Martin Mundt, Dr. Iuliia Pliushch, Prof. Dr. Visvanathan Ramesh

Pattern Analysis & Machine Intelligence
Praktikum: MLPR-SS/21

Week 1: part 1: introduction
part 2: naive Bayes classifier

Part 1: Course Outline

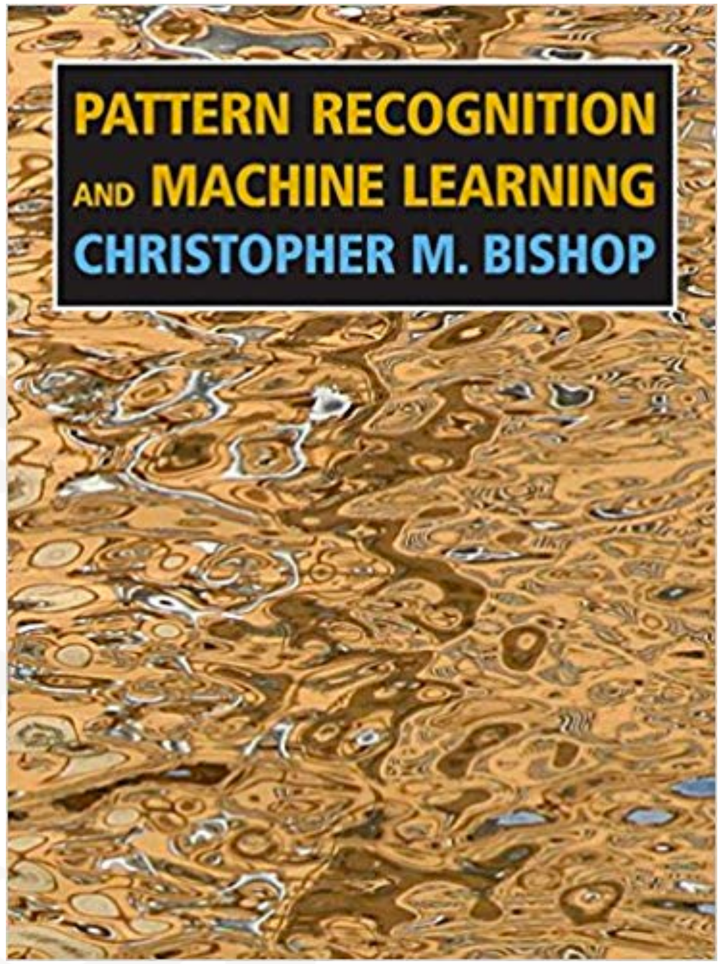
Lecture requirements

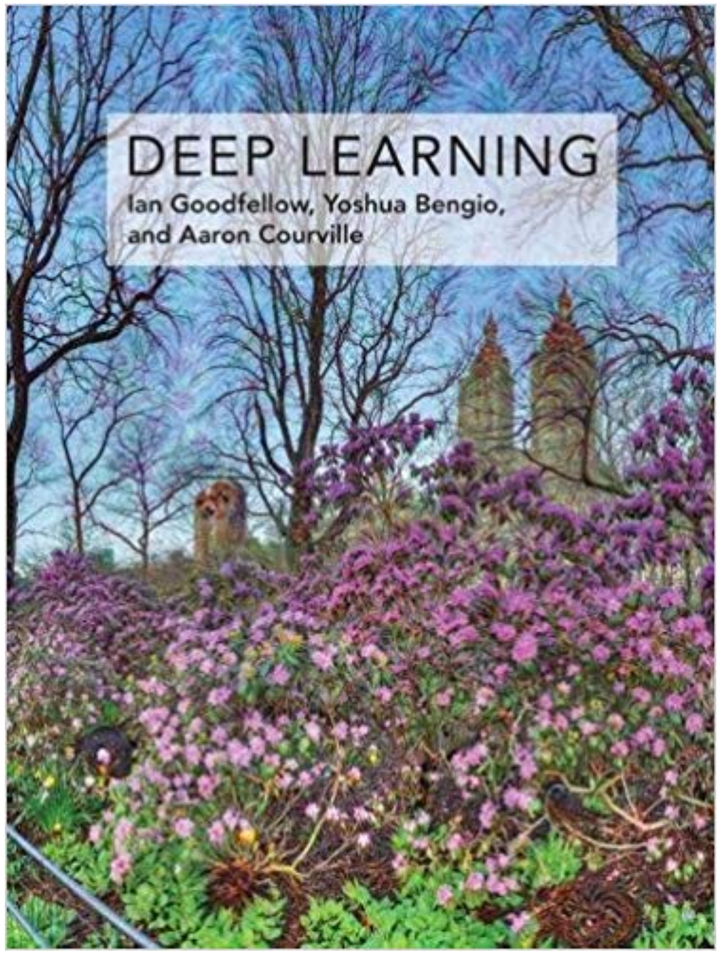
- 4 hours per week, 8 credit points -> attend the class!
- Final class group projects. Will start at the end of the lecture period with presentations at the end of the semester (we will choose a date together later).

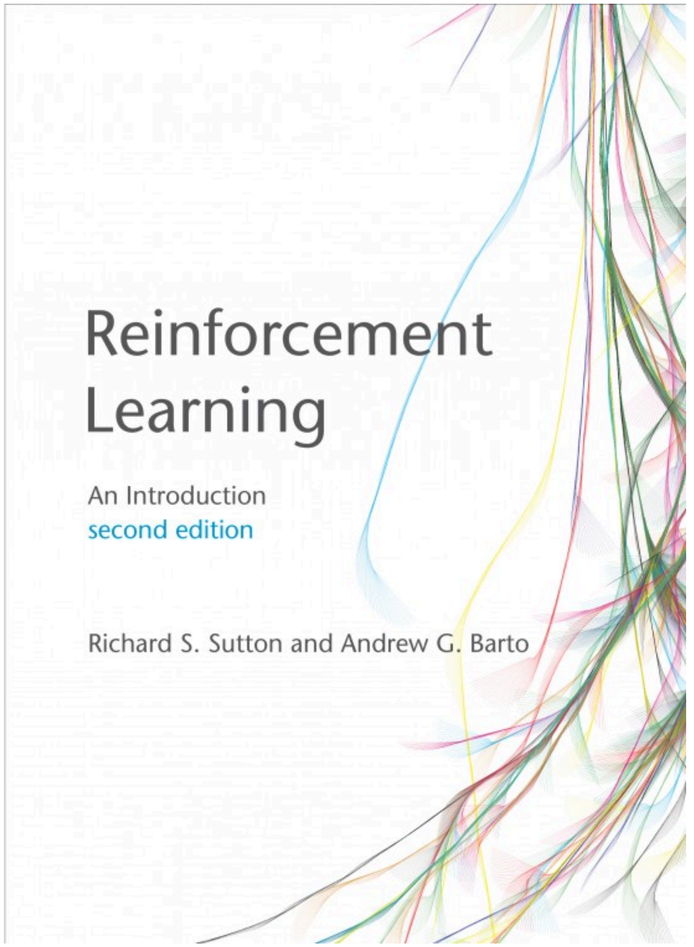
- Each Friday session consists of a traditional lecture, followed by an introduction to the practical assignment.
- Practical assignments are online notebooks that need to be filled with code.
- We will use Google's Collaboratory for cloud computation. If you have a Gmail, android etc. account, then it is the same account you already have.
- If you don't want to use Colab (because you don't want a google account), you can execute the notebooks locally, we advise a Linux or Mac OS (and will provide no Windows support). However, the later deep learning content will be close to impossible to run on your local laptops.
- Each Monday session is intended for questions, feedback and tips on the current assignment. We also discuss the solution of the previous assignment here.

