Technische Hochschule Rosenheim

Supervised Learning
Organization & Intro

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Slides based on lectures of
Prof. Dr. Markus Breunig & Prof. Dr. Jochen Schmidt

WS 2022/23

Organization

- Lecture
  - Wednesdays 9:45 – 11:15
  - Room: A5.07
- Exercises
  - Wednesdays 11:45 – 13:15
  - Room: B0.08a
  - Exercise sheets: Questions, Coding tasks (jupyter notebook)
- Certificate of achievement
  - Written exam
  - 90 min
  - End of semester

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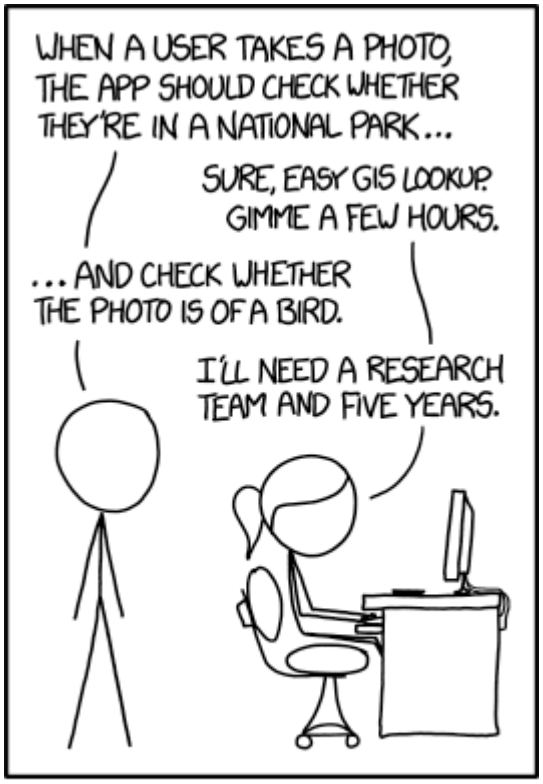
Machine Learning is hard…



© xkcd, https://xkcd.com/1425/, CC BY-NC 2.5

Chihuahua or Muffin?

© Twitter / Karen Zack / @teenybiscuit,
https://twitter.com/teenybiscuit/status/707727863571582978

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Content

Objectives

- Understand and explain the basic concepts of supervised learning
- Understand formalized concepts and methods and be able to implement them in the form of algorithms
- Sensibly select, adapt, and apply relevant methods
- Being able to educate oneself

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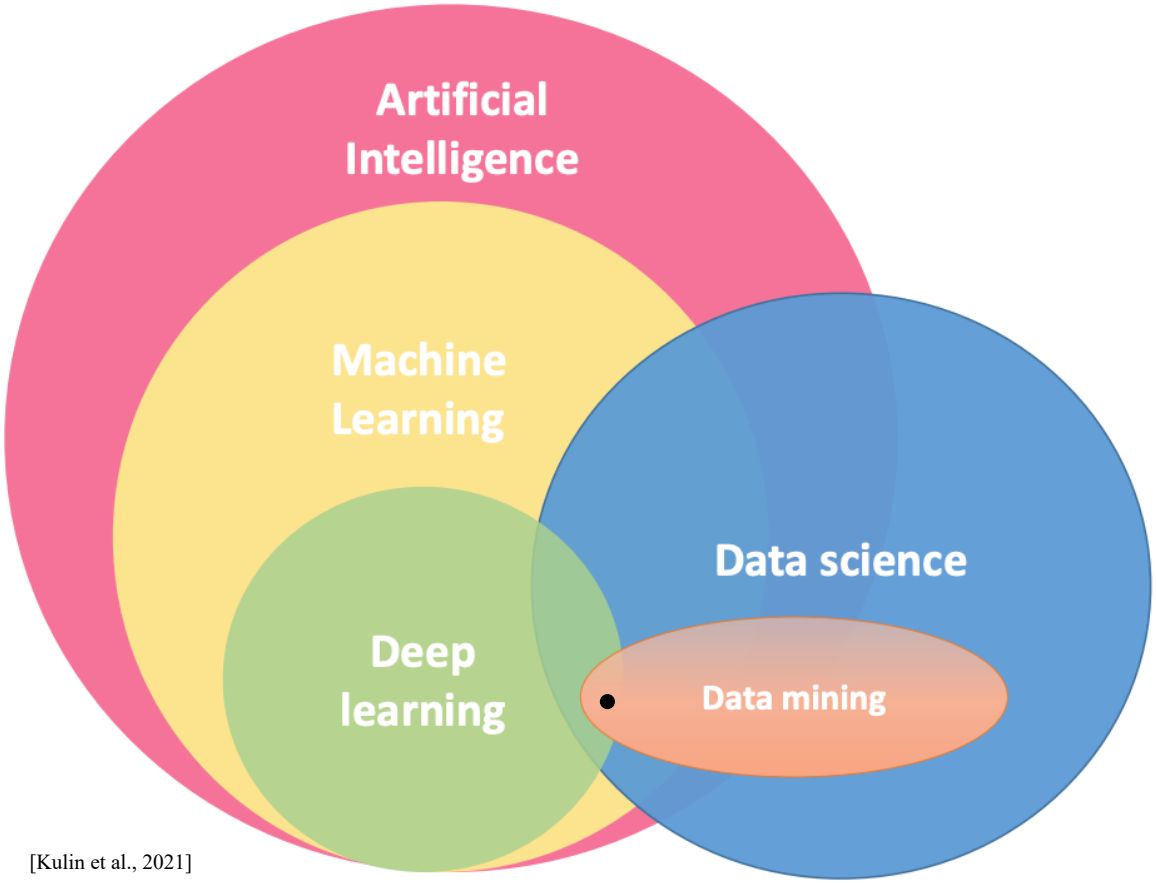
Unravelling the Buzzword Bingo



