



# „Look into my eyes – AI on IoT“

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# Outline

- Introduction
- A little Hands off
- Collecting data
- Amazon Sagemaker – A fully managed Plattform Services
- Model Deployment – Various Options
- Amazon Rekognition and Polly – Fully Managed Application Services AI on IoT
- RaspberryPi and Node-RED
- Demo!
- Questions & Discussions

Who we are and where we go

# **INTRODUCTION**

# Introduction – Speaker and his Company

## Malte Walkowiak

- First steps in C
- Felt in love with R
- Daily work mainly in Python
- (Maybe) next week: PhD in natural science/chemistry
- Strong interest on Arduino and Raspberry Pi



- **Founded in 1999** as a spin-off of the Herrlich & Ramuschkat GmbH
- **Owner-managed** group of companies
- **100+** employees
- **Locations** in Hannover, Duisburg, Frankfurt & Munich
- **AWS [Amazon Web Services] Partner since 2011**
- **AWS Authorized Training Partner**
  - AWS Premier Consulting Partner
  - AWS Data and Analytics Competency
  - Public Sector & Public Sector Channel Partners
- **AWS Audited Next Generation MSP Partner**
- **Amazon Connect Go-to Consulting Partner**

# Introduction – UseCase

- How can you access rental apartments without keys?
- AirBnB has asked this question. The solution was technically implemented on AWS.
- Registration and rental of the apartment



Client



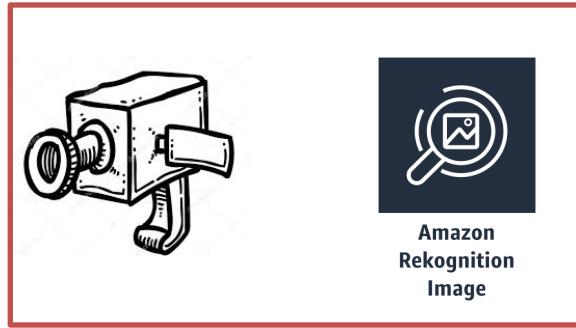
Amazon  
DynamoDB



Amazon S3

# Introduction – UseCase

- How can you access rental apartments without keys?
- AirBnB has asked this question. The solution was technically implemented on AWS.
- Getting access to the apartment



Here we go: AI on IoT

Where to start and where to go?

# A LITTLE HANDS OF

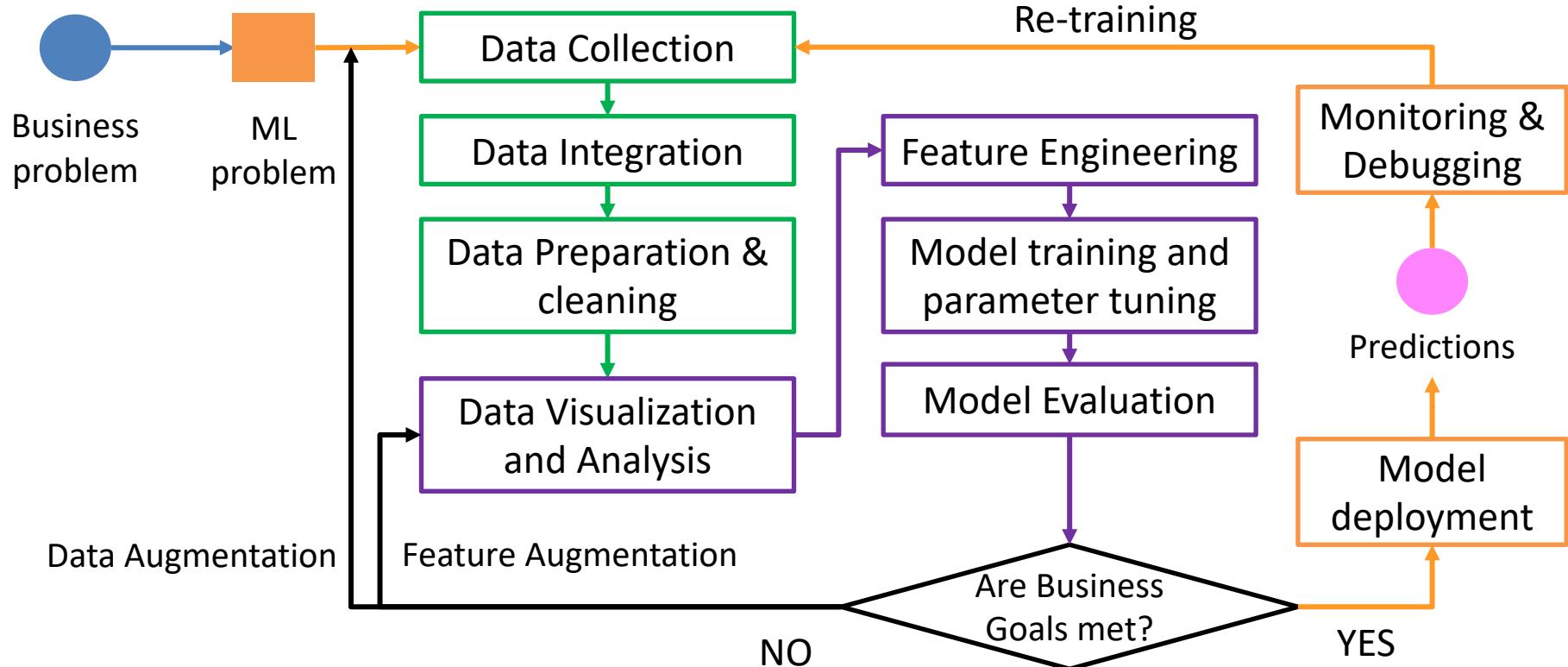
# A little Hands off - What comes up with AI/ML (on AWS)?