- **All lecture materials will be shared on GitHub: https://github.com/ccc-frankfurt/Practical_ML_SS21**

Literature


PATTERN RECOGNITION
AND MACHINE LEARNING
CHRISTOPHER M. BISHOP


DEEP LEARNING
Ian Goodfellow, Yoshua Bengio,
and Aaron Courville

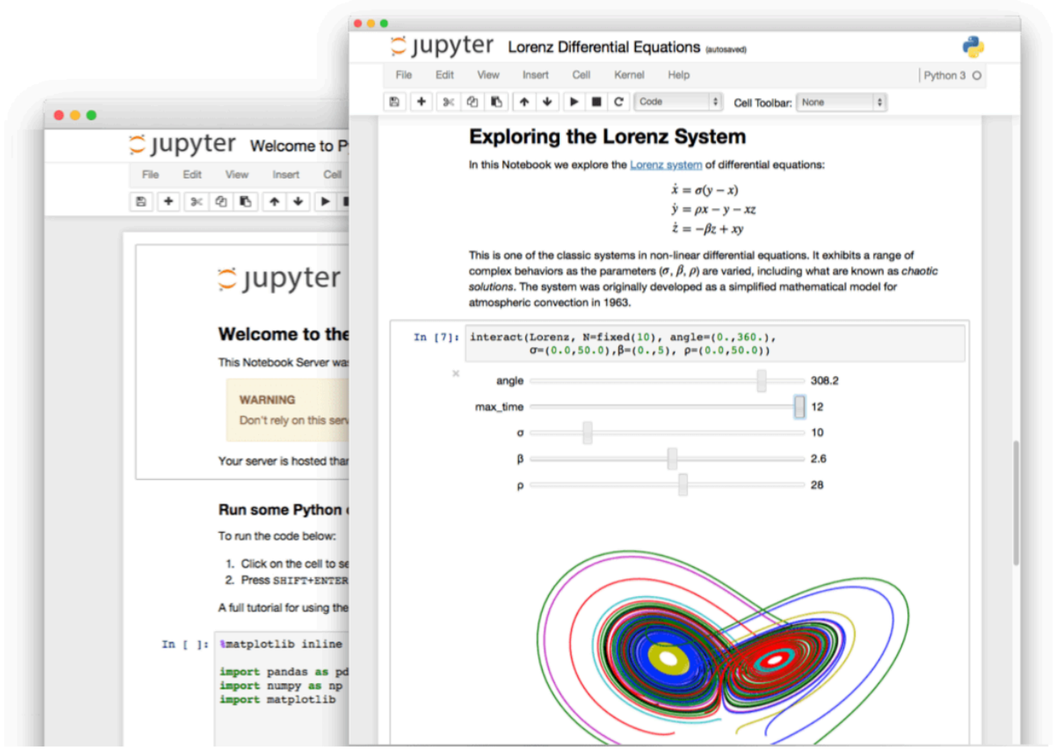

Reinforcement
Learning
An Introduction
second edition
Richard S. Sutton and Andrew G. Barto

Jupyter notebooks: https://jupyter.org/

- Execution of python code in cells
- We will provide step-by-step notebooks where sections are missing and need to be filled in