[Kulin et al., 2021]

- Agents in Environments
- Perceive, Think & Act
- Knowledge Representation
- Planning

- **Supervised Learning**
- Unsupervised Learning
- Reinforcement Learning

- Pre-Training
- Architectures
- Representation Learning

- Data Cleaning, Analysis, Visualization
- Knowledge Extraction
- Goal: Create value from data

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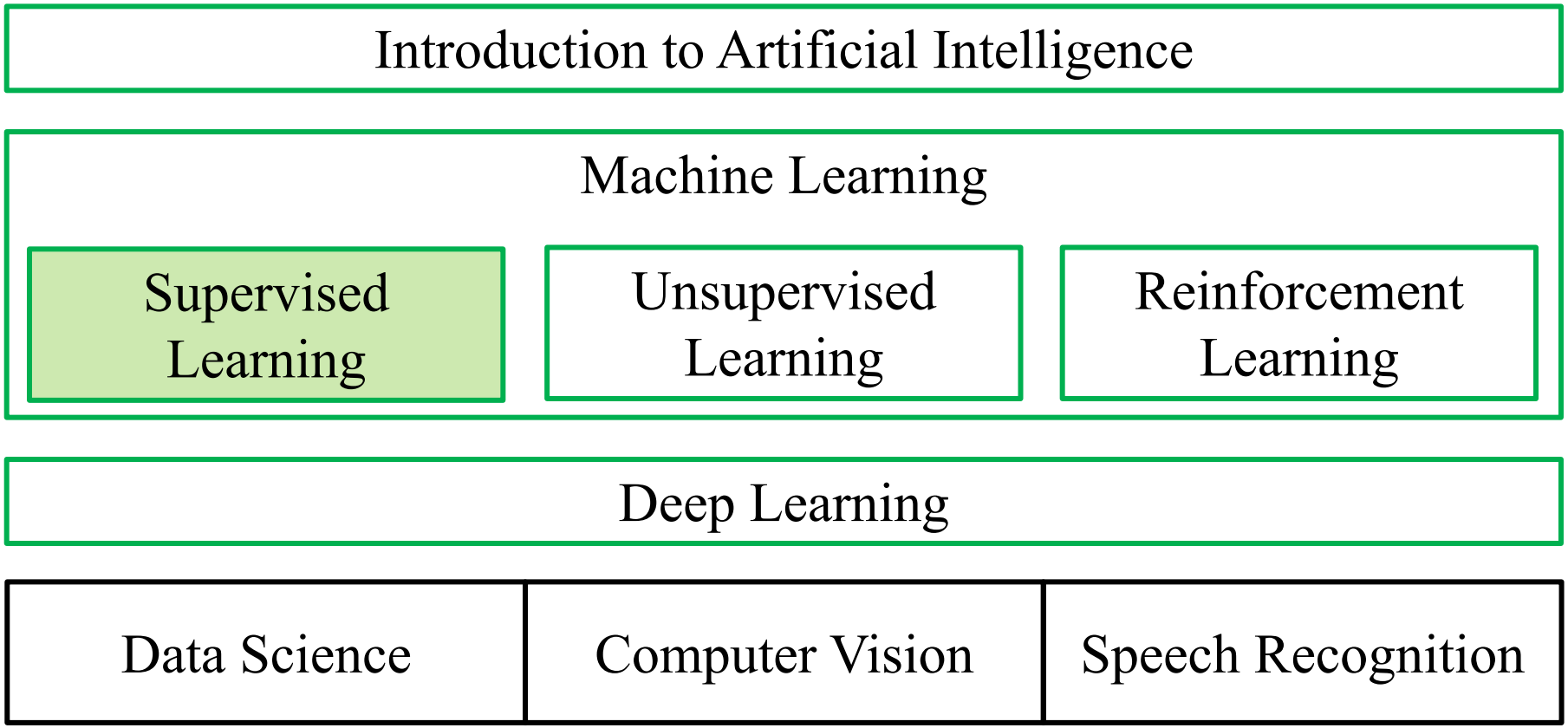
Study Curriculum



