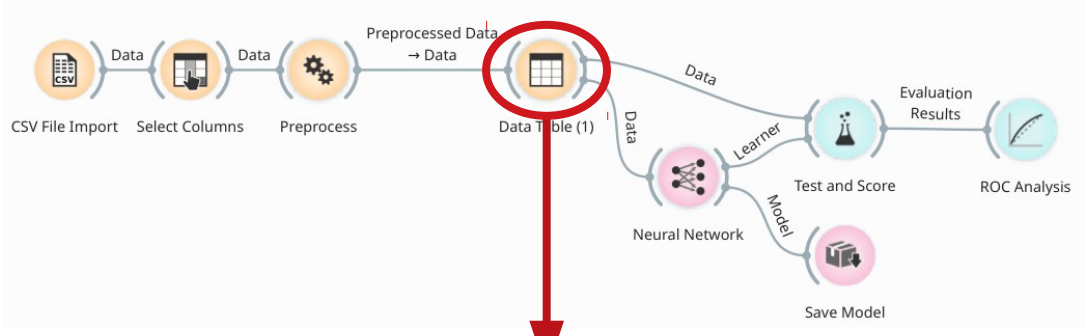
# Machine Learning – Orange3




Der Input in ein neuronales Netzwerk sollte auf 0..1 skaliert sein.

# Machine Learning – Orange3




Data Table (1)

Info

842 instances (no missing values)
6 features (no missing values)
Discrete class with 3 values (no missing values)
No meta attributes

Variables

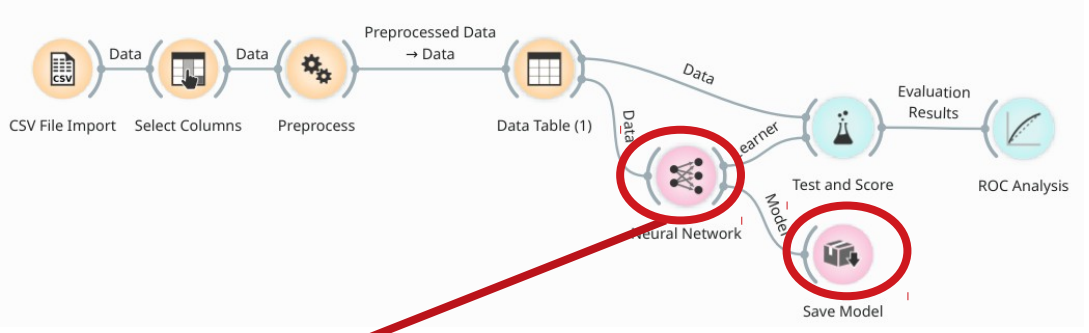
- [x] Show variable labels (if present)
- [ ] Visualize numeric values
- [x] Color by instance classes

