Courses in winter term 2021/22
Prof. Dr. Markus Bläser
Complexity of bilinear problems

- Monday 10:15–12:00
- Thursday 12:15–14:00
- starts Oct 21
- specialized lecture, 6 CP
- tutorial every second Thursday
- online lecture

- Flagship question: How fast can we multiply matrices?
- Solid knowledge of linear algebra is highly recommended

- Web: cms.sic.saarland/bil2122/
- Contact: Markus Bläser
  mblaeser@cs.uni-saarland.de

...no meme this time.
And owls are cuter than cats.
saarland-informatics-campus.de

Dr. Aleksandar Bojchevski
Trustworthy Graph Neural Networks Seminar

TL;DR: GNNs + [Robustness | Privacy | Fairness | Explainability | Uncertainty]

trustworthiness aspects

graphs across domains

robustness certificates

perturbed graphs

privacy guarantees

fairness constraints

uncertainty estimates

Organization: Block format, Kick-off meeting via Zoom, Final presentations at the end
Grade: Seminar paper (40%, 4 pages), Presentation (30%), Reviews (3 × 10%)
Lecturer: Dr. Aleksandar Bojchevski, bojchevski@cispa.de, abojchevski.github.io
Website: https://cms.cispa.saarland/tgnn_ws21/
Prof. Dr. Karl Bringmann
You will learn:

- Fundamental problems
- Efficient algorithms
- Algorithmic problem solving

Topics:

- Algorithms on graphs, strings, polynomials, points & lines, ...
- Randomized algorithms
- Advanced data structures using amortized analysis

Details:

**Intensive block course:** February 28 – March 25 with 2 lectures per day

**Lecturers:** Prof. Karl Bringmann, Prof. Raimund Seidel

**Requirements:** introductory course on algorithm design

**Website:** https://cms.sic.saarland/algodat_21/

Online participation will be possible
P vs NP is too coarse!
Even $O(n^2)$ can be too slow!

What you will see:
A fine-grained view on complexity theory
Conditional lower bounds and algorithm design

Where+When: Monday 14:15-16:00 hybrid (in room 024 E1.4 or on Zoom)
Lecturer: Prof. Karl Bringmann
Requirements: basics in algorithm design and theoretical computer science
Website: https://cms.sic.saarland/finegrained/
Derek Dreyer, Ph.D.
We will use Coq!

Semantics

- Formalize what programs do
- Show that they do the right thing!

Type systems

\[
\begin{align*}
& \Delta \vdash A : T \\
& \Delta; \Gamma, x : A \vdash e : B \\
\end{align*}
\]

\[
\Delta; \Gamma \vdash \lambda x : A. e : A \to B
\]

Semantic models

\[
[A \to B]_\delta \equiv \lambda v. \Box (\forall w. [A]_\delta (w) \Rightarrow [B]_\delta^e (v w))
\]

Program logics

\[
\{P_1\} C_1 \{Q_1\} \quad \{P_2\} C_2 \{Q_2\}
\]

\[
\{P_1 \ast P_2\} C_1 \parallel C_2 \{Q_1 \ast Q_2\}
\]
saarland-informatics-campus.de

Prof. Bernd Finkbeiner, Ph.D.
Verification

Core lecture with course project and weekly assignments = 9 ECTS

Lecture: Tue 14-16 and Thu 10-12 in HS001, E1 3 and online
Tutorials: Fri 10-12 or 12-14 in Room 206, E1 1 and online
Office Hour: Wed 10-12 in Room 106, E1 1 and online

www.verification.saarland
saarland-informatics-campus.de

Dr. Marc Fournelle
Ultrasound Imaging

Weekly lecture Mo 16-17h30 (or block seminar in Jan/Feb 2022)

- Lecture in English
- Final written or oral exam

Topics:
- Physics of Ultrasound
- Ultrasound Signal Processing
- Ultrasound Systems and Transducers
- Ultrasound Imaging modalities (B-mode, Doppler, …)
- Ultrasound Image Reconstruction → from signals to images
- Technical Ultrasound Applications (NDT, Sonar)
- Molecular imaging & hybrid approaches

Please register:
- Dr. Marc Fournelle (+49 6897 9071 310)
- marc.fournelle@ibmt.fraunhofer.de