APPLICATIONS

Quality Assurance

Example: fruit and vegetable analysis

[Dubey et al., 2015]

License-Plate Recognition

- electronic toll collection,
- law enforcement,
- speed-limit enforcement

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Brenner toll station, © Peter Müller, CC BY-SA 3.0 DE

Optical Character Recognition (OCR)

- offline/online recognition
- Example: MNIST data base
  - Training:
    contains 60000 hand-written digits, labeled, 20x20 = 400 Pixel
  - Validation: 10000 digits

Classifier	Year	Error Rate
2-layer neural network, 300 hidden units	1998	4,7%
Support Vector Machine, Gaussian Kernel	1998	1,4%
product of stumps on Haar features (Boosting)	2009	0,87%
committee of 35 convolutional networks, 1-20-P-40-P-150-10	2012	0,23%
Human		2,5%

Source: http://yann.lecun.com/exdb/mnist/

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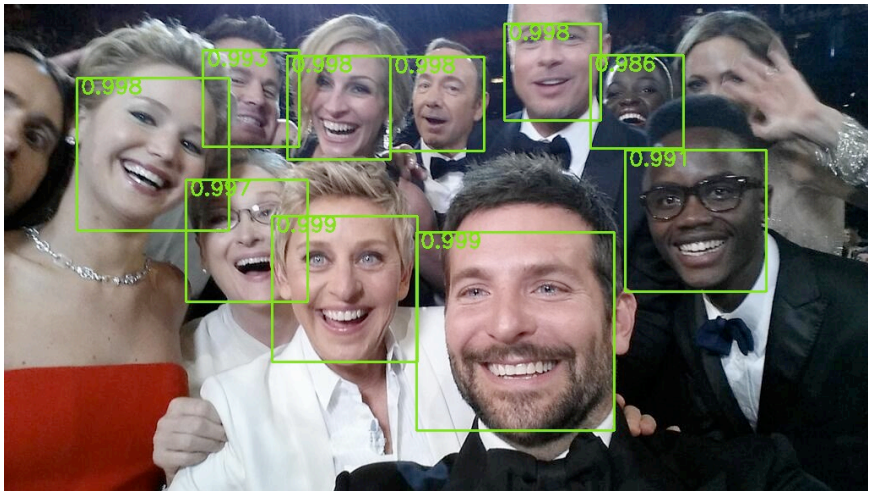
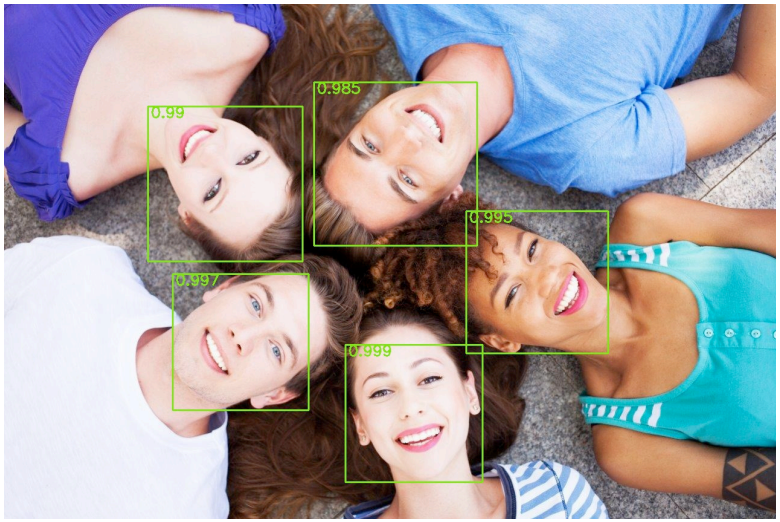
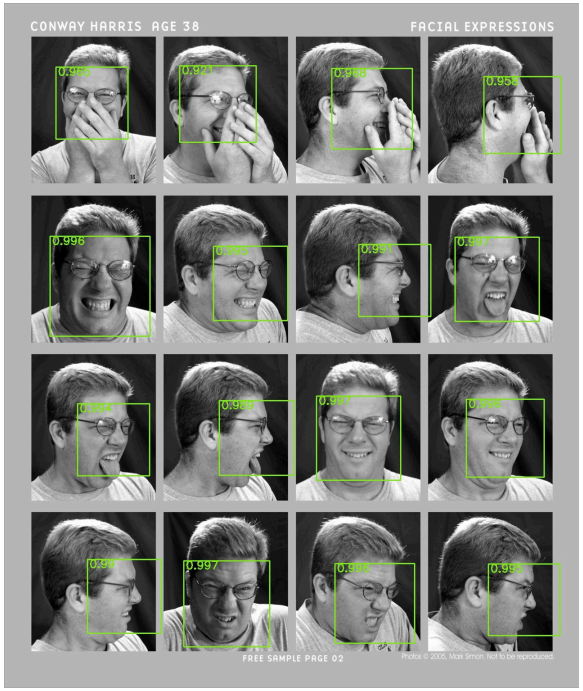
Face Detection & Recognition







