Courses in the Summer Term 2021

April 12, 2021
Image Processing and Computer Vision

three teaching awards

- **Lecturer:** Prof. Joachim Weickert
- **Type:** core class, 4h+2h, 9 ECTS
- **Scope:** transformations, image enhancement, motion, stereo, object recognition

Example: Motion Analysis in Videos

- **Extra Benefit:** enables you to write a bachelor thesis in our group
- **Requirements:** undergraduate mathematics, proficiency in English
- **Virtual Lectures:** Tuesday and Friday, 10:15–12:00 (starting April 13)

https://www.mia.uni-saarland.de/Teaching/ipcv21.shtml
Image Compression

two computer science teaching awards (2017, 2019)

 phẩm:  Dr. Pascal Peter  Type:  advanced class, 4h+2h, 9 ECTS

_requirements:  undergraduate mathematics, proficiency in English

_virtual lectures:  Mon 12–14 c.t. & Wed 14–16 c.t. (starting April 14)
https://www.mia.uni-saarland.de/Teaching/ic21.shtml

 Scope:  from basics of information theory to state-of-the-art image compression
 classics (JPEG, PNG, ...) and novel codecs (BPG, inpainting-/CNN-based)

Example: Inpainting-based Image Compression
Numerical Algorithms for Visual Computing

🔹 **Lecturer:** Dr. Matthias Augustin

🔹 **Type:** advanced class, 3h+1h, 6 ECTS

🔹 **Requirements:** undergraduate mathematics, proficiency in English

🔹 **Virtual Lectures:** Tue 8:30–10:00 & Thu 12:15–14:00 (starting April 13)
  https://www.mia.uni-saarland.de/Teaching/navc21.shtml

🔹 **Scope:** mathematical background and numerical aspects of
  - iterative solution methods for systems of linear equations
  - finite difference methods for partial differential equations
Prof. Dr. Jilles Vreeken
TADA!
Topics in Algorithmic Data Analysis

Who: Prof. Dr. Jilles Vreeken

What: Interpretable Models, Causality

How much: 2 hours of lectures per week, 6 credits

When: Thursdays 10–12 o’clock

Where: eda.mmci.uni-saarland.de/edu/tada21
DON'T PANIC

The Ultimate Guide to Surviving your PhD and Beyond

Thursdays in June, 16:00—17:00, 0 ECTS
Prof. Dr. Isabel Valera
Machine Learning – Prof. Isabel Valera

**How much?** 2 lectures and 1 tutorial per week, 9 credits

**When?** Lectures on Mon. 14-16 h & Wed. 16–18 h (starts 19th April)
Tutorials on Thu. 12–14 h (TBC, starts 22nd April)

**What?** Theoretical Foundations of Machine Learning:
- Probability theory
- Bayesian decision theory
- Linear classification and regression
- Model selection and evaluation
- Convex Optimization
- Kernel methods
- Societal Impact of Machine Learning
- Unsupervised learning (Clustering, Dimensionality Reduction)
- Deep Learning

More information and registration: [https://cms.sic.saarland/pml/](https://cms.sic.saarland/pml/)

Contact & questions to: [ml-course-team@lists.saarland-informatics-campus.de](mailto:ml-course-team@lists.saarland-informatics-campus.de)
Dr. Ben Stock
Foundations of Web Security (formerly known as Web Security)

- Highly practical lecture on Web Security
  - Client-Side Issues (XSS, CSRF, ...), Server-Side Issues (SQL Injections, Command Injections, ...), Infrastructure Security (TLS, ...)
- Accompanied by several practical tasks
  - Attack/Defense Challenges and Jeopardy Challenges
- Inverted-ish classroom
  - lecture videos each week, Q/A session with quizzes Friday 10-12
  - bonus material: complete script for all content of the lecture
- High effort, high reward course
  - Overall assessment thus far: 1.31, 1.3, 1.24, 1.33
    Overall requirements thus far: 2.45, 2.51, 2.54, 2.09 (wtf?!)
- All information through https://cms.cispa.saarland/websec21
Prof. Dr. Christoph Sorge
IT Forensics

• How to find and secure evidence in computer systems, and how to present evidence in court?

