Machine Learning:

An introduction for Developers (part. 1 & 2)

AUGUST / SEPTEMBER

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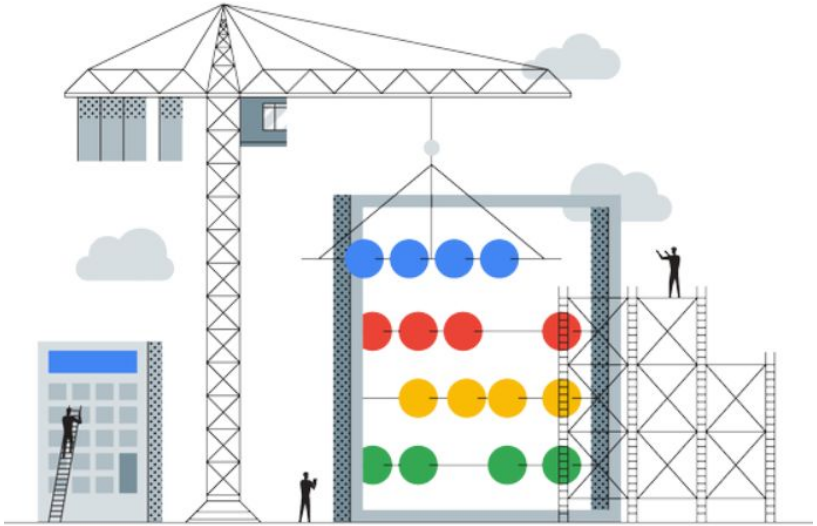
Agenda

1. What is Machine Learning?
    - History
    - Why only in recent years?
    - Objectives
2. Main types of machine learning algorithms & Technologies
3. Demonstration 1
4. Metrics
5. Consuming Models
6. Black-box
7. Demonstration 2
8. Starting the study

History



A history of Machine Learning

Why only in recent years?

- If Machine Learning is so old, why is it only in recent years that technologies that use statistical models are emerging?

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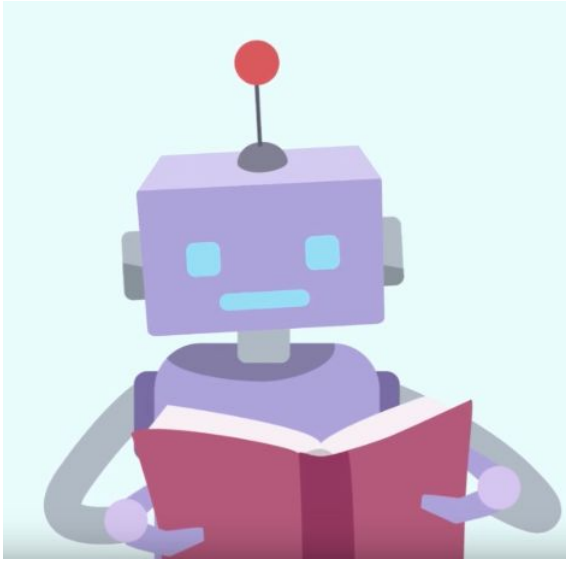
Mainly because of

What is Machine Learning?

- Machine Learning is a subfield of Artificial Intelligence, which was developed from the study of pattern recognition and computational learning.

- Machine learning as a "*field of study that* ***gives computers the ability to learn without being explicitly programmed***".
  [1] Arthur Samuel, 1959