- Question defines the effort
- Sufficient database needed
- Understanding of the data
- Preparation and making data available
- Development and implementation of models
- Check the models and improve



Up to 80% of the work is spent on this

# A little Hands off - What comes up with AI/ML (on AWS)?



# A little Hands off - AI/ML on AWS

## Application Services

API-driven services: Video, Image and Language Services as well as Chatbots

## Platform Services

Using high-performance ML-algorithms, broad framework support, one-click-proceeding (training, tuning, inference)

## Frameworks & Infrastructure

Develop sophisticated models with any framework, create managed, autoscaling clusters of GPUs for large scale training, or run inference on trained models

# A little Hands off - AI/ML on AWS

## Application Services



## Platform Services



## Frameworks & Infrastructure



“Big data isn’t about bits, it’s about talent.” – Douglas Merrill

## **COLLECTING DATA**

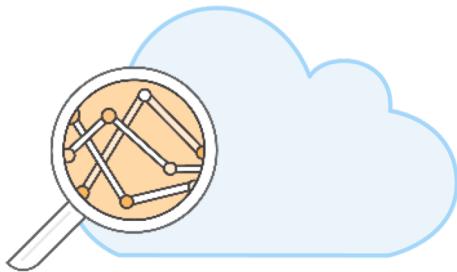
# Collecting data - Tooling

- Establishing Amazon S3 as Data repository/Data Lake
- Create a Data Catalogue with AWS Glue
- Query your Data Lake based on the Data Catalogue with Amazon Athena

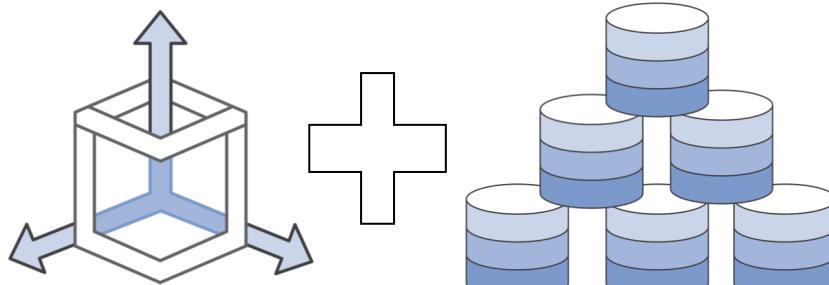


- Collecting all raw data.
- Transform and enrich the data.

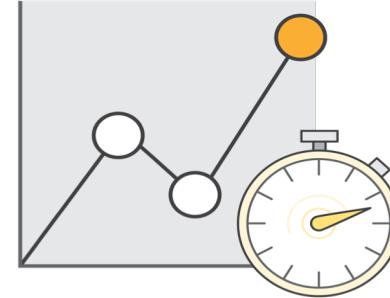
# Collecting data – Data Lake Benefits



Store and analyze data in one centralized location



Separate your storage and compute layer



Ingest data without a pre-defined schema



Perform ad hoc analysis

AI/ML is about finding patterns in data!