jupyter

Install About Us Community Documentation NBViewer JupyterHub Widgets Blog



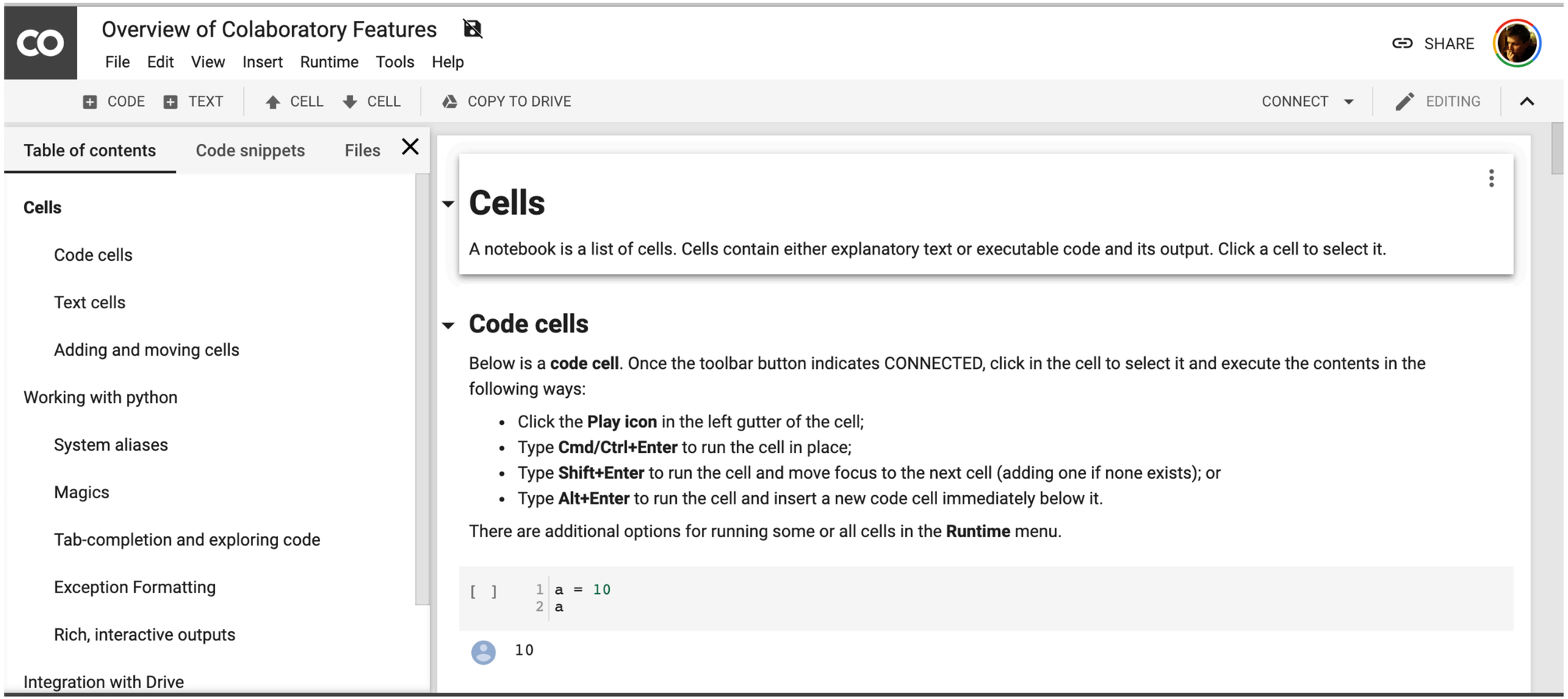
The Jupyter Notebook

The Jupyter Notebook is an open-source web application that allows you to create and share documents that contain live code, equations, visualizations and narrative text. Uses include: data cleaning and transformation, numerical simulation, statistical modeling, data visualization, machine learning, and much more.

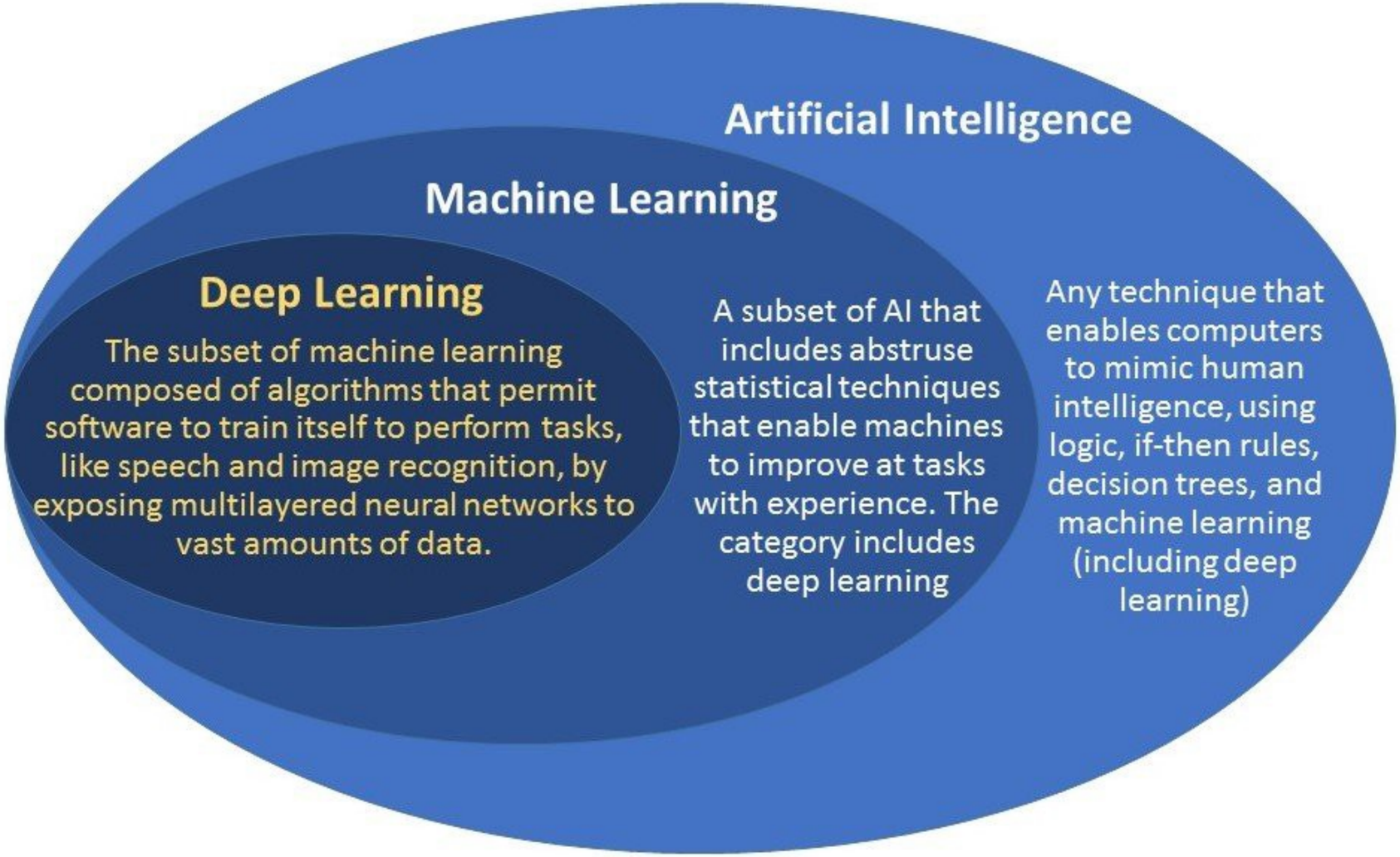
Try it in your browser | Install the Notebook

Google Colab: https://colab.research.google.com/

- Google Colab allows execution of notebooks in the cloud from a browser
- GPU/TPU instances are free with an execution time-out after 1 hour (enough for our purposes)