[1] Some Studies in Machine Learning Using the Game of Checkers - 1959

Objectives

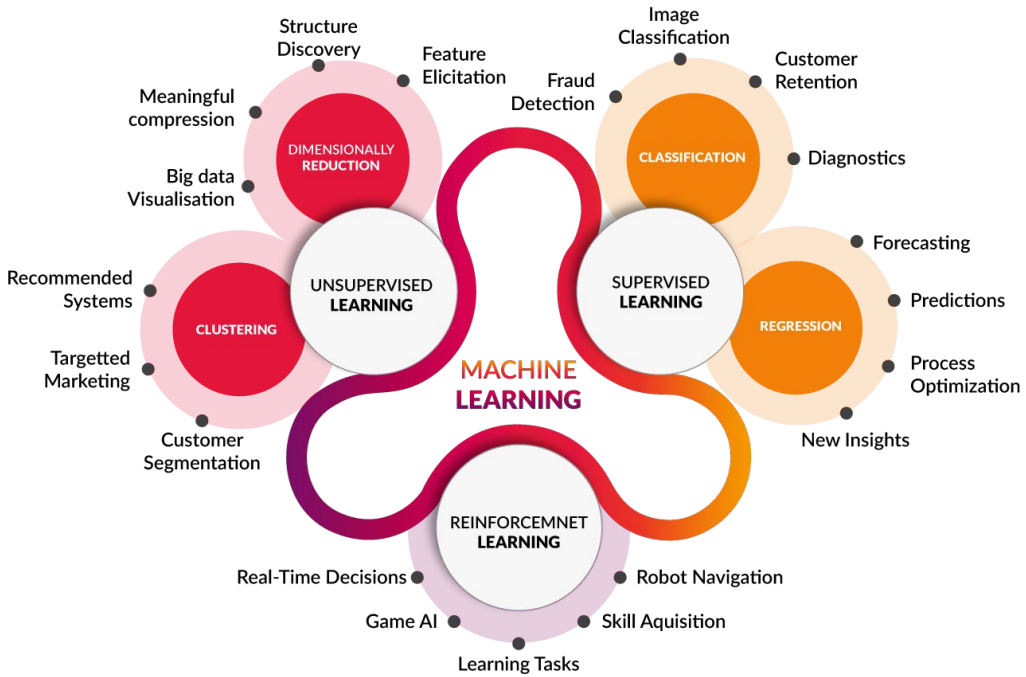
- The purpose of Machine Learning is to build computational models that can adapt and learn from experience. [2] Tom M. Mitchell, 1997

- In practical terms, machine learning algorithms aim to discover the relationship between the variables of a system (input / output) from data. [3] Cherkassky & Mulier, 2007

[2] Machine Learning - 1997
[3] Learning from Data: Concepts, Theory, and Methods 2nd Edition - 2007

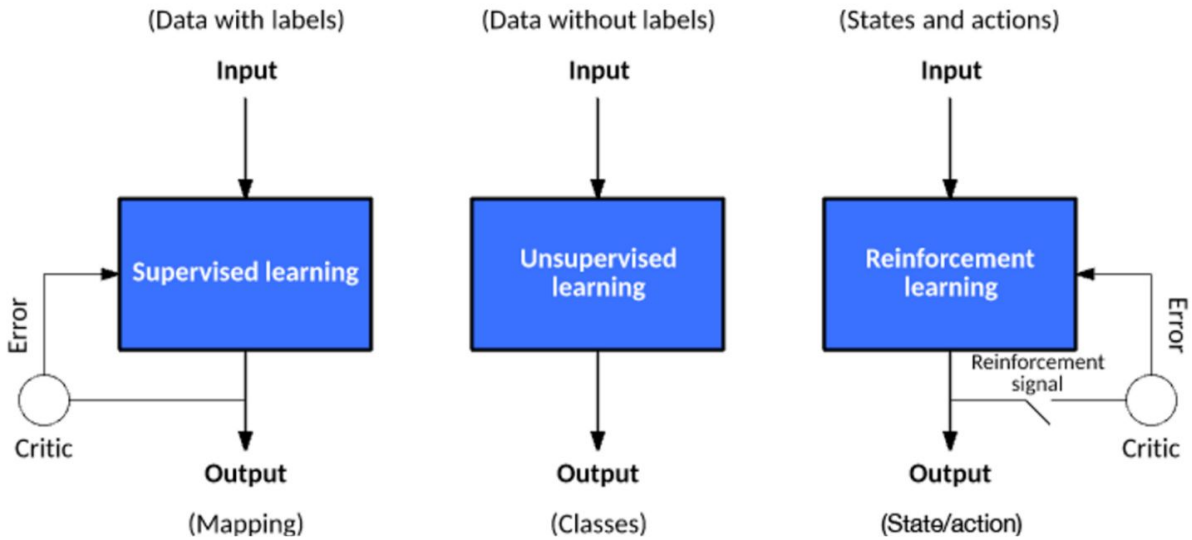
Main types of machine learning algorithms

- There are three main types of machine learning algorithms.