# **AMAZON SAGEMAKER – A FULLY MANAGED PLATTFORM SERVICES**

# Amazon SageMaker – A fully managed Plattform Services



Amazon  
SageMaker

- Fully managed Machine Learning service
- Fully flexible:
  - Several built-in algorithms
  - Bring your own algorithm
  - Supports common frameworks (TensorFlow, PyTorch, Caffe2,...)
- Paid by second

# Amazon SageMaker – A fully managed Plattform Services



Amazon  
SageMaker

- Build
  - Managed Jupyter Notebooks for Authoring Models
- Train
  - One-click Training
  - Automatic Model Tuning
  - Train Once, Run Anywhere
- Deploy
  - One-click Deployment
  - Automatic A/B Testing
  - Fully-managed Hosting with Auto Scaling
  - Inference Pipelines

# Amazon SageMaker – A fully managed Plattform Services



Amazon  
SageMaker

- Supports Inference Pipelines
  - Use raw data as input and execute pre-processing, predictions, and post-processing on real-time and batch inference requests.
  - Inference Pipelines can be comprised of any machine learning framework, built-in algorithm, or custom containers usable on Amazon SageMaker.

# Amazon SageMaker – Jupyter Notebooks

jupyter Demo Last Checkpoint: vor 2 Minuten (unsaved changes)

File Edit View Insert Cell Kernel Widgets Help

In [2]: `import pandas as pd  
import numpy as np  
import matplotlib.pyplot as plt  
%matplotlib inline`

In [7]: `fares = pd.read_csv("Pred:`

In [4]: `fares.describe()`

Out[4]:

	fare_amount	surcharge
count	49999.000000	49999.000000
mean	12.443674	0.320686
std	13.658216	0.362571
min	0.000000	0.000000
25%	6.500000	0.000000
50%	9.500000	0.000000
75%	14.000000	0.500000
max	2069.500000	1.500000

In [8]: `vals = np.random.normal(0,0.5,10000)  
plt.hist(vals,50)  
plt.show()`

# Amazon SageMaker – Jupyter Notebooks – a minimal Example

```
import sagemaker

algo = sagemaker.AlgorithmEstimator(
    algorithm_arn='arn:aws:sagemaker:us-west-2:1234567:algorithm/some-algorithm',
    role='SageMakerRole',
    train_instance_count=1,
    train_instance_type='ml.c4.xlarge')

train_input = algo.sagemaker_session.upload_data(path='/path/to/your/data')

algo.fit({'training': train_input})
algo.deploy(1, 'ml.m4.xlarge')

# When you are done using your endpoint
algo.delete_endpoint()
```

