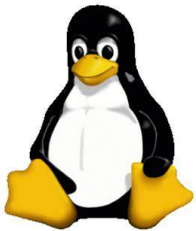# ~~Multimedia II:~~

Machine Learning & Computer Vision

SS 19

Prof. Dr. Rainer Lienhart

www.multimedia-computing.de

www.multimedia-computing.org

Lehrstuhl für Multimedia Computing

N.N. M.Sc. Stephan Brehm N.N. M.Sc. Moritz Einfalt M.Sc. Philipp Harzig M.Sc. Dan Zecha Prof. Dr. Rainer Lienhart

www.multimedia-computing.{de,org}

MMC Multi Media Computing

Universität
Augsburg
University

Foundational

- **Multimedia II**:
  Machine Learning & Computer Vision
  (SS, 4+2)

  Weil wir der zweite MM Lehrstuhl an der Uni Augsburg sind

  Der eigentliche Titel & Inhalt

    – is our main master level lecture, and we suggest taking it first. Its content is independent of any other master lecture.
    – The term "Multimedia II" does not imply at all that "Multimedia I" is required. The idea is that students should be offered a standard 4+2 lecture from us (the second MM professorship) as well as a standard 4+2 lecture from Prof. Andre (the first MM professorship, termed "Multimedia I: …")

Deepening or specializing

- **Bayesian Networks** (SS, 2+2)

- Probabilistic Robotics (WS, 2+2)

Foundational

- Machine Learning & Computer Vision (SS, 4+2)
  - incl. Deep Neural Networks (DNNs) & their application in computer vision

Deepening or specializing

- Bayesian Networks (SS, 2+2)
- Probabilistic Robotics (WS, 2+2)
- New: Reinforcement Learning (SS 2020, 2+2)

Master / Hauptstudium

Lectures / Exercises (Vorlesungen / Übungen)	Practical modules / Seminars (Praktika / Seminare)	Individual assignments (Einzelarbeiten)
(Lienhart, Zecha) **Multimedia II $^{+}$: Machine Learning & Computer Vision** 4+2 SWS (8 LP)	(Harzig) **Advanced Deep Learning** 2+4 SWS (8 LP)	(Mitarbeiter) **Projektmodul: Multimedia Computing** We offer projects related to research topics at our lab for implementation and development. Please contact us directly. 6 SWS (10 LP)
(Lienhart, Einfalt) **Bayesian Networks*** 2+2 SWS (5 LP)	(Lienhart, Zecha, Einfalt) **Seminar: Multimedia und Maschinelles Sehen** 2 SWS (4 LP)	

Machine Learning & Computer Vision

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Universität
Augsburg
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- **Language**

  – <u>Lecture</u>: slides and reading material in English, lecture in German

  – <u>Homework</u> & <u>Practice lecture (Übung):</u> Questions are in English, but answer can be given in English or German

  – <u>Exam</u>: Questions are in English, but answers can be given in English or German

- SS19: 23 April 2019 – 27 July 2019

- Lecture (Room 1058 N)
  - Tue: 8:15 - 9:45   (Room 1058 N)
  - Fri: 10:00 - 11:30   (Room 1058 N)
  - First lecture: April, 23rd
  - National holiday: Tue, June 11, 2019

- Exercise (Room 1058 N)
  - Fri: 12:15 - 13:45
  - First exercise: May, 3rd

- Examine (TBD)
  - Final date & location will be posted on Digicampus

NOTE: Changes, corrections and/or modifications will be posted on Digicampus

1. Introduction

2. Machine Learning

– Introduction

– Concept Learning

– Decision Tree Learning

– Random Forrest

– Discrete Adaboost

– Evaluating Hypotheses

– Bayesian Learning (incl. EM)

– Neural Networks (NNs)

- Deep Neural Networks (DNNs)
- Numerical Computations

– Computational Learning Theory

– Instance Based Learning

3. Data Reduction

– Quantization

- K-Means Clustering
- K-Centers Clustering
- Affinity Propagation (AP)

– Dimensionality Reduction Techniques

- Principle Component Analysis (PCA)
- Non-Negative Matrix Factorization (NMF)
- Random Projection (RP)
- Multi-Dimensional Scaling (MDS)

– Orderless Fixed Size Descriptions

- Histogram
- ~~VLAD~~
- ~~Fisher Vector~~
- ~~DeepTen~~

4. Computer Vision

- Object Detection I
  - Salient Points Detectors (Harris, SIFT)
  - Feature Descriptors (SIFT, Self-similarity, HoG)
  - RANSAC
  - Example: Logo Recognition
- Image Search with pLSA
  - With full derivation using the EM-Algorithm

- Object Detection II
  - Search Strategies
    - Sliding window
    - Detection proposals
      » Selective Search
      » Region Proposal Networks (RPNs)
  - Systems
    - with Adaboost Cascade
    - with R-CNN
    - with Fast R-CNN
    - with Faster R-CNN
    - with SSD

Book Recommendations

- M. Mitchell. *Machine Learning*. McGraw-Hill Science/Engineering/Math, 1997. ISBN: 0070428077; Chap. 1-8
  - (http://www-2.cs.cmu.edu/~tom/mlbook.html)
  - Chapter 1 – 8 is a must read!

- Selected Papers (referenced in the slides and listed on Digicampus)

- Ian Goodfellow, Yoshua Bengio, Aaron Courville. *Deep Learning*. MIT Press, 2016, ISBN-13: 978-0262035613.
  - https://www.deeplearningbook.org
  - Chapter 2 – 5 is a must read

- Max Tegmark. Leben 3.0: Mensch sein im Zeitalter Künstlicher Intelligenz. Ullstein eBooks, 2017, ISBN-13: 978-3550081453.

Every student needs to setup an appropriate software environment

→ Python3 (e.g., install Anaconda (https://www.continuum.io)) with OpenCV (http://opencv.org/), numpy and tensorflow/pytorch

→ **Required for Exercise**