Courses in winter term 2020/21
Please keep in mind ...

The status of the lectures like *core* lecture and *advanced* lecture might differ between the degree programmes.

The respective study regulation indicates the status of a course.

The course catalogue (LSF) also shows the course categories for each degree programme.
See also: Teaser Videos @ http://bit.ly/SIClectures
Prof. Dr. Karl Bringmann
Algorithms and Data Structures
Core Course 9CP

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:

Lecture: Tuesday+Friday 10-12 on Zoom (+ recordings + Discord)

Lecturers: Prof. Karl Bringmann and Dr. Marvin Künnemann

Requirements: introductory course on algorithm design and analysis such as “Grundzüge von Algorithmen und Datenstrukturen”

Prof. Dr. Vera Demberg
Statistics with R

or how to use hypothesis testing correctly

exploratory data analysis, experimental design, hypothesis tests, reporting statistics, linear mixed effects models

Lecture: Tuesday, 8:30-10:00
Tutorials: time to be doodled

from xkcd.com
Database Systems

Prof. Dittrich, Big Data Analytics Group
Core Lecture, 9 CP
https://cms.sic.saarland/dbsys20/

Lectures: Each Wednesday, 12:15 pm
Labs: Each Friday, 12:15 pm

Topics:
• How to manage large amounts of data?
• How to efficiently query these data?
• How to implement database techniques in practice?

Prerequisites:
• Introductory database course, e.g. Big Data Engineering
• Programming experience (preferably C++)
Prof. Dr. Mario Fritz
Machine Learning in Cybersecurity (Advanced Lecture) - Prof. Dr. Mario Fritz

- Machine Learning for
  - Malware classification, phishing detection
- Protect Machine Learning against
  - Attacks
  - Reverse engineering
- Mitigate risks of
  - Privacy leakage
  - Deep Fakes

Lecture: Thursday 4-6pm

Practical exercises on training and attacking Deep Learning models

Project phase: realize your own project in a team

For more information visit https://cms.cispa.saarland/mlcysec2021/
Prof. Dr. Sebastian Hack
Compiler Construction Core Course

**Lecturer:** Sebastian Hack  
**Where:** MS Teams  
**When:** Tue 16–18, Fri 10–12  
**Duration:** Nov 03–Feb 05

**Content:** Foundations of
- Syntax Analysis
- Program Analysis
- Program Optimization
- Machine Code Generation

**Programming Project:**  
Implement a non-trivial LLVM-based compiler in a team!

**You’ll learn about things like:**  
Abstract Interpretation, SSA, LR Parsing, Register Allocation, Polyhedral Model, LLVM, etc.

https://compilers.cs.uni-saarland.de
Courses WS2020/21
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 November 3rd
  • 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:
  https://lms.sulb.uni-saarland.de/moodle/enrol/index.php?id=3612
  • Will be duplicated into MS-Teams for all registered students!

Teaser: https://www.nt.uni-saarland.de/wp-content/uploads/2020/10/WS2020-Opening.mp4
Multimedia Transport

• Core- / Advanced Lecture 9CP (4L2T)
  • Tuesdays 14:15–15:45, Wednesdays 12:15–13:45, Start November 3rd
  • 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.sulp.uni-saarland.de/moodle/enrol/index.php?id=3614
  • Will be duplicated into MS-Teams for all registered students!

Teaser: https://www.nt.uni-saarland.de/wp-content/uploads/2020/10/WS2020-Opening.mp4
“Planning is the art and practice of thinking before acting.”
“Planning is the art and practice of thinking before acting.”

A little more technically:

- AI Planning is the reachability problem in compactly described transition systems. (Large ones: billions of states)
- Given an initial state $I$, a goal $G$, and a set $A$ of actions, find a path from $I$, using $A$, to a state $s$ s.t. $s \models G$. 
“Planning is the art and practice of thinking before acting.”

A little more technically:

- **AI Planning** is the reachability problem in compactly described transition systems. (Large ones: billions of states)
  
  → Given an initial state \( I \), a goal \( G \), and a set \( A \) of actions, find a path from \( I \), using \( A \), to a state \( s \) s.t. \( s \models G \).