Tanter et al: Journal of Cerebral blood flow & metabolism (2014), 34, 1009-1017
Prof. Dr. Thorsten Herfet
Courses WS2021/22
Telecommunications Lab

Prof. Dr.-Ing. Thorsten Herfet
Digital Transmission & Signal Processing

- **Core- / Advanced Lecture 9CP (4L2T)**
  - Tuesdays 12:15–13:45, Wednesdays 08:30–10:00, **Start October 19th**
  - Lectures & Tutorials: **MS-Teams** (LIVE, recordings available to class)
  - Assignments & Quizzes: **UdS-Moodle** (100% paperless)

- **All major building blocks of modern telecommunication systems**
  - Discretization (Sampling & Quantization), Digital Modulation (PSK, QAM), Multicarrier-Transmission (OFDM), Forward Error Coding

- **...and the underlying mathematical foundations**
  - Fourier-, Laplace-, Z- and Hilbert-Transforms, Algebra on Finite Fields (Prime Fields and extended Prime Fields), Stochastic Signal Analysis

- **Registration mandatory via Moodle:**
  - Will be duplicated into MS-Teams for all registered students!
Multimedia Transport

• Core- / Advanced Lecture 9CP (4L2T)
  • Tuesdays 10:15–11:45, Wednesdays 12:15–13:45, Start October 19th
  • Lectures & Tutorials: MS-Teams (LIVE, recordings available to class)
  • Assignments & Quizzes: UdS-Moodle (100% paperless)

• All major components of multimedia streaming
  • Latency- and Resilience-Awareness, Congestion- & Flow Control, Adaptive Hybrid-ARQ, Video- and Audio-Coding

• …and the underlying mathematical foundations
  • Markov-Chains, Gilbert-Elliot Erasure Channel Models, LDPC-Coding, Residual Error Rate Calculation, Delay Budgets

• Registration mandatory via Moodle:
  https://lms.sulb.uni-saarland.de/moodle/enrol/index.php?id=5803
  • Will be duplicated into MS-Teams for all registered students!
Hands on Networking

• Practical / Advanced Course 6CP (2L2T)
  • Block Course CW11/12 2022 (14.–25. March 2022), daily 8:30–15:00
  • Individual project work (10. April 2022)
  • Admission test in January (date to be communicated)
  • Course Announcements and Material: UdS-Moodle (100% paperless)

• Networking Practice
  • Wired & Wireless Networks (Physical & Link Layer)
  • Network Addressing (IPv4 & IPv6)
  • Transport Protocols (UDP, TCP, QUIC)
  • Network Management & Debugging (GNS3)

• Registration mandatory via Moodle:
  • Link will be provided on our websites:
    https://www.nt.uni-saarland.de/education/
    https://lms.sulb.uni-saarland.de/moodle/

*: Hands on Networking + Hands on Dependability
AG Prof. Dr. Holger Hermanns
Hands-On Dependability with Rust

Advanced Lecture*

Andreas Schmidt
register at dcms.cs.uni-saarland.de/hod_21/

Dependable Systems and Software Chair

* no requirements except Programming 1/2 or comparable
saarland-informatics-campus.de

Prof. Dr. Jörg Hoffmann
Planning? What’s that?

My mother:
“My son works on this but I have no idea what it is.”

Wikipedia: “... the process of thinking about the activities required to achieve a desired goal.”

Me: “... the reachability problem in large transition systems.”

Given an initial state $I$, a goal $G$, and a set $A$ of actions, find a path from $I$ to a state $s$ s.t. $s \models G$.

Symbolic AI (main content): heuristic search, pruning, decomposition.

Data-driven AI (we will have a brief look): Learn a policy $\pi$ mapping states to actions. But how to gain trust in $\pi$?

Policy explanation, verification, testing, visualization.

Programming projects: You’ll make your own planning system and participate in a competition!
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  - policy explanation, verification, testing, visualization.

**Programming projects:** You’ll make your own planning system and participate in a competition!
Spezialized Course: AI Planning
Tue 14:00–16:00 + Wed 10:00–12:00; 9 ECTS
Me: “Data-driven AI: Learn a policy $\pi$ mapping states to actions $\Rightarrow$ policy explanation, verification, testing, visualization.”