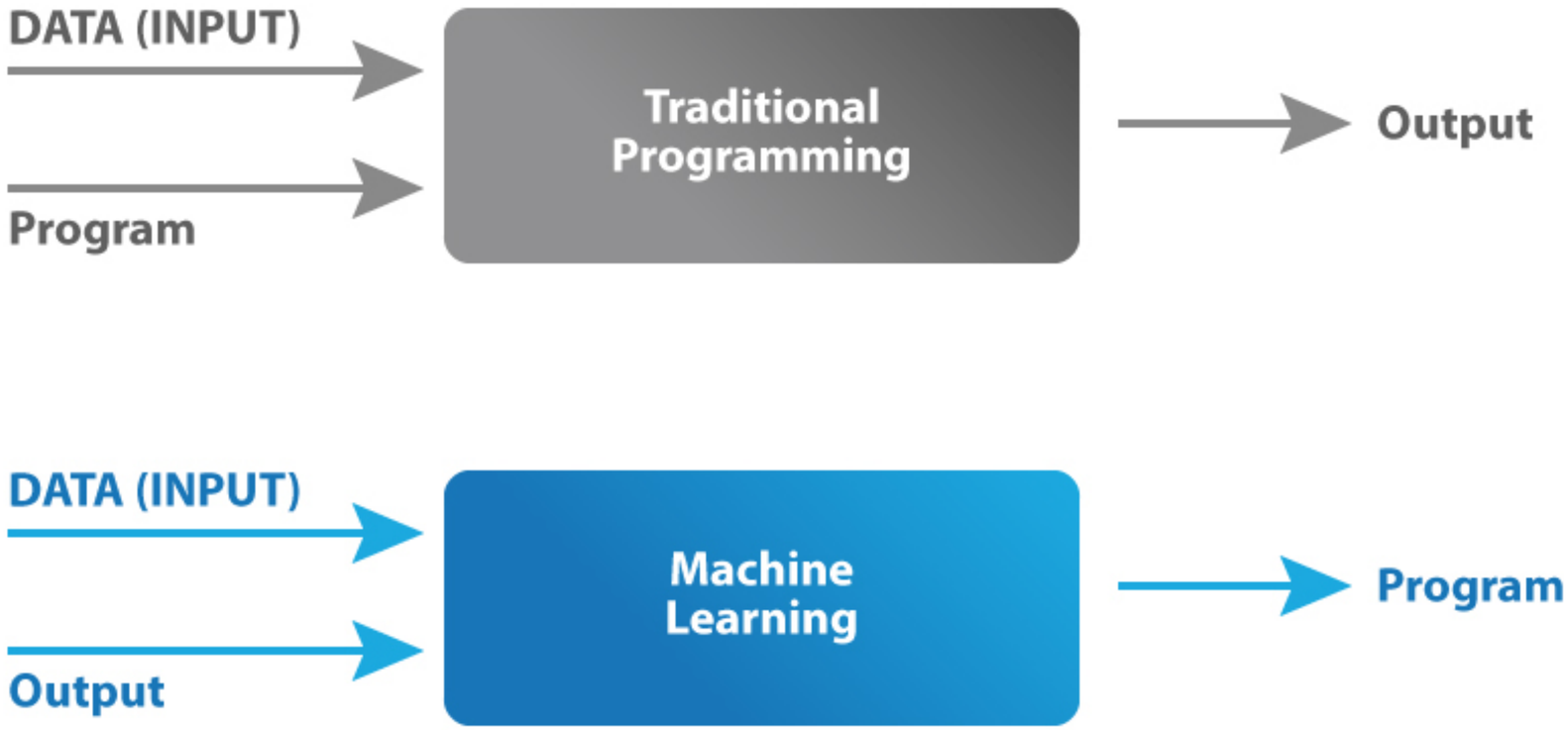


What is Machine Learning?



https://medium.com/@harish_6956/what-is-machine-learning-deep-learning-7788604004da

What is Machine Learning?