- **Heuristic Search**: Design, generation, and analysis of heuristic functions; combination/comparison frameworks.

- **Pruning**: Partial-order reduction.
“Planning is the art and practice of thinking before acting.”

A little more technically:

- AI Planning is the reachability problem in compactly described transition systems. (Large ones: billions of states)
- Given an initial state $I$, a goal $G$, and a set $A$ of actions, find a path from $I$, using $A$, to a state $s$ s.t. $s \models G$.

- Heuristic Search: Design, generation, and analysis of heuristic functions; combination/comparison frameworks.

- Pruning: Partial-order reduction.

Programming projects: You’ll make your own planning system and participate in a competition!
FAI Group  
Spezialized Course: AI Planning  
Tue 14:00–16:00 + Wed 10:00–12:00; 9 ECTS
Prof. Dr. Antoine Joux
Algorithms for Cryptanalysis

Lecture by Antoine Joux

Analysis of Cryptosystems
- RSA
- AES/DES
- PRNGs
- Modes (block-cipher)
- Post-quantum
- RSA
- AES/DES
- Diffie-Hellman
- PRNGs
- Post-quantum
- Modes (block-cipher)
- RSA
- AES/DES
- Diffie-Hellman
- PRNGs
- Post-quantum
- Modes (block-cipher)

Algorithms
- Collisions
- Polynomial equations
- Lattice reduction
- Subset-sums
- Factoring Dlog
- Finite field arithmetic
- Algorithms

https://cms.cispa.saarland/algocrypt/
Prof. Dr. Dietrich Klakow
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
Lecture: Tuesday 14:15-15:45
Starts: 10.11
Registration for participation: see web page
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: 9.11
Übung: Montag 12:00-13:30
6 CP

To participate register on the course home page
Dr. Pieter Kleer
Topics in Algorithmic Game Theory and Economics

Game Theory from the Computer Scientist’s point of view

Can we compute an “equilibrium” outcome of a game in polynomial time? (And more...)

Lecturer: Pieter Kleer, Max Planck Institute for Informatics (Algorithms and Complexity group).

Lectures: Wednesday, 14:00-16:00 (first lecture on November 4).

Prerequisites: Basic knowledge about algorithms and their (theoretical) analyses. Knowledge about combinatorial optimization is useful, but not required.

Website: https://www.mpi-inf.mpg.de/departments/algorithms-complexity/teaching/winter20/game-theory
Prof. Dr. Jana Köhler
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
Dr. Robert Künemann
Formal methods in Security
Advanced lecture, 2h lecture/week + 2h exercises/week

Analyze 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

https://cms.cispa.saarland/fms/
Dr. Giancarlo Pellegrino
Dr. Nils Ole Tippenhauer
SECURITY
Core Lecture (9 ECTS)
Dr. Tippenhauer & Dr. Pellegrino (CISPA)
Tue 14:00 – 15:30 & Thu 10:15 – 11:45

Reasons to take this lecture:
- Comprehensive introduction
- Applied Exercises+self test
- CTF competition at end

Reasons not to take this lecture:
- Tons of material to learn
- >50% of exercise points needed
- Overlap with Foundations of Cybersecurity 1 and 2

Yes, it’s gonna be fun.
https://cms.cispa.saarland/sec2021/
Prof. Dr. Jan Reineke
Program Analysis (Advanced Course, 6 CP)
Jan Reineke

Applications:
- Runtime error analysis
- Side-channel analysis
- Timing analysis

Techniques:
- Data-flow analysis
- Abstract interpretation
- Symbolic execution

When: Tuesday 12-14
     Friday 12-14

Where: Online (via MS Teams)

Web: https://cms.sic.saarland/pa20/
Prof. Dr. Frank-Olaf Schreyer
Frank-Olaf Schreyer

Computer Algebra and Gröbner bases
Core lecture, online, Monday, Thursday 10-12, Exercises starting November 5, Exercises

Goal: How to solve algebraic systems of equations? Number of solutions, dimension of the solution space, etc.