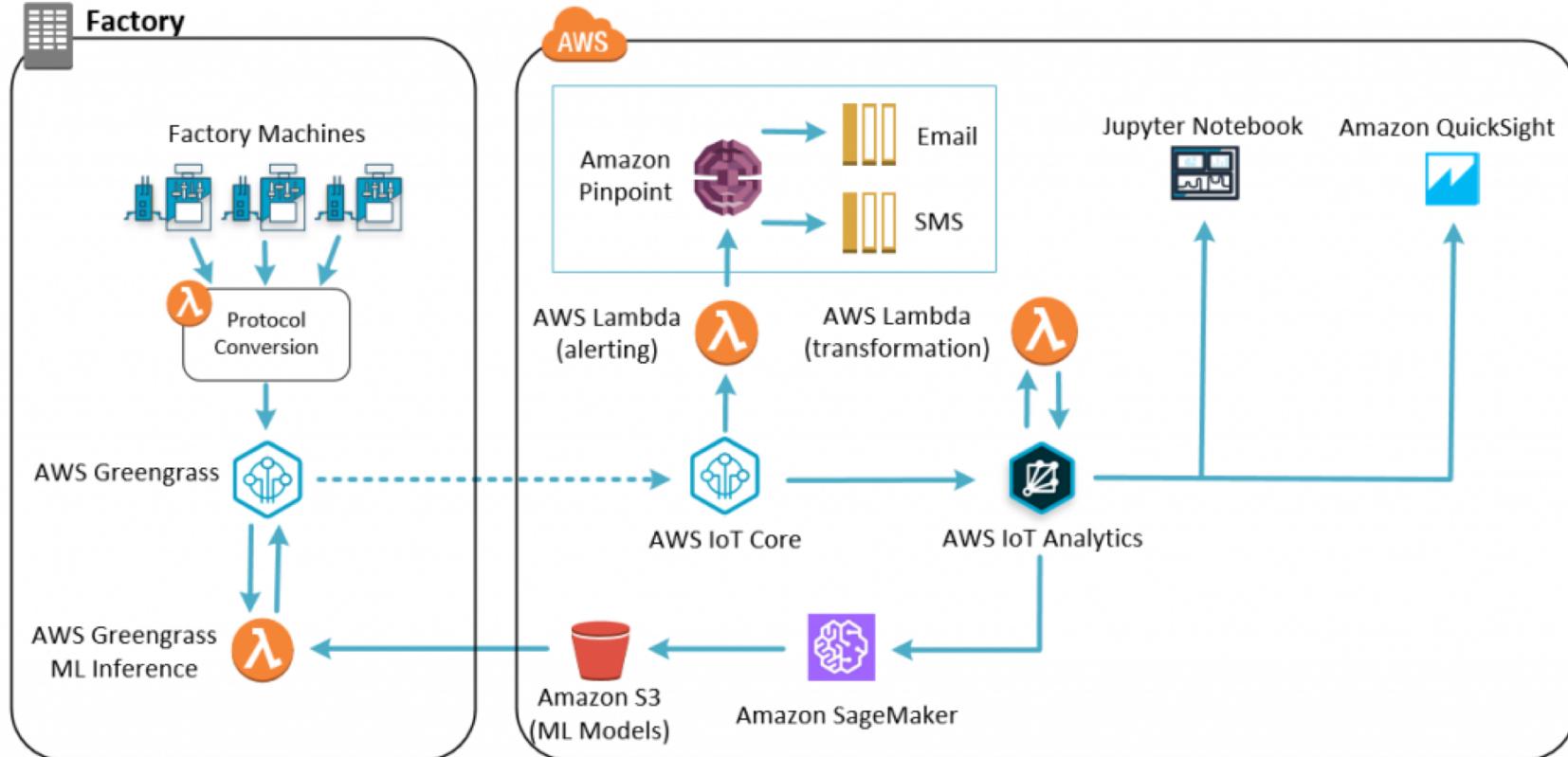
“Before we developed Sagemaker, the data scientist passed her/his model to the data engineer. Putting a model in production could took months!” – An AWS Solutions Architect

## **MODEL DEPLOYMENT – VARIOUS OPTIONS**

# Model Deployment – Various Options

	Amazon SageMaker Deployment	AWS Lambda
Real-time Sync	Use managed real-time inference cluster	On-demand request-based model
Real-time Async	Use Amazon Kinesis and AWS Lambda to invoke the real-time inference endpoint	Use Amazon Kinesis and AWS Lambda to host the model and execute inferences in Lambda
Batch	Use batch transform	Need to implement batch processing
Edge (Greengrass)	Use built-in AWS Greengrass model hosting	Deploy a Lambda function on AWS Greengrass to execute inferences

# Deployment - Predictive Maintenance with AWS Greengrass



<https://aws.amazon.com/de/blogs/iot/using-aws-iot-for-predictive-maintenance/>

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Sounds good! But I have no Data Lake (and maybe I do not want one)!

# **AMAZON RECOGNITION AND POLLY– FULLY MANAGED APPLICATION SERVICES**

# Amazon Rekognition (Movie & Image)

- Deep Learning
- Recognises image content
- Finding and comparing faces (AirBnB UseCase)
- Recognition is a highly scalable deep learning technology
- Prime Photos (every day billions of images)
- Output:
  - Detected objects with a confidence value
  - Coordinates of a rectangular bounding box around the object
- Easily available by API-calls

<https://aws.amazon.com/de/rekognition/>

# Amazon Rekognition (Movie & Image)



# Amazon Rekognition (Movie & Image)



| Don't – 98% |

| think – 99% |

| outside – 99% |

| the – 98% | box. – 78% | Think – 96% |

| like – 89% |

| there – 98% | is – 97% |

| no – 71% | box. – 78% |

# Amazon Rekognition (Movie & Image)



Done with the demo?