https://www.mygreatlearning.com/blog/what-is-machine-learning/

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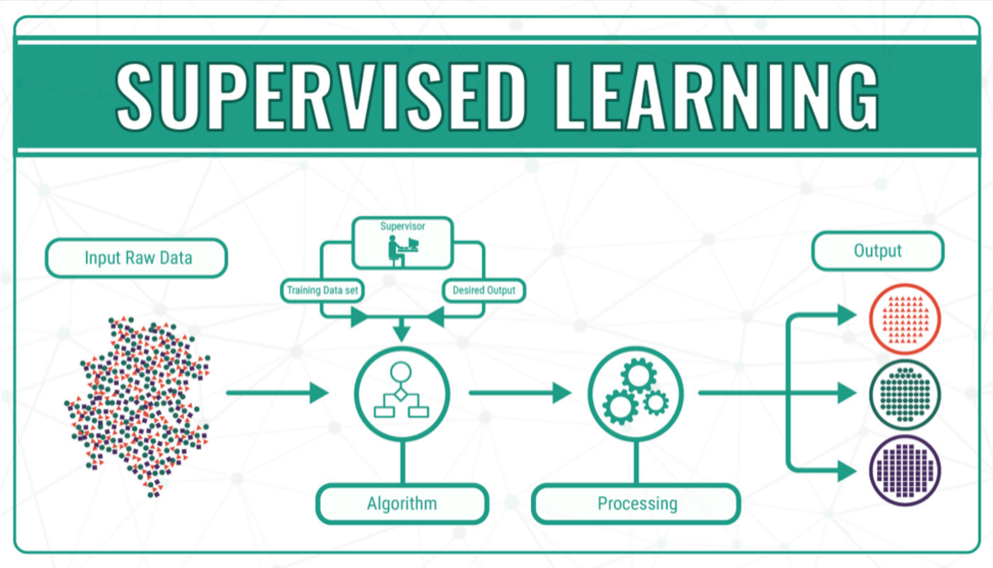
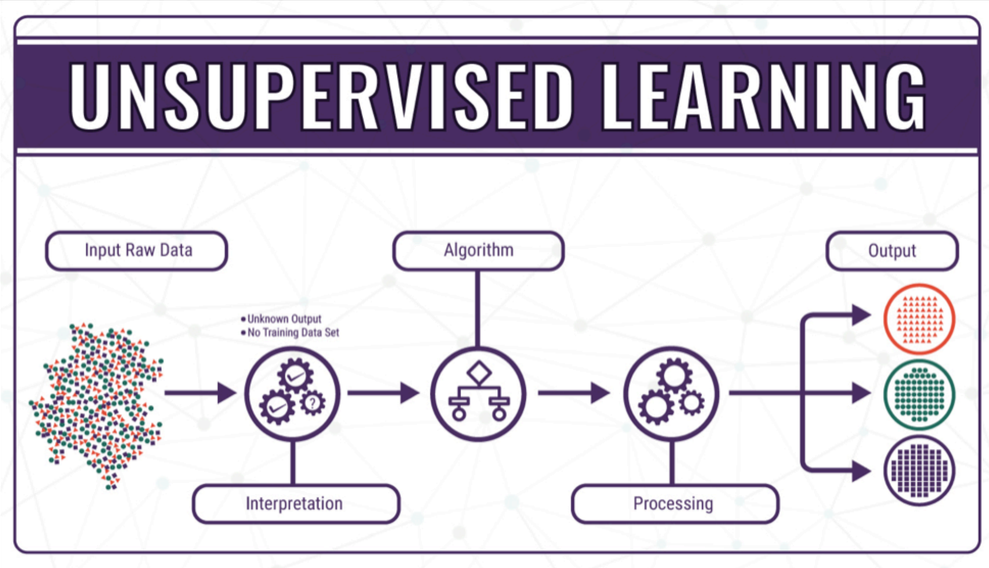
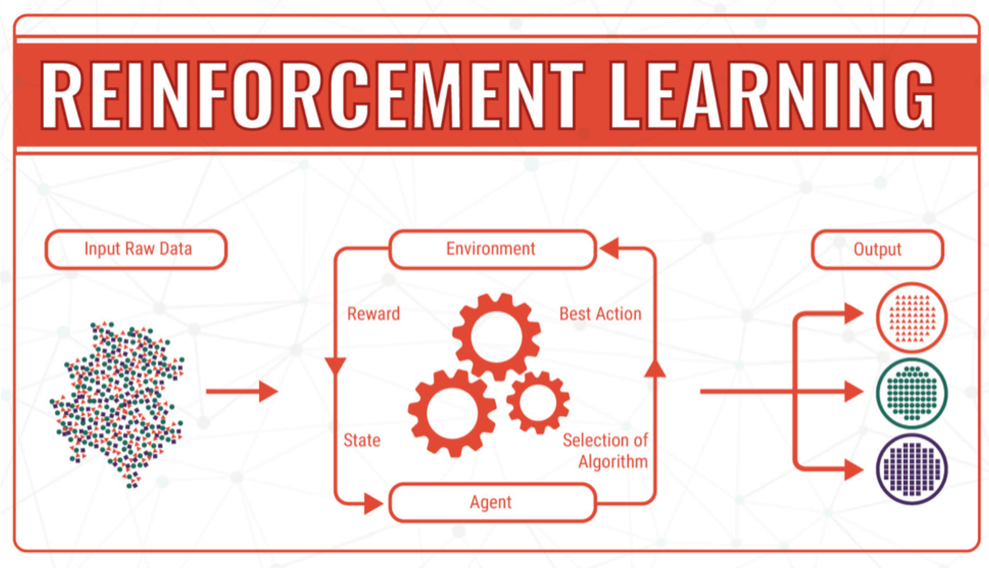
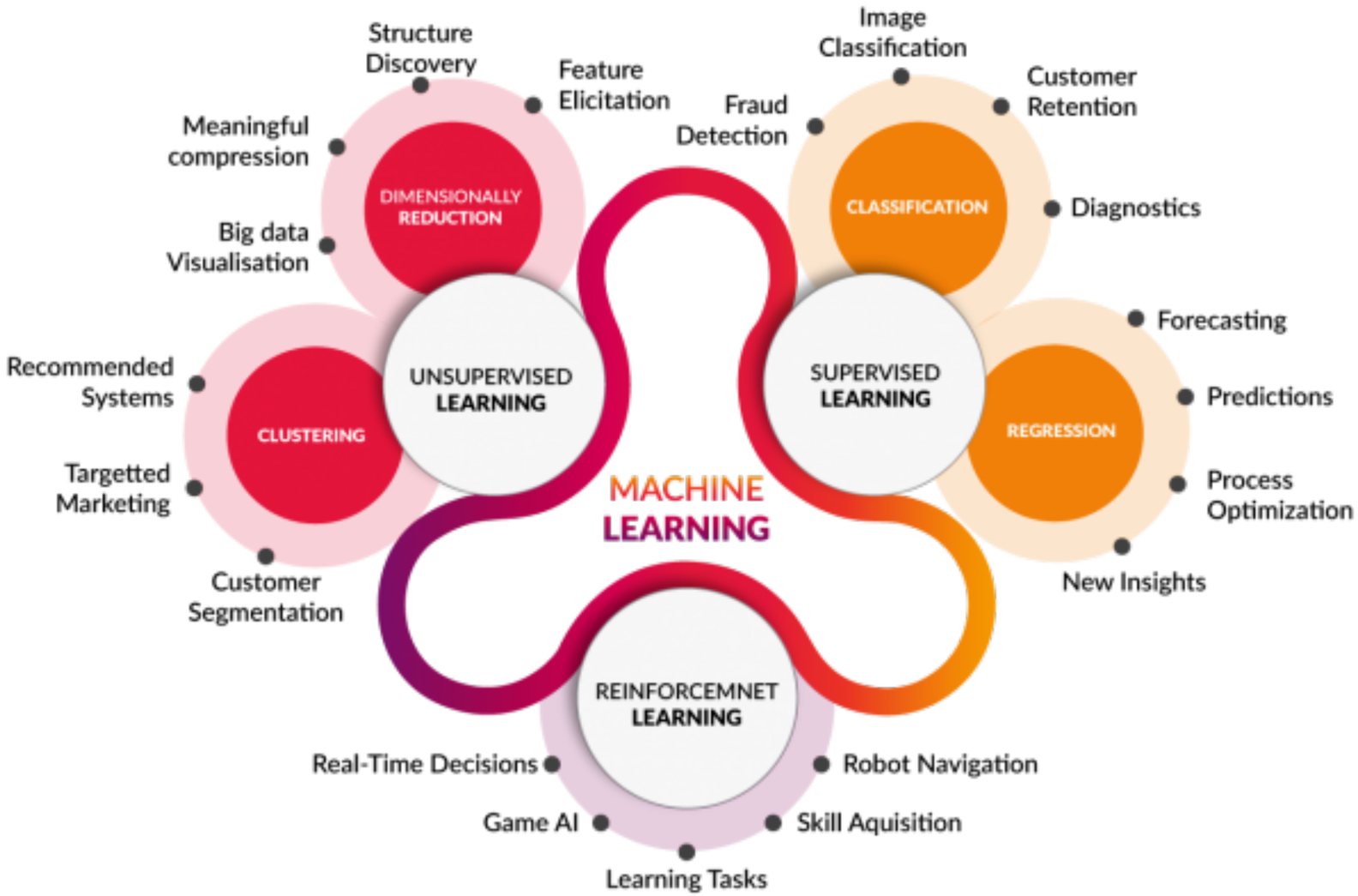






https://bigdata-madesimple.com/machine-learning-explained-understanding-supervised-unsupervised-and-reinforcement-learning/

What is Machine Learning?



https://www.ironhack.com/en/data-analytics/what-is-machine-learning

Schedule

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Introduction:

Week 1: Today – Introduction to machine learning and course utilities
optional slides on version management -> optional practical: python review

Week 1: Today – Classification with naive Bayes -> practical: spam message identification

Block 1 - Supervised Learning (weeks 2-6):

Week 2: 23.04 – Logistic regression and gradient descent -> practical: gradient descent variants and titanic survivor prediction

Week 3: 30.04 – Random Forests -> practical: revisiting titanic survivor prediction + another challenge (tbd)

Week 4: 07.05 – Introduction to neural networks: the multi-layer perceptron -> practical: classification of fashion images with pure Numpy

Week 5: 14.05 – Convolutional neural networks and introduction to PyTorch -> practical: revisiting fashion images and reading traditional Japanese characters

Week 6: 21.05 – Neural sequence models, recurrent networks -> practical: Shakespeare poetry generation

Schedule

Block 2 - Unsupervised Learning (week 7-9):

Week 07: 28.05 – Introduction to unsupervised learning. Clustering with k-means. Principal and idependent component analysis (PCA and ICA) -> pratical: finding clusters in generated distributions and signal source separation.