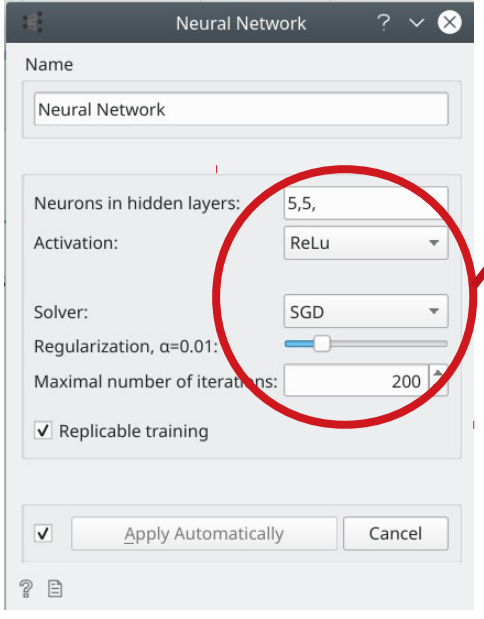
Selection

- [x] Select full rows

| | Action | PlayerPos | Car1Pos | Car2Pos | Car3Pos | Car4Pos | Car5Pos |
|---|---|---|---|---|---|---|---|
| 1 | x | 0.5 | 0 | 0 | 0 | 0 | 0 |
| 2 | x | 0.5 | 0 | 0 | 0 | 0 | 0 |
| 3 | x | 0.5 | 0 | 0 | 0 | 0 | 0 |
| 4 | x | 0.5 | 0.25 | 0 | 0 | 0.5 | 0 |
| 5 | x | 0.5 | 0.5 | 0.25 | 0 | 0.75 | 0 |
| 6 | x | 0.5 | 1 | 0.5 | 0 | 1 | 0 |
| 7 | B | 0.5 | 1 | 0.75 | 0.25 | 1 | 0.25 |
| 8 | x | 0.75 | 1 | 1 | 0.75 | 0 | 0.75 |
| 9 | x | 0.75 | 1 | 1 | 1 | 0.25 | 1 |
| 10 | A | 0.75 | 1 | 1 | 1 | 0.5 | 1 |
| 11 | x | 0.5 | 1 | 1 | 1 | 1 | 0.25 |
| 12 | A | 0.5 | 1 | 1 | 1 | 1 | 0.5 |
| 13 | B | 0.25 | 1 | 1 | 1 | 1 | 0.75 |
| 14 | x | 0.5 | 0.25 | 0.25 | 1 | 0 | 1 |
| 15 | x | 0.5 | 0.75 | 0.5 | 0 | 0.25 | 1 |
| 16 | x | 0.5 | 1 | 0.75 | 0.25 | 0.5 | 1 |

# Machine Learning – Orange3

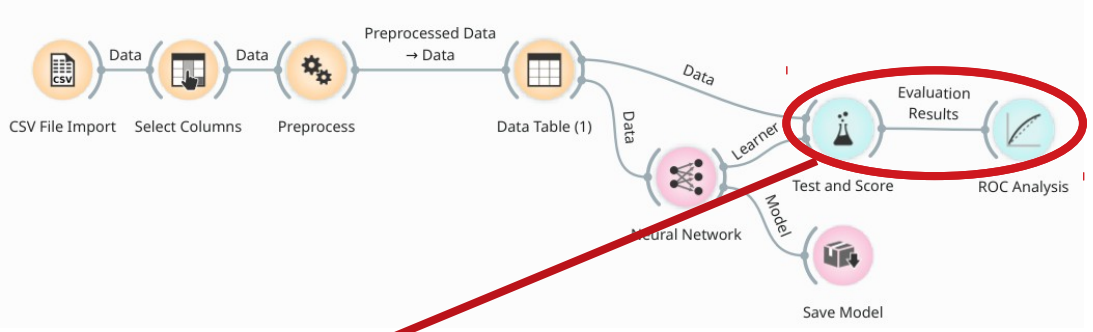


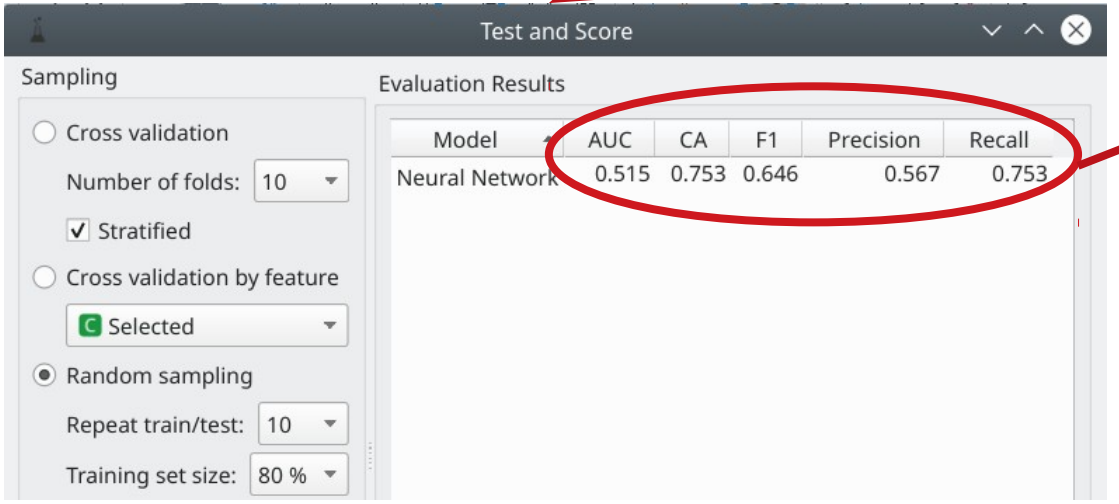




Die Hyperparameter des neuronalen Netzwerks werden hier definiert.
In der Dokumentation beispielhaft ein sehr kleines NN:
Zwei Hidden Layer mit je 5 Neuronen.

Das fertig trainierte Modell kann zur Einbindung in Anwendungen gespeichert werden (Save Model Widget)

# Machine Learning – Orange3




Wie man sieht ist die Leistung des Netzwerks mit nur 10min Trainingsdaten relativ schlecht. “Gut“ wären Wert >0.8, besser >0.9