• Some exemplary topics:
  • Statistics and the prosecutor’s fallacy
  • Collection of persistent data
  • File system analysis
  • Investigator as an expert witness

• Time: Lecture Tuesday, 10-12, Tutorials TBA

• Contact:
  • www.legalinf.de – lehrstuhl.sorge@uni-saarland.de
Prof. Dr. Gert Smolka
Introduction to Computational Logic
Prof. Gert Smolka

Core Course, 9 CP

• Programming language for developing computational and mathematical theories
• Interactively construct mathematical models and proofs using the Coq theorem prover
• Computational type theory, a foundational language different from set theory
• Case studies (numbers, lists, compilation, regular exp. matching, proof systems)
• Foundational issues and engineering issues
• Intuitionistic proofs, computer-verified proofs, general inductive definitions
• Important for programming languages, system verification, automated reasoning, mathematics
• Course well-suited for online teaching
  (comprehensive lecture notes, feedback through interactive prover)
• Visit course page via Gert Smolka’s homepage to register and learn more

Definition nat_rec (p: N → Type) :
p 0 →
(∀ n, p n → p (S n)) →
∀ n, p n
:=
λ e₁ e₂ → fix f n :=
  match n with
  | 0 → e₁
  | S n' → e₂ n' (f n')
end.
Prof. Dr. Philipp Slusallek
Lecture: Realistic Image Synthesis
Philipp Slusallek, Karol Myszkowski, Gurprit Singh

• Topics:  
  - Realistic Rendering  
  - Lighting Simulation  
  - Monte-Carlo Methods  
  - Sampling-Techniques  
  - HW-based Techniques  
  - High-Dynamic Range Imaging  
  - Animation & Perception

• Organization:  
  - Lectures, assignments, oral exam

• Schedule (online via Zoom):  
  - Mon 10-12h & Thu 8:30-10h

See: https://graphics.cg.uni-saarland.de/courses/
Contact: slusallek@cs.uni-saarland.de
saarland-informatics-campus.de

Prof. Dr. Sven Rahmann
New at UdS CS and ZBI: Prof. Sven Rahmann

- Research topic: Algorithmic Bioinformatics
- Bioinformatics Master Courses
  - Algorithms for Sequence Analysis
  - Seminar on Algorithms and Data Structures
  - Python Programming (Winter?)
- BSc and MSc Theses
- Website (needs update):
  [https://www.rahamnlab.de/](https://www.rahamnlab.de/)
Special lecture: Algorithms for Sequence Analysis

- Exact and approximate pattern matching
- Full-text inverted index data structures (suffix trees / arrays); applications to biosequences
- Text compression and succinct indexing
- Pairwise and multiple sequence alignment
- Combinatorial and probabilistic models for patterns
- DNA/peptide motif search and discovery
- Alignment-free methods, $k$-mers and hashing
- More information and registration: [https://www.rahmannlab.de/](https://www.rahmannlab.de/) → Lehre → Algorithms...

- Summer 2021: 4V+2Ü, 9 ECTS
- Tue 12:30-14:00, Thu 08:30-10:00, Exercises TBD
Dr. Anand Narayanan
Algebraic Coding Theory

How to transmit information over noise?

Complexity theory applications: How to write a proof that can be verified by reading a few bits?

How to conduct an interactive protocol amidst noise? ..or.... How to play blindfold chess when your friends are screaming?

Wednesdays 14-16 hr.
Instructor: Anand Narayanan (CISPA)
Advanced lecture, 6CP

Warning: May contain mathematics; arithmetic, algebra, geometry, discrete probability and graph theory.

https://cms.cispa.saarland/algebraic_coding
saarland-informatics-campus.de

Prof. Dr. Martina Maggio
Embedded Systems, 9 credits

- Models of the physical environment
- Control and computation
- Implementation

http://cms.sic.saarland/es20/
maggio@cs.uni-saarland.de

Continuous-Time Models

State-space System Model: Linear Time-Invariant

\[
\dot{x}(t) = \frac{dx}{dt}, \text{first derivative of } x(t)
\]

\[
\dot{x}(t) = f (x(t), u(t), \tau)
\]

\[
y(t) = h (x(t), u(t), \tau)
\]

A function \(f\) is linear when it preserves vector addition and scalar multiplication:

\[
f(x + y) = f(x) + f(y)
\]

\[
f(\alpha \cdot x) = \alpha \cdot f(x)
\]

\(f : \mathbb{R}^n \times \mathbb{R}^p \times \mathbb{R} \rightarrow \mathbb{R}^n\), and \(f\) is linear
states \(\times\) inputs \(\times\) time \(\rightarrow\) states derivatives

\(h : \mathbb{R}^n \times \mathbb{R}^p \times \mathbb{R} \rightarrow \mathbb{R}^q\), and \(h\) is linear
states \(\times\) inputs \(\times\) time \(\rightarrow\) output

Scheduling

Scheduling Example

\[
\begin{align*}
#1 & & p_1 = d_1 & p_1 = d_1 & p_1 = d_1 & p_1 = d_1 \\
& \tau_1 & & & & \\
& \tau_2 & & & & \\
#2 & & p_1 = d_1 & p_1 = d_1 & p_1 = d_1 & p_1 = d_1 \\
& \tau_1 & & & & \\
& \tau_2 & & & &
\end{align*}
\]
Data Science (6CP)

Univ.-Prof. Dr.-Ing. Wolfgang Maaß

Professor für Wirtschaftsinformatik
Fakultät für Empirische Humanwissenschaften
und Wirtschaftswissenschaft

Professor für Informatik (kooptiert)
Fakultät für Mathematik und Informatik

Wissenschaftlicher Direktor
Deutsches Forschungszentrum für Künstliche Intelligenz (DFKI)
“A data scientist is someone who knows more statistics than a computer scientist and more computer science than a statistician.”