[Learn more](#)

## ▼ Results



**Jeff Bezos**  
[Learn More](#)

Match confidence

100 %

## ▼ Request

```
{  
  "Image": {  
    "S3Object": {  
      "Bucket": "console-sample-images-dub",  
      "Name": "jeff_portrait.jpg"  
    }  
  }  
}
```

# Amazon Rekognition – Detecting Jeff Bezos

```
{  
  "CelebrityFaces": [  
    {  
      "Urls": [  
        "www.imdb.com/name/nm1757263"  
      ],  
      "Name": "Jeff Bezos",  
      "Id": "1SK7cR8M",  
      "Face": {  
        "BoundingBox": {  
          "Width": 0.4337500035762787,  
          "Height": 0.651358962059021,  
          "Left": 0.28312501311302185,  
          "Top": 0.12277413159608841  
        },  
        "Pose": {  
          "Roll": -4.307190418243408,  
          "Yaw": 5.115738391876221,  
          "Pitch": -6.360623359680176  
        },  
        "Quality": {  
          "Brightness": 88.5540542602539,  
          "Sharpness": 97.46806335449219  
        }  
      },  
      "MatchConfidence": 100  
    }  
  ],  
  "UnrecognizedFaces": []  
}
```

# Amazon Rekognition – Under Different Circumstances

Done with the demo?

[Learn more](#)

## ▼ Results



=



Similarity

99.8 %

# Amazon Rekognition – Under Different Circumstances



$\neq$



$\neq$



# Amazon Polly – Under Different Circumstances

- Amazon Polly turns text into realistic speech output
- Develop engaging applications
- Language-enabled products
- Dozens of lifelike voices

Sprache	Weiblich	Männlich	Probentext
Englisch	<a href="#">Joanna</a>	<a href="#">Matthew</a>	Guten Tag. Sprechen Sie eine Fremdsprache? Eine Sprache ist niemals genug.
Brasilianisches Portugiesisch	<a href="#">Vitória</a>	<a href="#">Ricardo</a>	Oi. Você fala algum idioma estrangeiro? Somente um idioma nunca é bastante.
Dänisch	<a href="#">Naja</a>	<a href="#">Mads</a>	Hej. Taler du et fremmed sprog? Et sprog er aldrig nok.
Französisch	<a href="#">Léa</a>	<a href="#">Mathieu</a>	Bonjour. Parlez-vous une autre langue que le français? Une langue n'est jamais assez.
Japanisch	<a href="#">Mizuki</a>	<a href="#">Takumi</a>	こんにちは、外国語を話せますか？ 世界にはたくさんの言語があります。
Koreanisch	<a href="#">Seoyeon</a>		? 외국어를 구사하십니까? 이 세상에는 수많은 언어들이 있답니다.
Mandarin (Chinesisch)	<a href="#">Zhiyu</a>		你好，你会不会说其他外语？只会一种语言是不够的。
Spanisch	<a href="#">Penélope</a>	<a href="#">Miguel</a>	Hola. ¿Hablas algún idioma extranjero? Un solo idioma no es suficiente.

# Amazon Polly – WebPress Reader

## Amazon AI Plugin for WordPress



Amazon AI Plugin for WordPress

By AWS Labs, WP Engine

Download



“Anytime someone asks me how to start a tech project into reality, my immediate instinct is to recommend the Raspberry Pi. Cheap and indestructible.” - Thorin Klosowski

## **RASPBERRYPI AND NODE-RED**

# RaspberryPi and Node-RED

- IoT (Internet of Things)
- Possibility of data transfer to the cloud
- Perform cloud functions on narrow devices
  
- Raspberry PI
  - Single board computer of the Raspberry Pi Foundation
  - Broadcom single-chip system with an ARM microprocessor,
  - Size of the board is about the equivalent of a pack of cigarettes.
  - 2012: Introduction
  - 2017: 17 million units sold