Main types of machine learning algorithms

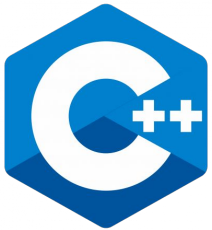
- Basic idea of each type:



Algorithm Reinforcement learning: Markov Decision Process
Super Mario Bros: MarI/O - Machine Learning for Video Games

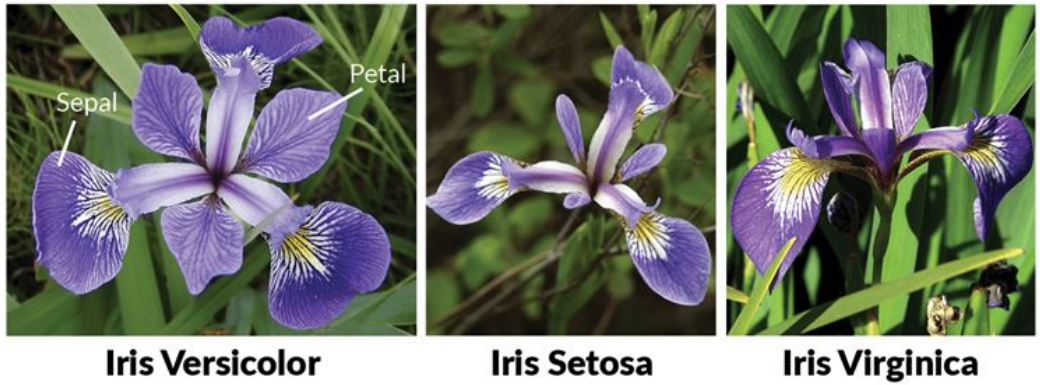
Technologies

Languages used to work with Machine Learning algorithms:



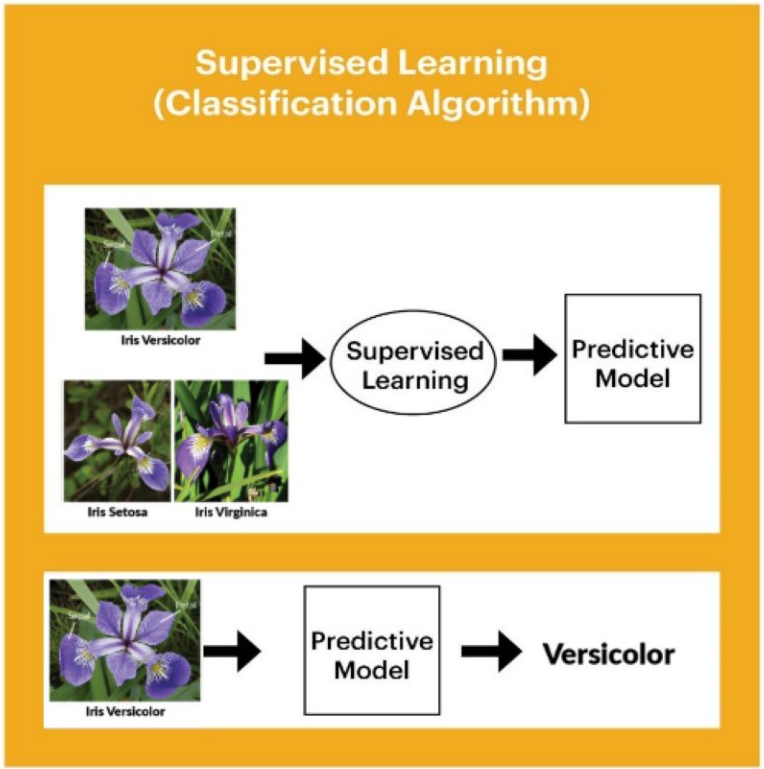
Demonstration 1

- In this demo, I show the difference in practice between supervised and unsupervised Machine Learning. (source code)