– Josh Blumenstock

Lecture topics:
- Machine Learning
- Deep Learning
- Visualization
- CNN & GANs
- Business Context
- Case Study

What you will learn:
- Asking the right question.
- Choosing the right model for the problem.
- Concepts in data science
- Applying algorithms in practice and manipulating data sets.
- Visualizing data analysis results and transforming them into business models

Course structure:
- Exam: 40%
- Mini Project: 60%

Lecturer: Univ.-Prof. Dr.-Ing. Wolfgang Maaß
Contact person: Maxx Richard Rahman
(m.rahman@iss.uni-saarland.de)

Lecture (via zoom): Fri 11:45 - 13:45
Registration: https://lms.sulb.uni-saarland.de/moodle/course/view.php?id=4679
Prof. Dr. Jana Köhler
Artificial Intelligence 2021

Monday 4-6pm and Thursday 4-6pm

Register at https://cms.sic.saarland/ai_21

Prof. Jörg Hoffmann
http://fai.cs.uni-saarland.de/hoffmann/
hoffmann@cs.uni-saarland.de

Prof. Jana Koehler
https://jana-koehler.dfki.de/
jana.koehler@dfki.de

- General introduction into the field of Artificial Intelligence (AI), its history, key assumptions, paradigms, concepts, and fundamental methods
- Learn and apply techniques developed in the fields of intelligent agents, search algorithms and game playing, knowledge representation, logical reasoning and deduction, planning, constraint reasoning, machine learning, and reasoning under uncertainty
- With the knowledge acquired in this course, students are well-prepared to successfully attend the many special lectures on AI offered at UdS or to write their Bachelor or Master thesis in the field of AI
- New in 2021: AIden chatbot supports students when working on assignment cheats
Prof. Dr. Dietrich Klakow
Topics

1. Introduction
2. Signal Representations
3. Microphone Arrays
4. Filtering and Smoothing
5. Feature Extraction from Speech Signals
6. Musical Genre Classification
7. Speaker Recognition
8. KL-Transform and Linear Discriminant Analysis
9. Linear Predictive Coding
10. Wiener Filter
11. Spectral Subtraction
12. Kalman-Filter

Lecture:
- Monday 10:15-11:45
- Location: MS Teams
- Starts: Monday April 17th
- Tutorials: one group by arrangement (doodle)
- Register by April 14$^{rd}$ 23:59 on course home page
Topics
1. Natural Language as a Sequence of Symbols
2. Basics of Language Modeling
3. Entropy
4. Backing-Off Language Modeling
5. Text Classification
6. Word Sense Disambiguation
7. Information Retrieval
8. Topic Detection and Tracking
9. Part-Of-Speech Tagging
10. Named Entity Tagging
11. Machine Translation

Lecture:
- Friday 8:30-10:00
- Location: MS Teams
- Starts: April 23rd
- Tutorials: by arrangement (doodle)
- Register on course home page by 16th, 23:59
Software Project: Representation Learning with Deep Learning

adavody@lsv.uni-saarland.de

The learning objectives are:

- Reading papers on recent advances in deep learning related topics.
- Implementing an (ideally novel) idea and getting hands-on experience.
- Working as a group to create a software.

Topics:

- Natural Language Processing related topics.
- Few-shot learning.
- Transfer Learning.

Lecture:

- Major parts of the software project will be done in the summer break as a 5 weeks block course.
- During the coming semester the effort will be about 3h per week for preparing the project and planning it.
- Register by April 14th, 23:59, email: adavody@lsv.uni-saarland.de
Dr. Andreas Karrenbauer
Optimization

Core lecture: 9 credit points

- two lectures per week (Wednesdays + Thursdays 14-16)
- one tutorial per week (Mondays 16-18)
- theoretical course with (optional) practical exercises

(integer/linear) Optimization is not only a key topic in theoretical CS

\[
\begin{align*}
\min & \quad c^T x \\
\text{s.t.} & \quad Ax = b \\
& \quad x \geq 0
\end{align*}
\]
Prof. Dr. Holger Hermanns
Space Informatics
Juan Fraire, Holger Hermanns