But how to learn $\pi$ in the first place?

- We will cover graph neural networks as an essential paradigm, then cover the current state of the art in learning policies (among others).
- Prerequisites: Basic knowledge assumed (AI core course, neural networks general background). More specialized knowledge helpful (AI Planning course, neural network courses).
saarland-informatics-campus.de

Dr. Swen Jacobs
Formal Verification of Systems with arbitrary # of components

\[ \forall a: \text{author}, \ p: \text{paper}. \ (\text{in } \pi = a, p \text{ in } \pi' \Rightarrow \text{out } \pi = a, p \text{ out } \pi') \land \forall a: \text{author}, \ p_1, p_2: \text{paper}. \ (\text{in } \pi = a, p_1 \text{ in } \pi' \land p_1 \neq p_2 \Rightarrow \text{ALWAYS out } \pi = a, p_2 \text{ out } \pi') \land \forall r: \text{reviewer}, \ p: \text{paper}. \ (\text{conflict-declared} (r, p) \land \text{in } \pi = r, p \text{ in } \pi' \Rightarrow \text{out } \pi = r, p \text{ out } \pi' \text{ UNTIL conflict-deleted} (r, p)) \]

Advanced Lecture
Swen Jacobs

Block Course in Feb/Mar 2022

Registration and further information: cms.cispa.saarland
FORMAL METHODS FOR FINDING AND FIXING INFORMATION LEAKS

∀a: author, p: paper. ∀𝜋, 𝜋'. (in 𝜋 = a, p in 𝜋' ⇒ out 𝜋 = a, p out 𝜋')
UNTIL notification

∀a: author, p1, p2: paper. ∀𝜋, 𝜋'. (in 𝜋 = a, p1 in 𝜋' ∧ p1 ≠ p2 ⇒ ALWAYS out 𝜋 = a, p2 out 𝜋')

∀r: reviewer, p: paper. ∀𝜋, 𝜋'. (conflict-declared(r, p) ⇒ out 𝜋 = r, 𝑝 out 𝜋' UNTIL conflict-deleted(r, p))

Register at Seminar Assignment Platform:
seminars.cs.uni-saarland.de
(until tonight 23:59)
Neural Networks: Theory and Application

Topics:
- Intro to Machine Learning
- Deep Feedforward Networks
- Regularization for Deep Learning
- Optimization for Training Deep Models
- Convolutional Networks
- Sequence Modeling: Recurrent and Recursive Nets

Location: MS Teams (for the start)
Lecture: Tuesday 14:15-15:45
Starts: October 26th
Registration for participation: https://www.lsv.uni-saarland.de/neural-networks-theory-and-implementation-winter-2021-2022/

Contact: dietrich.klakow@lsv.uni-saarland.de
Grundlagen der Signalverarbeitung

Themen:
• Darstellung von Signalen
• Systemtheorie
• Lineare Zeitinvariante Systeme
• Fourier Transformation
• Numerische Fouriertransformation (FFT Algorithmus)
• Korrelation von Signalen
• Statistische Beschreibung von Signalen
• Filter

Ort: MS Teams
Zeit Vorlesung: Montag 10:15-11:45
Beginn: 25. Oktober
Übung: Montag 12:00-13:30
CP: 6

To participate register on the course home page:
https://www.lsv.uni-saarland.de/grundlagen-der-signalverarbeitung-winter-2021-22/

Contact: dietrich.klakow@lsv.uni-saarland.de
Proseminar ‘Computational Pragmatics’

Teacher: Dr. Volha Petukhova

You will learn:

1. understand how to compute pragmatic meaning;
2. study the mechanisms underlying the main pragmatic inferences and aspects of pragmatic meaning;
3. discuss algorithms that enable the use of theoretical concepts in practical applications.

Focus will be put on computational dialogue modelling for dialogue system design.