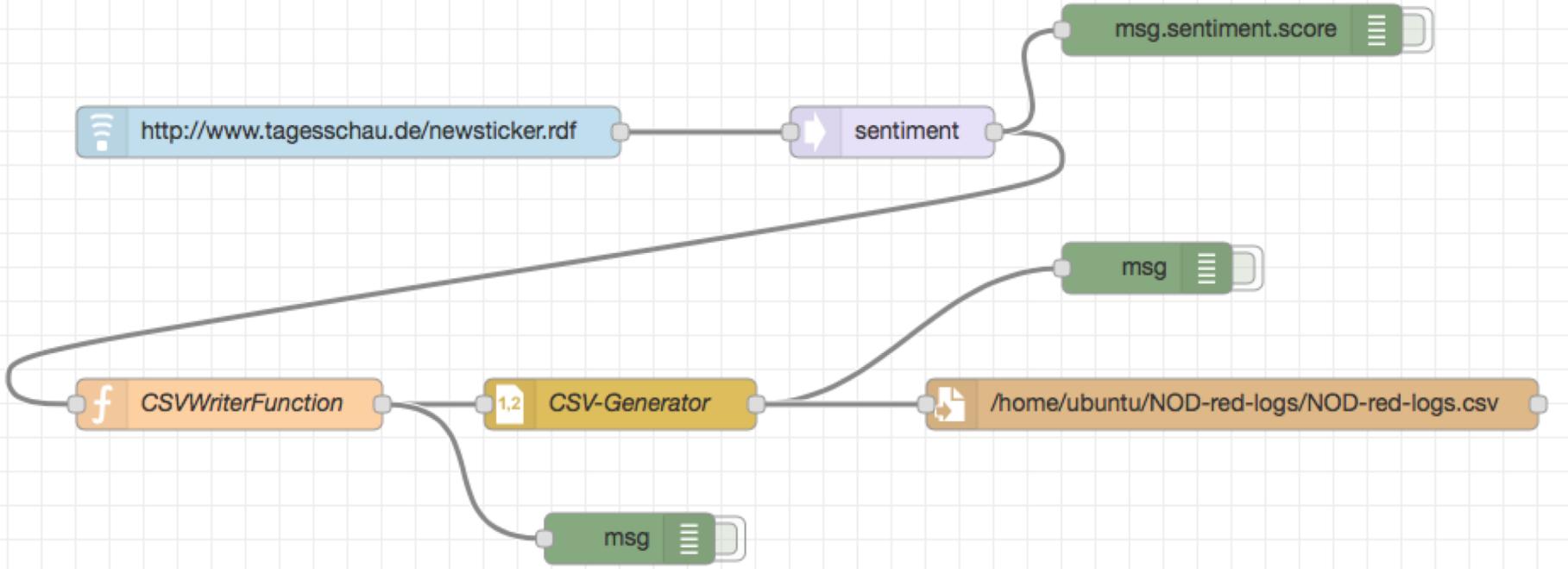
# RaspberryPi and Node-RED

- Node-RED is a graphical development tool developed by IBM.
- Modular principle: Function blocks are connected by pulling connections
- Large selection of included components
- In 2016, IBM has transferred Node-RED as open source software to the JS Foundation.

# RaspberryPi and Node-RED

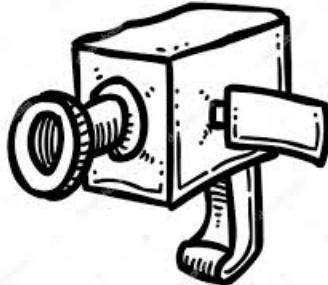
- Flow-based Programming: Behaviour of an application = network of black boxes
  - Each node has a well-defined purpose
  - Data is read in, processed and forwarded by specific nodes
  - The options for processing data are determined by the node-type
  - Only functions-Nodes can be programmed
  - Debug nodes after each step
- Network regulates the data flow
- Visual representation and makes it suitable for a larger number of users (more accessible)

# RaspberryPi and Node-RED



# Demo!

- On the Raspberry Pi runs a Node-RED flow
- The camera takes a picture
- Rekognition recognizes labels
- Polly creates a sentence from the labels plus fixed components



Amazon  
Rekognition  
Image



Amazon Polly

# Questions?

- Pricing
  - Rekognition: Price per 1,000 Images Processed: 1 \$
  - Polly: 1,000 requests, 1,000 characters per request → 1 million characters → 4 \$
- Workflows for ML/AI in production
- GDPR/ Security