Dataset Iris

Demonstration 1 : Flow Supervised Learning

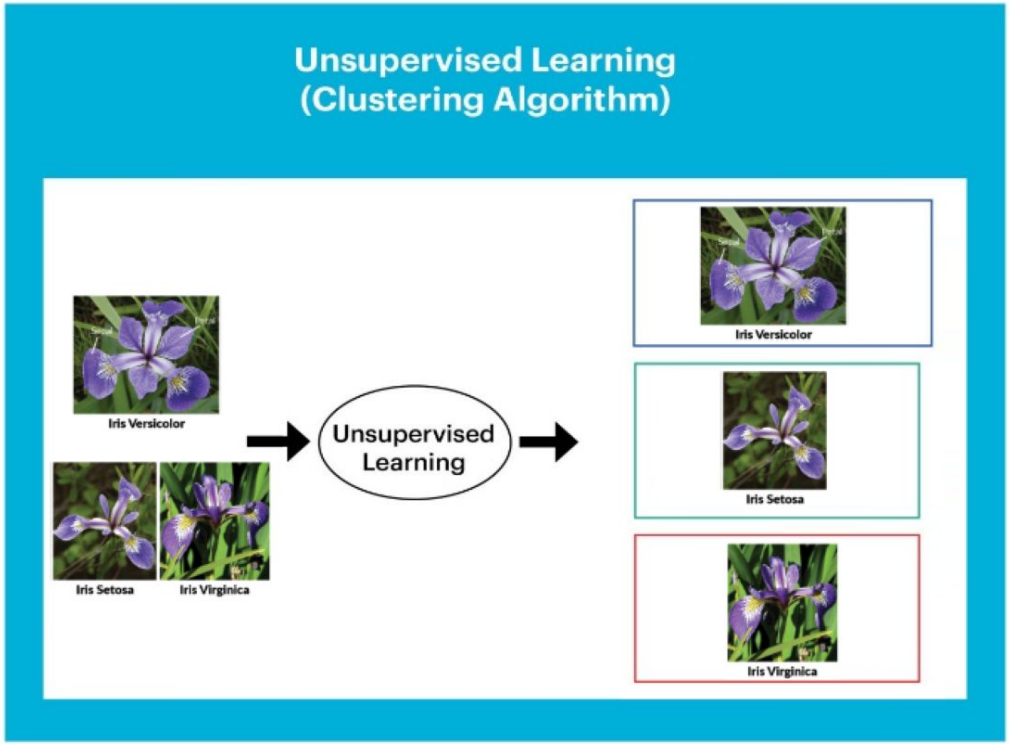


Algorithms:

Support Vector Machine (SVM)

Artificial Neural Networks(ANN)

Demonstration 1 : Flow Unsupervised Learning



Algorithms:
K-Means

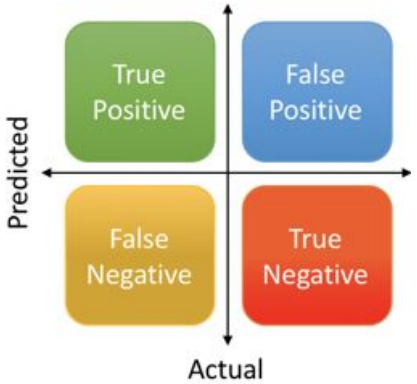
Metrics

- Metrics is the main way to validate the results of a Machine Learning algorithm. And for each type of learning, there is a metric.

$$\text{Precision} = \frac{\text{True Positive}}{\text{True Positive + False Positive}}$$

$$\text{Recall} = \frac{\text{True Positive}}{\text{True Positive + False Negative}}$$

$$\text{Accuracy} = \frac{\text{True Positive + True Negative}}{\text{Total}}$$



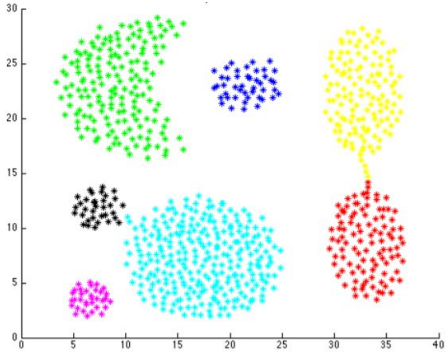
[Precision vs Recall]
[Precision and recall]

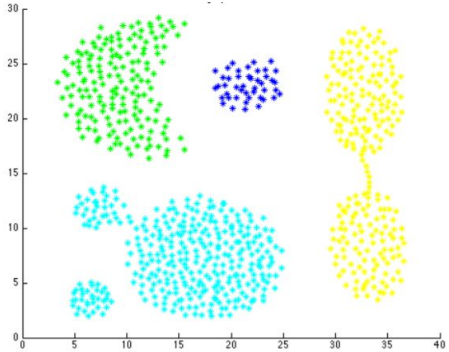
Metrics

- Cluster assessment measures:

$$\text{Índice de Rand}: \frac{(A+D)}{(A+B+C+D)}$$

$$\text{Índice de Jaccard}: \frac{A}{(A+B+C)}$$





```
indice_rand =

    0.8936

indice_jaccard =

    0.6706
```