Method: 10 topics with paper selection; a presentation for each participant based on a research paper (40% of final scores); active participation in discussions and exercises (20% of final scores); Final assignment: 10 pages report (40% of final scores)

First meeting: 26.10.2021 at 12:15 in TEAMS link on the course homepage: https://www.lsv.uni-saarland.de/upcoming-courses/proseminar-computational-pragmatics-winter-2021-2022/
If you think good architecture is expensive, try bad architecture

Brian Foote and Joseph Yoder: “Big Ball of Mud”  http://www.laputan.org/mud/

- Learn about established methods to build a „good“ architecture
  - „good“ = viable and fit for a purpose
- Practice architectural thinking on an AI project step-by-step
  - Focus is on systematic conceptual thinking, no coding, no proofs
- Master the language and methods used by software architects
- Lay foundation to prepare for professional certifications
- Get insights into AI architectures

Register at  https://lms.sulb.uni-saarland.de/moodle/enrol/index.php?id=3991

Starts Thursday 10/21 4:15 PM in HS001 in E1.3
AG Prof. Dr. Antonio Krüger
Seminar
Walk While Work!

Why
Because you will learn how to nudge people to a healthier work-life-style!

Who
Dr. Pascal Lessel (DFKI) + Support
Thomas Immich (Centigrade) + Support

What
UX-Driven Development of Player Type-Centric Motion Games

When
Fridays, 10-12 am

Where
Adaptive Human Machine Interfaces for Autonomous Systems

Our research attempts to combine the powers of Multimodal Dialogue and Machine Learning to make human-machine interaction more *personalized* and *explainable*.

Thursdays, 16:15 (Hybrid)
20 Places
**Practical Group Projects** + **Topic Presentation** + **Active Discussion**

Visit our webpage for up-to-date information:

Contact: Dr. Michael Feld
michael.feld@dfki.de
Amr Gomaa
Niko Kleer
Maurice Rekrut
Guillermo Reyes
Julian Wolter

Adaptive Interfaces & Dialogue Group
Seminar: SupRTwin
Sensing, Understanding and Provisioning of Robotic Digital Twins
Cooperation between UMTL (Prof. Krüger) and ZeMA (Prof. Müller)
Daniel Porta (DFKI), Tim Schwartz (DFKI), Ali Kanso (ZeMA)
Andreas Luxenburger (DFKI), Caspar Jacob (DFKI), Jonas Mohr (DFKI), Khansa Rekik (ZeMA), Xiaomei Xu (ZeMA)

Gain practical experience with
- Robots
- Drones
- Digital Twins
- Industrie 4.0 concepts

Requirements
- basic knowledge in AI (computer vision, planning)
- good programming skills in Java
- programming skills in Python or C++ (for CV tasks)
- beneficial: experience in Unity 3D

Location: Power4Production Hall at ZeMA (Eschberger Weg 46) and Online
Kick-off: to be announced

https://umtl.cs.uni-saarland.de/teaching/winter-2021/2022/
Contact: suprtwin@dfki.de
saarland-informatics-campus.de

Dr. Marco Patrignani
Dr. Hamed Nemati
Dr. Robert Künnemann
Formal methods in Security

Advanced lecture, 2h lecture/week + 2h exercises/week

Analyse computer security problems and solutions with mathematical precision

Learn various techniques to design and implement secure software stack:

- Protocol
- Protocol verification
- Program
- Language-based Information-flow control
- System
- System-level verification

Robert Künnemann
Marco Patrignani
Hamed Nemati
Perspectives of Entrepreneurial Cybersecurity (5 ECTS)

- Lecture series ("Ringvorlesung")
  - weekly presentations by successful founders and VCs in the vicinity of cybersecurity about their experience for starting a company and insights for a successful startup
  - For 5 CP: Create a pitch for a joint event at end of the semester and participate in weekly meetings

- It is possible to join to just listen to the presentations!
  - Still need to sign up in CISPA CMS

- Course website and schedule:
  https://cms.cispa.saarland/poser_2122/
Prof. Dr. Sven Rahmann
Special lecture (MSc/BSc Bioinformatics), Elective (others): Statistics, Probability and Applications in Bioinformatics

Probabilistic modeling, specialized to bioinformatics

- elementary probability and combinatorics
- discrete and continuous distributions
- statistics: description, parameter estimation, testing
- stochastic processes: e.g., Poisson; PAAs

Applications: DNA Motifs, PCR process, significance of pairwise sequence alignment, differential gene expression, methylation level estimation, variant calling