<https://github.com/Zirkonium88/AWS>

**KEEP ON GOING!**



# Thank You!

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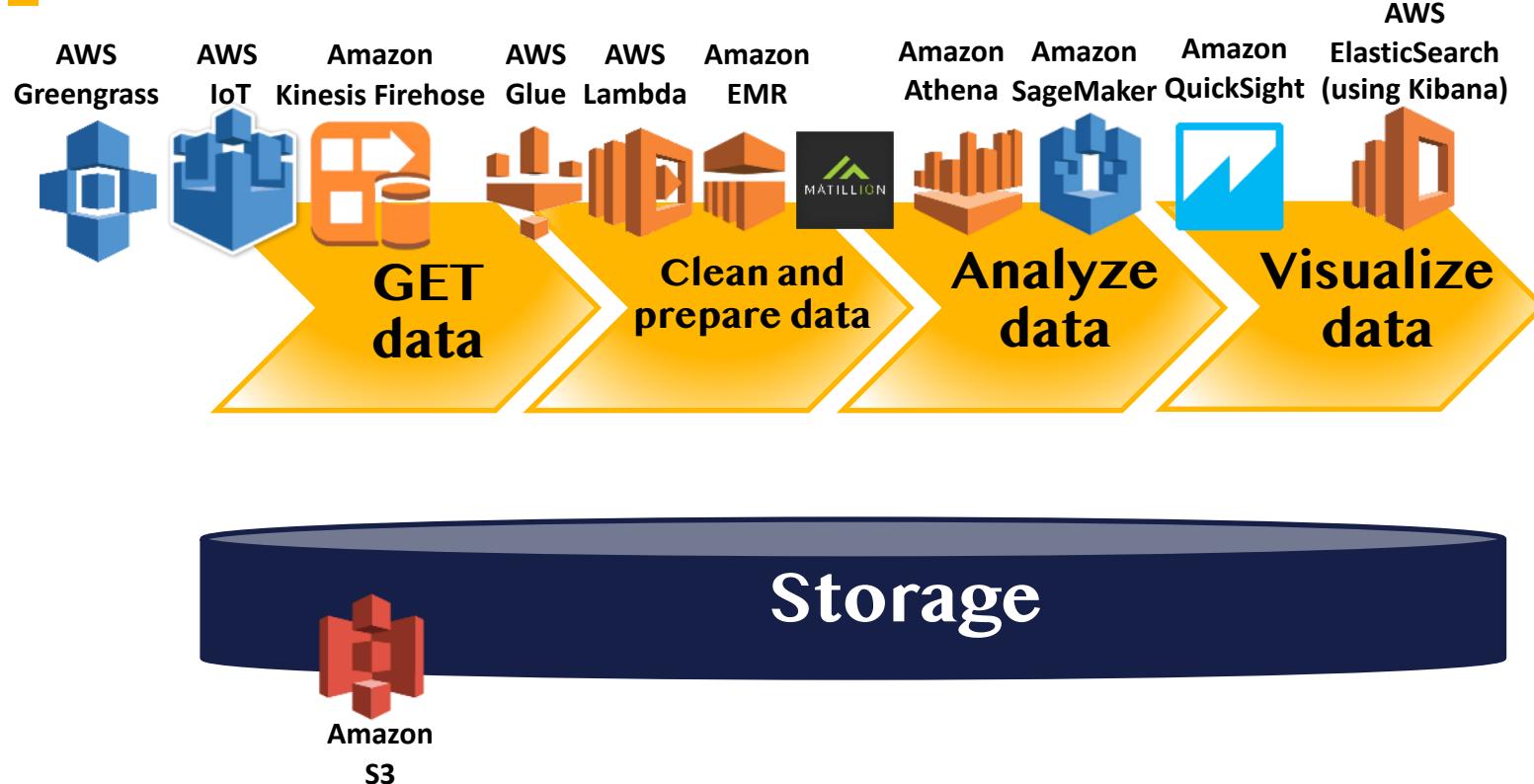
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Public Sector Channel  
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# Services for Big Data Workflow auf AWS



# Exploring and Preparing data

- Getting in contact with Data:
  - Distribution, Variance, Correlations
  - How? → Univariate and Multivariate Plots