The Rand index
Jaccard index
Avaliacao Clustering

Consuming Models

- There are three main ways to consume models created from machine learning algorithms:

  a. Creating http endpoint:
     - programming language;
     - black-box.

  b. Create a stream to produce / consume the input / output:
     - Apache Kafka; RabbitMQ; ActiveMQ; and etc.

  c. Creating batch processes to process and store in storages.

Black-box

- They are tools and libraries that facilitate the development of models or products of Machine Learning.

  - Amazon Machine Learning;
  - Watson Machine Learning;
  - AI and machine learning products;
  - Azure Machine Learning;
  - outros.

Consuming Models

- More recently, ONNX (Open Neural Network Exchange) technology has emerged.

- **ONNX is an open format built to represent machine learning models.**

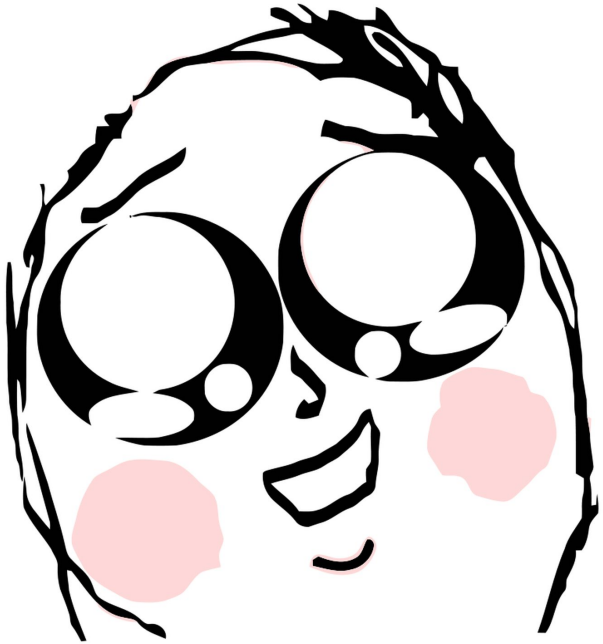
ONNX

Demonstration 2 - The ONNX technology in action

- In this demo, a statistical model will be created in Python using the MNIST data set and this model will be used in C# to make a prediction of a drawn number. (source code)

ONNX and ONNX Runtime
ONNX models

I loved it... I want to learn more!



Starting the study - Video lessons

- MIT - 6.034 Artificial Intelligence, Fall 2010 (30 lessons)
- University of Oxford - Deep Learning (16 lessons)
- Stanford CS229: Machine Learning - 2018 (20 lessons)
- Redes Neurais - USP - Introdução às Redes Neurais (10 lessons)
- Reconhecimento de Padrões - USP (52 lessons)

- [SEI 2019] Automated Machine Learning by WeDo - Univ. Minho
- Aplicações de Inteligência Artificial nas áreas fiscal, auditoria e saúde - 2020

- Introduction to the Developer's Intro to Data Science Video Series (28 videos)
- ML.NET - Machine Learning Introduction (8 videos)
- [Online] Nerdzão #214 - Linguagem R

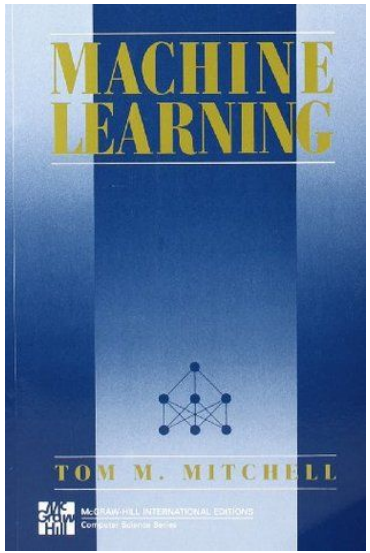
Starting the study - Websites

- DAVE TANG'S BLOG
- Machine Learning for Everyone (blog)