- Winter 2021/22: 4V+2Ü, 9 cr, Tue+Thu 08:30-10:00
- Tutorials: 1x on-campus, 1x online
- Information: [https://www.rahmannlab.de/lehre/spab](https://www.rahmannlab.de/lehre/spab)
- Registration at CMS: [https://cms.sic.saarland/spab/](https://cms.sic.saarland/spab/)
- Contact: Sven Rahmann, rahmann@cs...
saarland-informatics-campus.de

Prof. Dr. Jürgen Steimle
Core lecture (9 ECTS):
Human-Computer Interaction

Prof. Dr. Jürgen Steimle
TA: Adwait Sharma

• What makes user interfaces good or bad?
• Learn from the past and get to see the future of UIs
• How to design great user interfaces?
• How can we shape next generations of UIs?

Registration in first lecture
Tuesday 10:15am

https://hci.cs.uni-saarland.de
Block Seminar (7 ECTS): Interactive Touch Surfaces

Prof. Dr. Jürgen Steimle
Narges Pourjafarian

• Hands-on block course during the winter semester break
• Learn about state-of-the-art technologies for touch sensing
• Implement your own project of how you envision future touch systems

More information: https://hci.cs.uni-saarland.de
Dr. Sebastian Stich
Seminar on Optimization for Machine Learning

many ML tasks can be formulated as an optimization problem:

$$\min_x f(x) = \text{Classification} \quad \text{Regression} \quad \text{Deep Learning}$$

This seminar is about algorithms that we use to train ML models.

- Stochastic gradient descent (SGD)
- Variance reduction (SVRG)
- Adaptive algorithms (ADAM)
- Distributed training (Local SGD)
- basic classic techniques (convex settings, standard assumptions and tools, etc.)
- standard algorithms for ML/DL
- advanced techniques (tailored to special applications)

seminar = we will discuss, present, read & review a selection of papers

Contact: Sebastian Stich
sebastian.stich@uni-saarland.de
Prof. Dr. Isabel Valera
Prof. Dr. Jilles Vreeken
Elements of Machine Learning

**Who**
Prof. Jilles Vreeken & Prof. Isabel Valera

**What**
- Classification
- Regression
- Exploration

**How much**
1 lecture and 1 tutorial per week, 6 credits

**When & Where**
- Lectures: Thu 16-18 onsite+online (starts: 21 Oct)
- Tutorials: Mo/Tu 12-14 onsite+online (starts: 25/26 Oct)

https://cms.sic.saarland/eml/
Automated Reasoning (I)
Uwe Waldmann

Mondays 16:00–18:00 and Wednesdays, 16:00–18:00
(starting Wednesday, October 20)
Bldg. E1.3, Lecture hall 2
4h Lecture + 2h Tutorial (9 CP)

Contents:

Syntax and semantics of logics, proof calculi, and how to implement them:
- Propositional Logic, CDCL, OBDD
- First-Order Logic, Resolution, Tableaux
- Equality, Rewriting, Completion, Termination

More info: https://rg1-teaching.mpi-inf.mpg.de/autrea-ws21/
(Online students: contact me as soon as possible!)
Differential Equations in Image Processing and Computer Vision


- Lecturer: Prof. Joachim Weickert
- Type: advanced class, 4h+2h, 9 CP
- Scope: denoising, restoration, segmentation, motion analysis, compression

Example: Shadow Removal with Osmosis Processes

- Extra Benefit: enables you to write a master thesis in our group
- Requirements: undergraduate mathematics, elementary C programming
- Virtual Lectures: Wednesday and Friday, 10:15–12:00 (starting Oct. 20)
  https://www.mia.uni-saarland.de/Teaching/dic21.shtml
Image Acquisition Methods

Two computer science teaching awards (2014, 2018)

https://www.mia.uni-saarland.de/Teaching/iam21.shtml

- Lecturer: Dr. Pascal Peter  
- Type: advanced class, 2h+2h, 6 CP

- Requirements: undergraduate mathematics

- Virtual Lectures: pre-recorded videos + live discussions, Thursday, 10–12 c.t.

- Interactive Tutorials: Monday, 8:30–10 s.t. and 10–12 c.t.