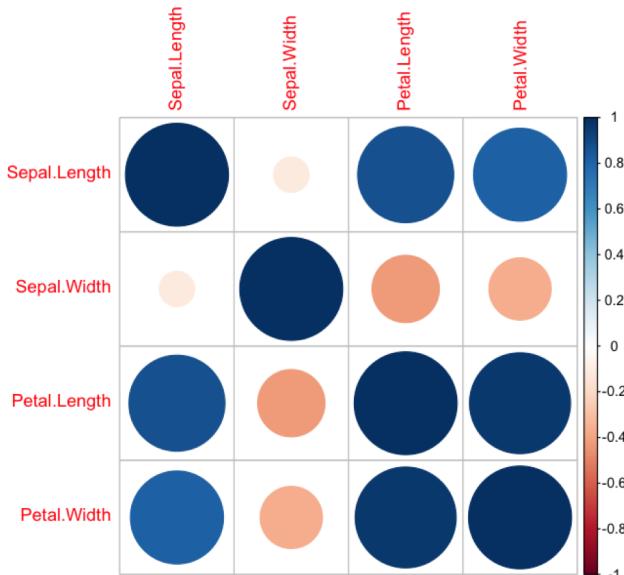
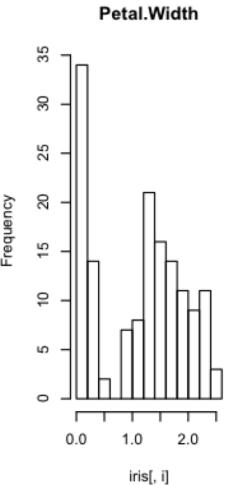
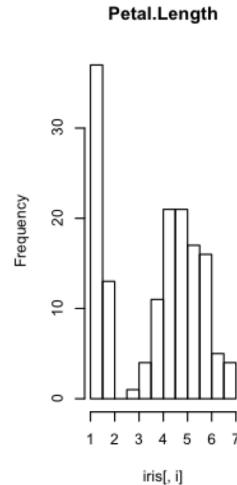
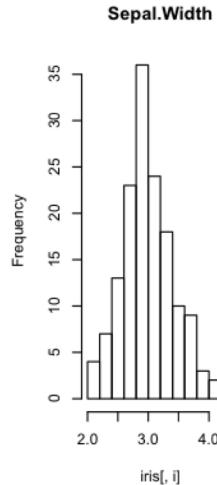
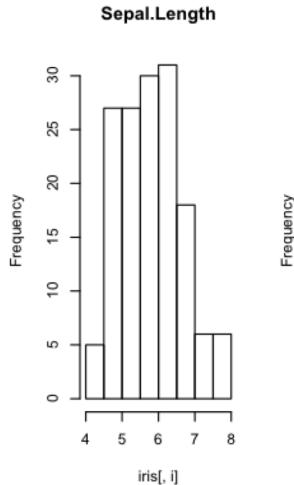
Amazon  
QuickSight



Amazon  
SageMaker

# Exploring and Preparing data

- Getting in contact with Data:
  - Distribution, Variance, Correlations
  - How? → Univariate and Multivariate Plots



# Training a Model on the Data

- Choose an Algorithm according to your ML-Problem.
- Choose appropriate Parameters and Hyperparameters.

Parameters	Hyperparameters
Learned and updated during training	Values are set before training the model
Tuned during the training	Tuned during the training
Example: Weights, Bias, Splitrules ...	Example: Learning Rate, Loss Function, Batch Size ...

# Training a Model on the Data

- Choose an Algorithm according to your ML-Problem
- Use built-in Algorithms

BlazingText Algorithm

DeepAR Forecasting Algorithm

Image Classification Algorithm

IP Insights Algorithm

K-Means Algorithm

K-Nearest Neighbors (k-NN) Algorithm

Latent Dirichlet Allocation (LDA) Algorithm

Linear Learner Algorithm

Neural Topic Model (NTM) Algorithm

Object2Vec Algorithm

Object Detection Algorithm

Principal Component Analysis (PCA) Algorithm

Random Cut Forest (RCF) Algorithm

Semantic Segmentation Algorithm

Sequence-to-Sequence Algorithm

XGBoost Algorithm

Linear Learner Algorithm

Factorization Machines Algorithm

- Or bring own via Docker container

# Evaluating Model Performance

- Why should I evaluate my model?
  - Gaining accuracy
  - A model is always constructed by the data scientist and therefore as good as her/his decisions.
  - Keep in mind: A model is not a mirror of reality! A model is an approximation to reality.
- How do I evaluate a model?
  - By comparison with another model and by fit indices.
  - **For a classification problem** you evaluate the proportion of true and false as well as positive and negative predictions.
  - **For a regression problem** you evaluate the residuals (difference between the observe and the "true value") to determine fit indices.
  - Does the model reflects my/the business understanding in a right way?

# Node RED - Motivation

- The Internet of Things does not have a one-size-fits-all solution
- Why? – It's often required to pull together multiple APIs and online services
- IBM suggests: It's more worth to spent time on value solutions then figuring out access to various sources.
- The latter may be fine for programmers, but is suitable for all.
- It is therefore necessary to have a tool that allows developers of all levels to bring together data streams, events and responses. A standard for the Internet of Things.

# Ressources

- **Amazon Sagemaker:** <https://github.com/awslabs/amazon-sagemaker-examples>
- **Main website: Node-RED guide and main website:** <http://noderedguide.com/> & <https://nodered.org>
- **Tutorials:** <http://www.steves-internet-guide.com>
- **GitHub:** <https://github.com/node-red/node-red>
- **Flow examples:** <https://flows.nodered.org>



# Thank you!

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