Week 08: 04.06 – Unsupervised neural networks: representation learning through auto-encoding (AE) and generative modelling through variational auto-encoding (VAE) -> practical: revisiting fashion and Kuzushiji for unsupervise pre-training and image generation.

Week 09: 11.06 – Generative adversarial networks (GAN) and variational generative adversarial hybrids (VAE-GAN) -> practical: face generation

Block 3 – Reinforcement Learning (week 10-11)

Week 10: 18.06 – Classic tabular q-learning -> practical: cart pole balancing

Week 11: 25.06 – Deep reinforcement learning, QNN -> practical: Taxi driver

Schedule

Block 4 – (Some) Prospects and limitations (weeks 12-13):

Week 12: 02.07 – Meta-learning -> practical: (neural) architecture search using reinforcement learning.

Week 13: 09.07 – Robustness beyond benchmarks (unknown data or attacks) and continual learning -> assignments: intuition behind overconfident classifiers, log-likelihood overestimation in unsupervised learning and catastrophic forgetting when training continuously.

Projects (week 14 – semester end):

Week 14: 16.07 – Project proposals and disussion

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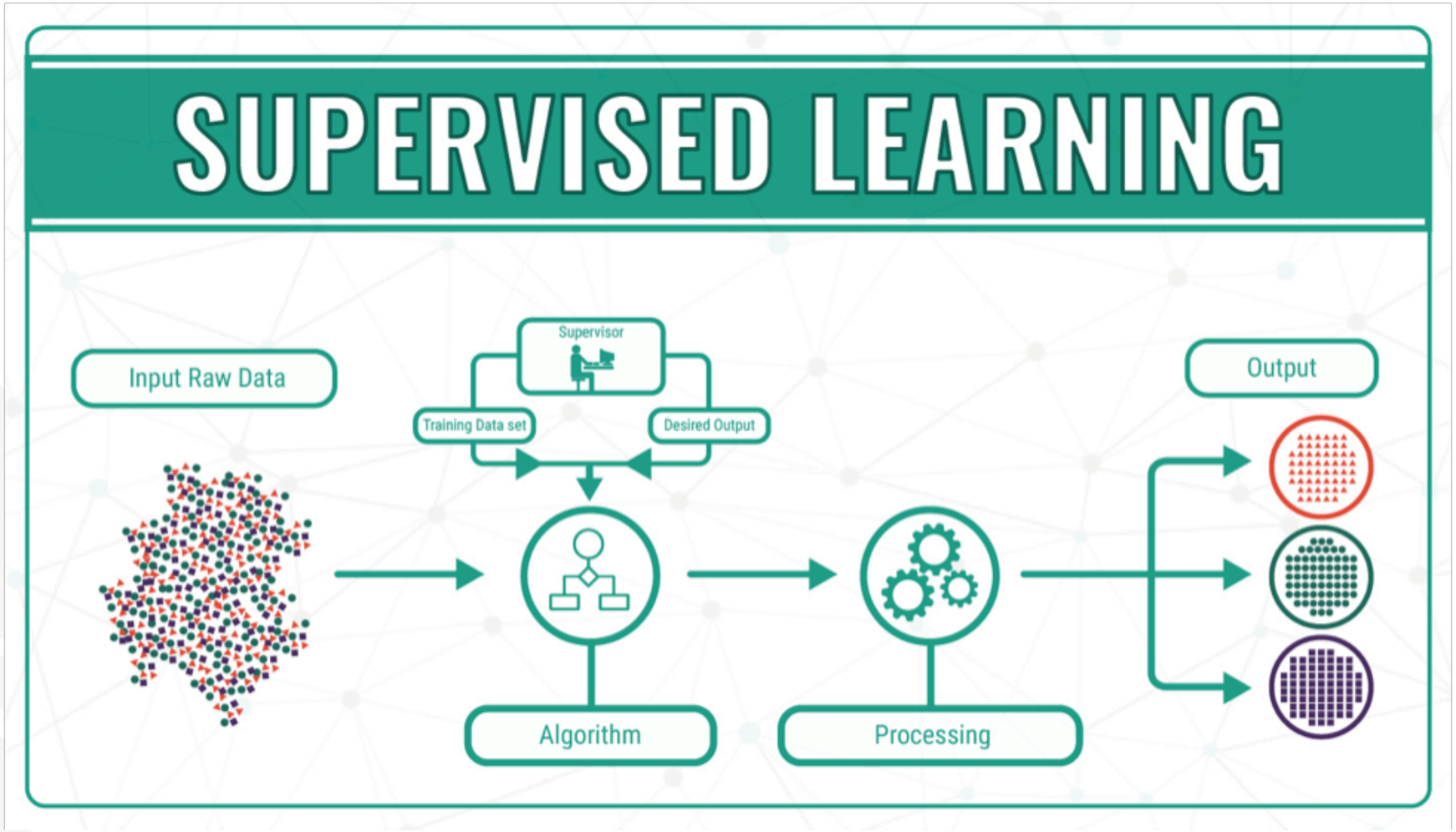
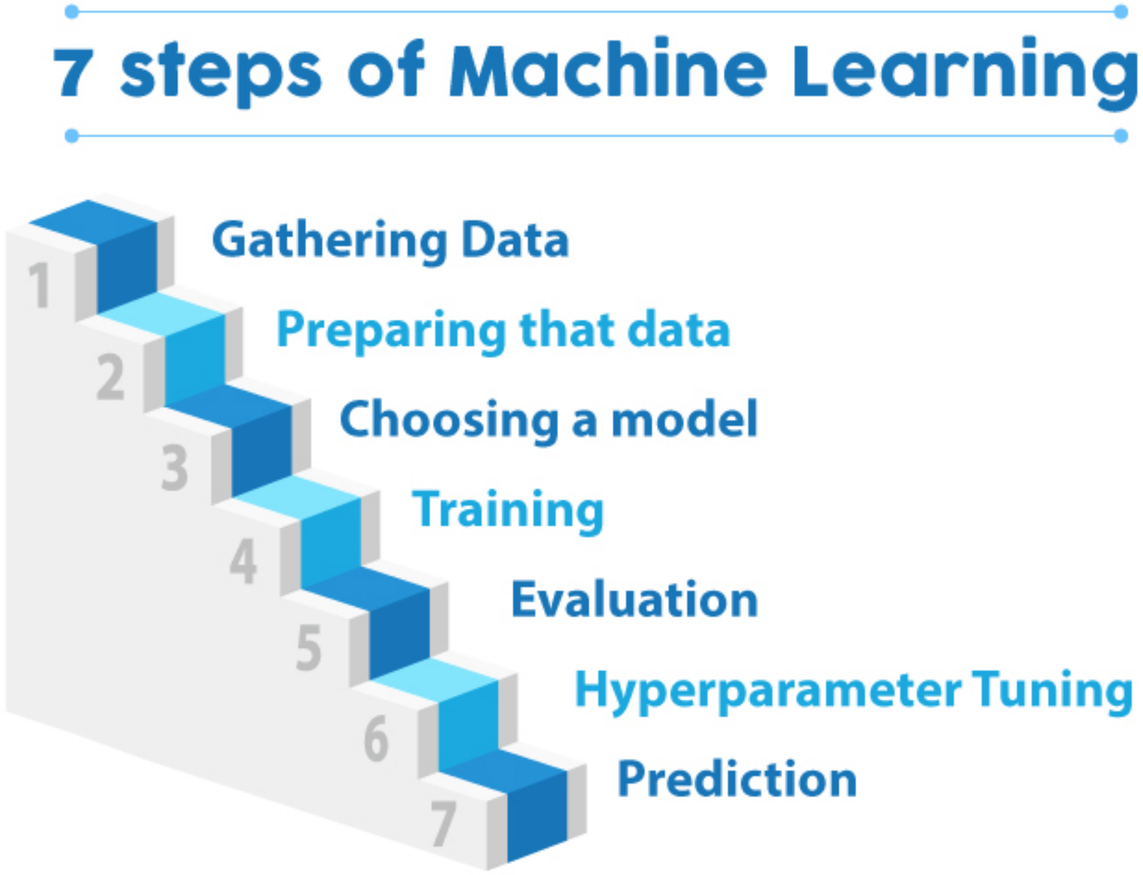
Course Block 1: Supervised Learning