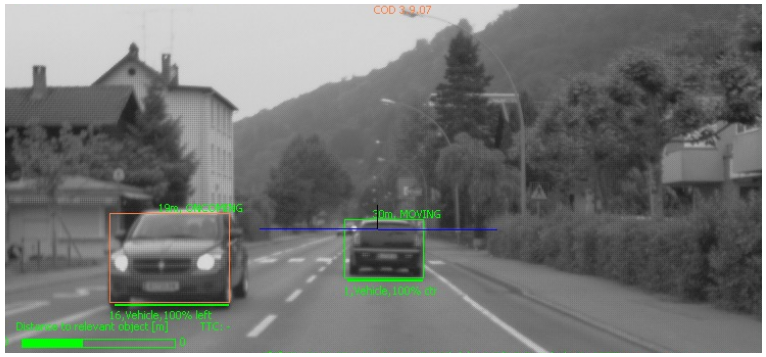
[Farfade et al., 2015]

[Jain & Learned-Miller, 2010]

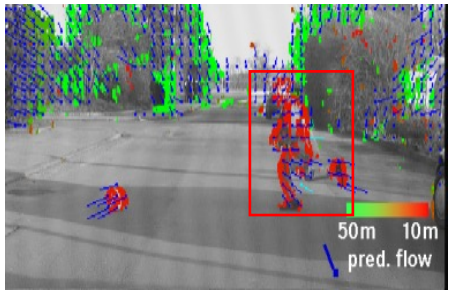
Advanced Driver Assistance Systems

Traffic-Sign Recognition

Vehicle Recognition



Pedestrian Recognition



Images: Continental, A.D.C. GmbH, Lindau

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Speech Processing

Speech Processing

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Speech Processing

- The human voice – a very accessible bio-signal
- We can learn biometrics of a speaker
  - Sex
  - Age


  - Identity

  - Health


  - Emotional state (arousal, nervous, anxious, …)

Speech Processing

- We can learn to transcribe speech *(speech-to-text)*
- We can learn to index speech *(keyword search)*
  - *It's hard to recognize speech.*
  - *It's hard to wreck a nice beach.*

https://www.w3.org/TR/emma/

Speech Processing

- We can learn to understand speech
  - Command and control
  - Information extraction

Literature

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- Mitchell, Tom. *Machine Learning.* 1st edition, McGraw-Hill, 1997. www.cs.cmu.edu/~tom/mlbook.html
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- Goodfellow, I., Bengio, Y., Courville, A.: *Deep Learning*, MIT Press, 2017. http://www.deeplearningbook.org/

Links & Resources

- scikit-learn
  - comprehensive ML library (Python)
  - https://scikit-learn.org
- Tensorflow/Keras
  - neural networks (Python)
  - https://www.tensorflow.org
- PyTorch
  - neural networks (Python)
  - https://pytorch.org/
- Python
  - https://www.python.org/
- Python IDE
  - PyCharm https://www.jetbrains.com/pycharm/
  - Spyder https://www.spyder-ide.org/
  - Jupyter-Notebook https://jupyter.org/
- Data sets
  - Kaggle https://www.kaggle.com/
  - UCI ML Repository https://archive.ics.uci.edu/ml/

References

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