Maschinelles Lernen mit MATLAB®

MATLAB EXPO 2015
DEUTSCHLAND

Jérémy Huard
Applikationsingenieur
The MathWorks GmbH
Machine Learning is Everywhere

- Image Recognition
- Speech Recognition
- Stock Prediction
- Medical Diagnosis
- Data Analytics
- Robotics
- and more…
Machine Learning

Machine learning uses **data** and produces a **program** to perform a **task**

**Task:** Human Activity Detection

### Standard Approach

**Hand Written Program**

If $X_{\text{acc}} > 0.5$
then “SITTING”
If $Y_{\text{acc}} < 4$ and $Z_{\text{acc}} > 5$
then “STANDING”
...

**Formula or Equation**

$Y_{\text{activity}} = \beta_1 X_{\text{acc}} + \beta_2 Y_{\text{acc}} + \beta_3 Z_{\text{acc}} + ...$

### Machine Learning Approach

**model:** Inputs $\rightarrow$ Outputs

```latex
model = <\textbf{Machine@Learning@Algorithm}>(\text{sensor\_data, activity})
```
Different Types of Learning

Machine Learning

Supervised Learning

Classification

Unsupervised Learning

• Discover a good internal representation
• Learn a low dimensional representation

Regression

• Output is a choice between classes
• (True, False) (Red, Blue, Green)

• Output is a real number (temperature, stock prices).
“Essentially, all models are wrong, but some are useful”
– George Box
### General Challenges in Machine Learning

**Hard to get started**

<table>
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<tr>
<th>Steps</th>
<th>Challenge</th>
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<tr>
<td>Access, explore and analyze data</td>
<td><strong>Data diversity</strong></td>
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<td></td>
<td>Numeric, Images, Signals, Text – not always tabular</td>
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Supervised Learning Workflow

Train: Iterate till you find the best model

Predict: Integrate trained models into applications
Statistics and Machine Learning

What’s New

Classification Learner

- New app to train models and classify data using supervised machine learning

Features

- Import and interactively explore data
- Choose kfold or holdout validation
- Train SVM, kNN, bagged trees and other algorithms
- Assess results using classification accuracy, ROC curves and Confusion Matrices
- Export models to the MATLAB or generate MATLAB code
Train a Model with the Classification Learner App
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1. Data import and Cross-validation setup
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2. Data exploration and feature selection
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4. Model comparison and assessment
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5. Share model
Train a Model with the Classification Learner App

1. Data import and Cross-validation setup
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3. Train multiple models
4. Model comparison and assessment
5. Share model or automate process
Statistics and Machine Learning

What’s New?

New:
- Classification Learner app
- Multiclass SVM
- Statistical tests for comparing classifiers
- Kmediods Clustering (robust to outliers)
- C Code Generation for PCA

Enhancements:
- Speedup of the kmeans and gmdistribution using the kmeans++
- Performance enhancements for decision trees and performance curves
Key Takeaways

Machine Learning with MATLAB:

- For complex tasks with no equation or formula
- Interactive App-driven workflow
- Flexible architecture for customized workflow
Additional Resources

Documentation

mathworks.com/machine-learning