Supervised machine learning



https://bigdata-madesimple.com/machine-learning-explained-understanding-supervised-unsupervised-and-reinforcement-learning/

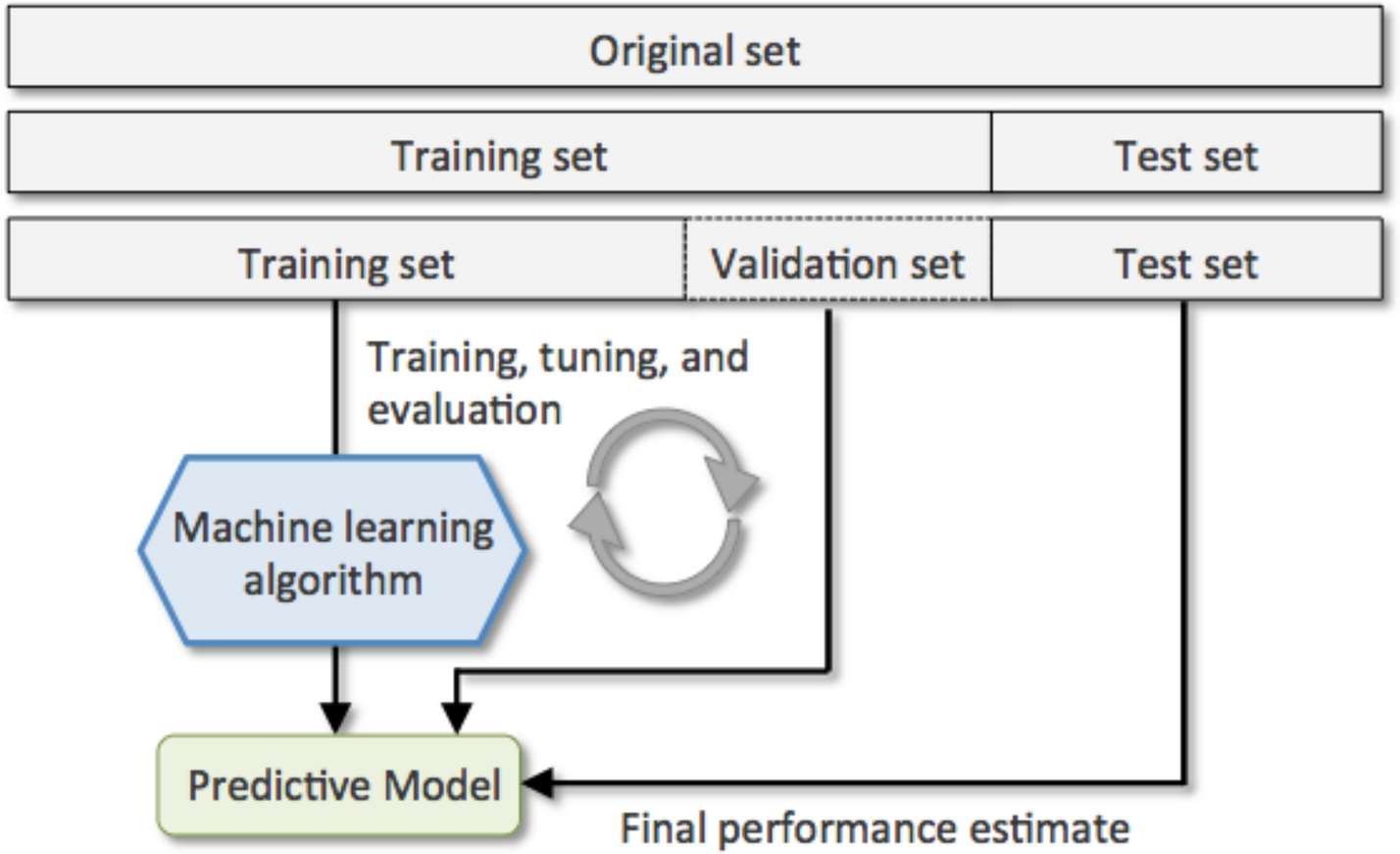
Machine Learning is not just tuning a model



The rigor with which we perform the steps surrounding a machine learning system will majorly impact its usefulness and our gained insights.