- broad overview of image acquisition methods and their physical background

- oldest existing photograph
- confocal microscopy
- electron microscopy

(Joseph Nicéphore Niépce, 1826)  
(ImageJ Data Set)  
(Dartmouth EMF)
Advanced Image Analysis

https://www.mia.uni-saarland.de/Teaching/aia21.shtml

◆ **Lecturer:** Dr. Pascal Peter  
◆ **Type:** advanced class, 2h+2h, 6 CP

◆ **Requirements:** undergraduate mathematics, C programming  
helpful: image processing/computer vision knowledge

◆ **Virtual Lectures:** pre-recorded videos + live discussions, Monday, 14-16 c.t.

◆ **Online Tutorials:** Friday, 14-16 c.t.

◆ advanced image processing methods that (mostly) fuse multiple input images

◆ HDR imaging, super resolution, focus fusion, image stitching, ...

images courtesy of Zimmer et al.
Seminar Milestones and Advances in Image Analysis

- **Organisers:** Karl Schrader (and Prof. Joachim Weickert)
- **Scope:** influential and novel papers on image analysis

- **Requirements:**
  - needed: undergraduate mathematics, image analysis
  - helpful: machine learning basics

- **Online Talks:**
  - Tuesday, 16:15–18:00 (starting Nov. 16)
  - [https://www.mia.uni-saarland.de/Teaching/maia21.shtml](https://www.mia.uni-saarland.de/Teaching/maia21.shtml)

- **Registration:**
  - via the SIC seminar system by tomorrow, 23:59:
  - [https://seminars.cs.uni-saarland.de](https://seminars.cs.uni-saarland.de)

- **First Meeting:**
  - Tue, Oct. 26, 16:15–18 (paper distribution)
Proseminar Simulation der Welt

Organisatoren: Kristina Schaefer, Karl Schrader (und Prof. Joachim Weickert)

Themen: Modellierung und Computersimulation von Naturvorgängen
Hauptwerkzeug: Differentialgleichungen
breites Spektrum: Fußpilzwachstum bis Umweltverschmutzung

Vorkenntnisse: Grundkenntnisse in Mathematik (mindestens MfI 1+2)

Vorträge: Mittwochs, 16:15–18:00, online über Teams
https://www.mia.uni-saarland.de/Teaching/sdw21.shtml

Registrierung: über das SIC Seminar System bis morgen 23:59 Uhr:
https://seminars.cs.uni-saarland.de

Vorbesprechung: Mittwoch, 27. 10., 16:15–18 Uhr
Dr. Rhaleb Zayer
Geometric Modeling

Rhaleb Zayer

- **Part I: Geometric Modeling Techniques**
  - Differential geometry of curves
  - Bezier curves, B-Splines, NURBS, ...

- **Part II: Geometry Processing**
  - Differential geometry of surfaces
  - 3D data and mesh processing, subdivision, ...

- **What else?**
  - Mathematical background
  - Practical skills: hands on implementation

- **When & where:**
  - **First Lecture:** Monday Oct. 25\textsuperscript{th} 12-14h
  - Mon. 12-14h, Thu. 14-16h.
  - Zoom (link by email)

- **Contact:**
  - Mail: rzayer@mpi-inf.mpg.de
Automated Testing and Debugging

Software has bugs and vulnerabilities. This proseminar explores and evaluates **automated techniques for testing and debugging software.**

**Weekly (virtual) Meetings**
- Read, summarize, discuss a paper on a particular technique
- Give 5-minute presentations (ungraded) for training

**Final Presentations (at End of Semester)**
- Each participant presents one technique (graded)

Details, registration, more at seminars.cs.uni-saarland.de
Security Testing

Software has bugs and vulnerabilities. We find them through automated test generation (fuzzing). This advanced course (6 ECTS) teaches you how to build fuzzers.

Inverted Classroom
- Jupyter notebooks w/ Python code + videos every week at fuzzingbook.org
- Weekly coding exercises (⅓ of final grade)

Two Programming Projects
- One on black-box fuzzing, one on white-box fuzzing (⅔ of final grade)

Hybrid Meeting every Tuesday 16-18 @ CISPA
- Discuss material, exercises, projects

Details, registration, more at cms.cispa.saarland
The End.
Enjoy your studies

@ Saarland Informatics Campus

@ Saarland University

& stay safe!