Seminar: Quantum Computing
Mondays, 14-16, online in style of a reading course

Computer Graphics Course (CG)

Learn about the fundamentals of computer graphics

Theory: Broad overview on **graphics technologies**
Practice: Implement your personal **ray tracer**
Beyond: Show your work in **rendering competition**

When? Monday 14-16h & Thursdays 8-10h

We start Thursday 8:15h

Where? Online via Zoom

Contact? slusallek@cs.uni-saarland.de
Prof. Dr. Maria Isabel Valera Martinez
Probabilistic Machine Learning – Prof. Isabel Valera

How much? 1 lecture and 1 tutorial per week, 6 credits
When? Lectures on Wed. 16–18 h (starts 4th Nov) & Tutorials on Mon. 14–16 h (starts 9th Nov)
Where? On Zoom

Dataset

What?

Model design

Inference algorithm

Predict & Explore

Model Testing

Expectation maximization (EM)
Markov Chain Monte Carlo (MCMC)
Variational Inference (VI)

Hidden Markov Models (HMMs)
Temporal Point Processes (TPPs)
Variational Autoencoders (VAEs)

Mixture models

I.i.d. data (e.g., text corpus, images)
Temporal data (e.g., sensor data, online activity)

https://cms.sic.saarland/pml/
Prof. Dr. Maria Isabel Valera Martinez
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 14-16 Zoom/YT (starts: 5 Nov)
Tutorials: Mo/Tu 12-14 Zoom (starts: 9/10 Nov)

https://eda.mmci.uni-saarland.de/edu/eml20/
Prof. Dr. Joachim Weickert
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:** Monday and Friday, 10:15–12:00 (starting Nov. 2)
  
  www.mia.uni-saarland.de/Teaching/dic20.shtml
Image Acquisition Methods

Two computer science teaching awards (2014, 2018)

https://www.mia.uni-saarland.de/Teaching/iam20.shtml

- **Lecturer:** Dr. Pascal Peter
- **Type:** advanced class, 2h+2h, 6 CP
- **Requirements:** undergraduate mathematics
- **Virtual Lectures:** pre-recorded videos + live discussions, Friday, 12-14 c.t.
- **Interactive Tutorials:** Wednesday, 8:30-10 s.t. and 10-12 c.t.
- broad overview of image acquisition methods and their physical background

![oldest existing photograph](Joseph Nicéphore Niépce, 1826)

![confocal microscopy](ImageJ Data Set)

![electron microscopy](Dartmouth EMF)
Advanced Image Analysis

https://www.mia.uni-saarland.de/Teaching/aia20.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, Tuesday, 8:30-10 s.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, ...

underexposed  overexposed  merged HDR

images courtesy of Zimmer et al.
Interpolation and Approximation for Visual Computing

- **Lecturer:** Dr. Matthias Augustin
- **Type:** advanced class, 3h+1h, 6 CP
- **Scope:** Interpolation and approximation are omnipresent in visual computing.
  - Examples:
    - polynomial interpolation and splines
    - radial basis functions
    - least squares approximation
- **Requirements:** undergraduate mathematics
- **Virtual Lectures:** Online sessions with Q & A and tutorial sections
  Monday 16–18, Thursday 12–14 (starting Nov. 5)
  www.mia.uni-saarland.de/Teaching/iavc20.shtml
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:** Thursday Nov. 5th 14-16h
  • Mon. 12-14h, Thu. 14-16h.

• **Contact:**
  • Site: [http://geomod.mpi-inf.mpg.de/](http://geomod.mpi-inf.mpg.de/)
  • Mail: rzayer@mpi-inf.mpg.de
Prof. Dr. Andreas Zeller
Automated Debugging
Andreas Zeller + Konstantin Kuznetsov

We explore automated debugging techniques:

- Interactive Debuggers
- Checking Assertions and Invariants
- Locating Failure Causes
- Repairing Failures Automatically

and build these as tools in course projects!

Tue 16–18 • cms.cispa.saarland/debug