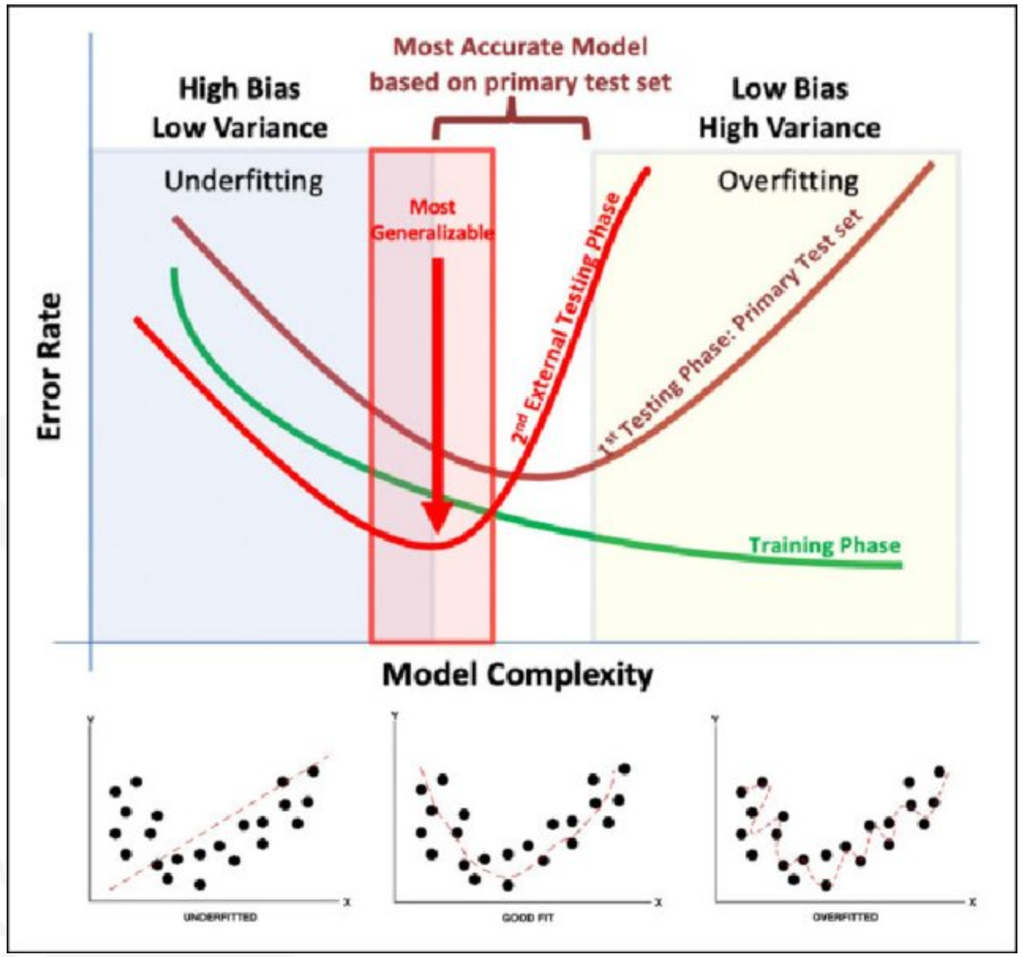
https://www.mygreatlearning.com/blog/what-is-machine-learning/

How do we train and evaluate?



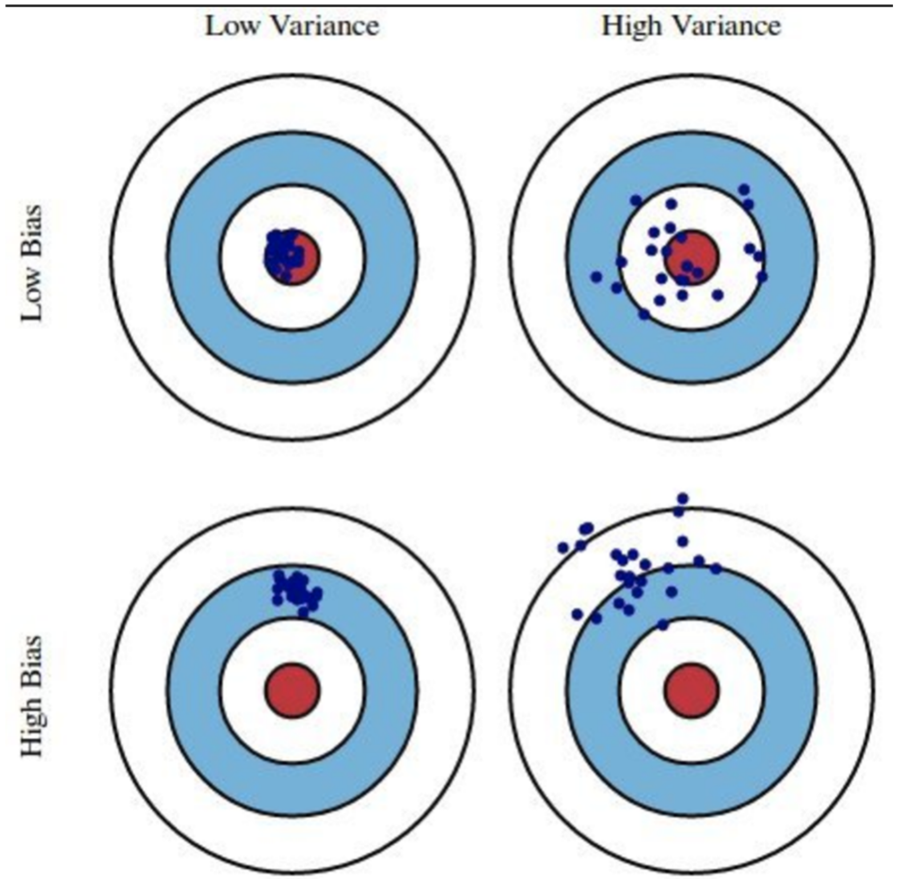
https://stats.stackexchange.com/questions/410118/cross-validation-vs-train-validation-test

The bias-variance trade-off



Taken from “Artificial Intelligence and Machine Learning in Pathology: The Present Landscape of Supervised Methods”, Academic Pathology 6:237428951987308, 2019

https://www.researchgate.net/publication/335604816_Artificial_Intelligence_and_Machine_Learning_in_Pathology_The_Present_Landscape_of_Supervised_Methods/figures?lo=1



https://becominghuman.ai/machine-learning-bias-vs-variance-641f924e6c57