Starting the study - Courses

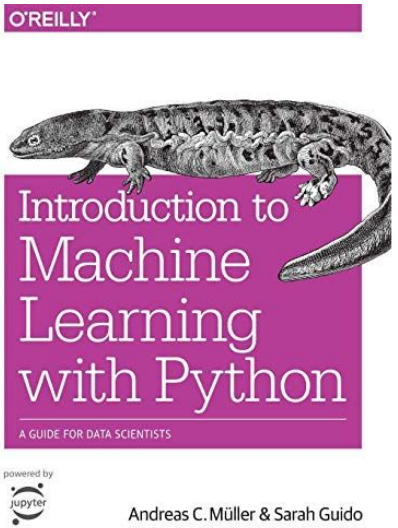
- **Coursera**:
  - Machine Learning, by Andrew Ng;
  - Data Science.
- **EDX**:
  - Data, Analytics and Learning.
- **Udemy**:
  - Data Science A-Z™: Real-Life Data Science Exercises Included;
  - Machine Learning A-Z (Python & R in Data Science Course);
  - Complete Google Cloud Data Engineer & Architect Course (GCP).
- **Udacity**:
  - Intro to Machine Learning;
  - Machine Learning.

Starting the study - Books



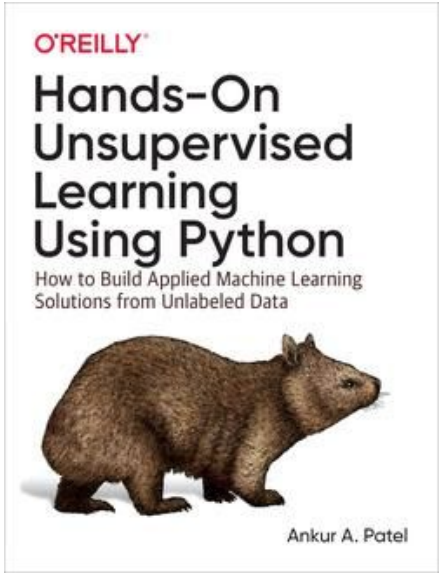
Machine Learning, Tom Mitchell, McGraw Hill, 1997.

Introdução à Mineração de Dados: Com aplicações em R, 2016.

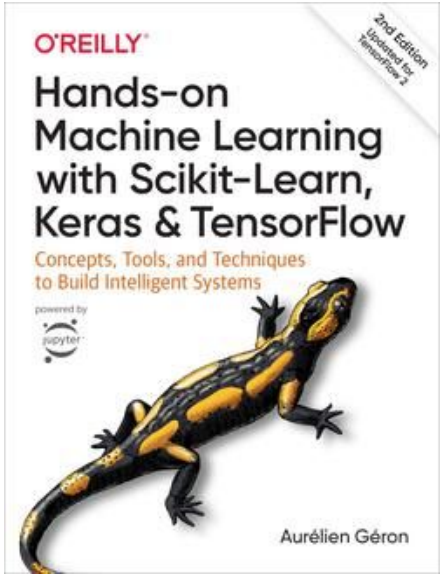


Introduction to Machine Learning with Python: A Guide for Data Scientists, 2016

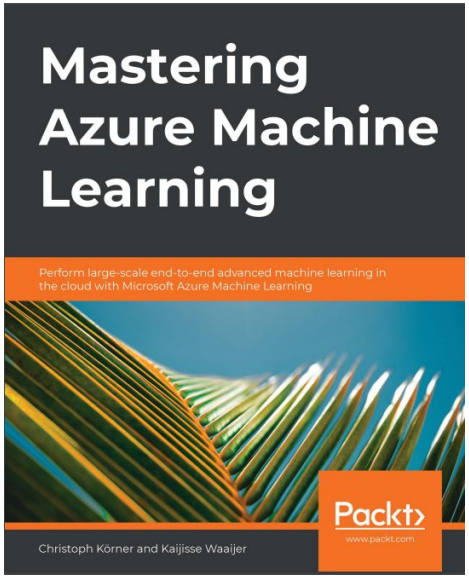
Starting the study - Books



Hands-On Unsupervised Learning Using Python, 2019. Code Examples on GitHub.



Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, 2nd Edition, 2019. Code Examples on GitHub.



Mastering Azure Machine Learning, 2020. Book free, link.

Thank you

Contacts

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- **Blog**: http://charlesmms.azurewebsites.net/