**System Design**
- Orbit Dynamics
- Launchers, Spacecrafts, Satellites, Space Stations
- System Architecture, System Components

**Communication**
- Transmission and Encoding Basics
- Delay Tolerant Networking, Routing, Congestion, Contact Plans
- Interplanetary Internet and beyond

**Planning and Operation**
- Power, Memory, Space, Time
- Telerobotics vs. Autonomy vs. Human-Operated
- Task Graphs, Priced Timed Automata
- Optimisation DP, LP, ILP, MILP, ...
- SAT and OMT

**Applications and Challenges**
- LEO vs. GEO Satellites
- Space Missions
- Exploration, Observation, Communication, Tourism
- Space Debris

**What?**
- Advanced Lecture
  Vertiefungsvorlesung
- 6 CP
- Thu 14-16 weekly
  otherwise online

Interested?
dcms.cs.uni-saarland.de/spain21/
### Blocks I
**Philosophical Tool Box**
- What are your *moral* intuitions?
- What is *right and wrong*?
- How to write a proper argument?
- What are *Codes of Ethics*, where do you find them, and how may they help you?
- ...

### Block II
**Contemporary Topics**
- What is wrong with *filter bubbles* and *echo chambers*?
- What problems are there with *machine learning*?
- What about *surveillance* and *whistle blowing*?
- ...

### Block III
**Oncoming & Sci-Fi Topics**
- How should *machines behave* towards humans?
- Is it possible to built *thinking machines*?
- Would a *super-intelligence* be dangerous?
- ...

### Organization
- Advanced Lecture
  - Vertiefungsvorlesung
- 6 CP
- *short videos* instead of lectures
- grading though *exam* (or re-exam) and *essay*
- exam admission through assignments and group work

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Interested?

[dcms.cs.uni-saarland.de/ethics_21/](dcms.cs.uni-saarland.de/ethics_21/)
COURSES SUMMER TERM 2021

1. Audio/Visual Communication and Networks (5G New Radio)
   - 4L2T, Start April 13th (tutorials start Wednesday Apr. 21st)
     Tuesday 12:15–13:45 and Wednesday 8:30–10:00
   - Implementation:
     - eBook “5G NR” available to all students!
     - Background theory via interactive manuscript
     - Quizzes & Tutorials via (UdS)-Moodle
     - (Partially Inverted) Lecture via (UdS)-Teams
   - 5G New Radio (you’ll finally understand how it works 😊)
     - Wireless transmission (propagation, link budgets)
     - Multiple access (T-/F-/C-/S-DMA)
     - (Massive-) MIMO
   - Contact: herfet@cs.uni-saarland.de
COURSES SUMMER TERM 2021

2. Hands on Networking (HON)
   - 2L2T, Start August 2\textsuperscript{nd}, Block-Course until August 27\textsuperscript{th}
     Each Day 08:30–15:00 (August 2\textsuperscript{nd}-13\textsuperscript{th})
     Practical Project Work (individual, August 14\textsuperscript{th}-27\textsuperscript{th})
   - Implementation (YET TO BE DECIDED!):
     - Admission Test: We, July 21\textsuperscript{st}, 2021, 16:00st
     - Slides available via web!
     - Tutorials via (UdS)-Moodle
     - (Partially Inverted) Lecture via (UdS)-Teams
   - Networking Practice
     - Wired and Wireless (Physical and Link)
     - Network addressing (IPv4 and IPv6)
     - Transport Protocols
     - Network Management and Debugging
   - Contact: herfet@cs.uni-saarland.de
Prof. Dr. Anja Feldmann
What enabled the **Internet** to evolve from a simple network of a few hosts in its early days to a complex network of **billions of hosts** today?

We will dive deep into network **architectures**, **protocols**, and **technologies**.

- Self-contained, **downloadable video** lectures
- Interactive **live Q&A** with lecturers
- **Engaging exercises** and tutorials

Contact: inet-teaching@lists.mpi-inf.mpg.de
Dr. Nico Döttling, Prof. Dr. Antoine Joux, Prof. Dr. Cas Cremers
Lecturers: Nico Döttling, Antoine Joux, Cas Cremers

https://cms.cispa.saarland/crypto21/
Complexity Theory (core lecture)

- Monday 10:15–12:00
- Wednesday 8:15–10:00
- starts April 14

- Complexity theory is the science of classifying problems with respect to their usage of resources

- Flagship question: P \( \equiv \) NP

- “Grundzüge der Theoretischen Informatik” (Introduction to Computability and Complexity) or equivalent highly recommended

- Web: cms.sic.saarland/cct21/
- Contact: Markus Bläser 
  mblaeser@cs.uni-saarland.de
The End.
Enjoy your studies

@ Saarland Informatics Campus

@ Saarland University

& stay safe!