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Courses in winter term 2020/21

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Please keep in mind ...

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

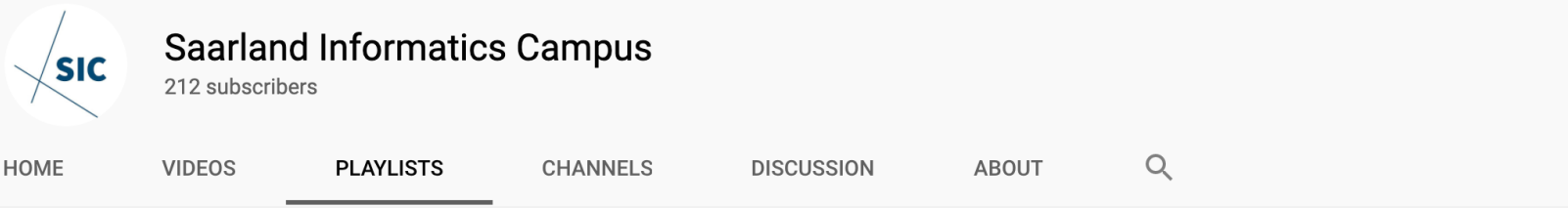
The respective study regulation indicates the status of a course.

The course catalogue (LSF) also shows the course categories for each degree programme.

Example MSc DSAI

See also: Teaser Videos @ http://bit.ly/SIClectures

Saarland Informatics Campus SIC | UNIVERSITÄT DES SAARLANDES | max planck institut informatik | MAX PLANCK INSTITUTE FOR SOFTWARE SYSTEMS | DFKI | CBI CENTER FOR BIOINFORMATICS



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Prof. Dr. Karl Bringmann

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Algorithms and Data Structures

Core Course 9CP

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mpi

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“

https://www.mpi-inf.mpg.de/departments/algorithms-complexity/teaching/winter20/algorithms-and-data-structures

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Prof. Dr. Vera Demberg

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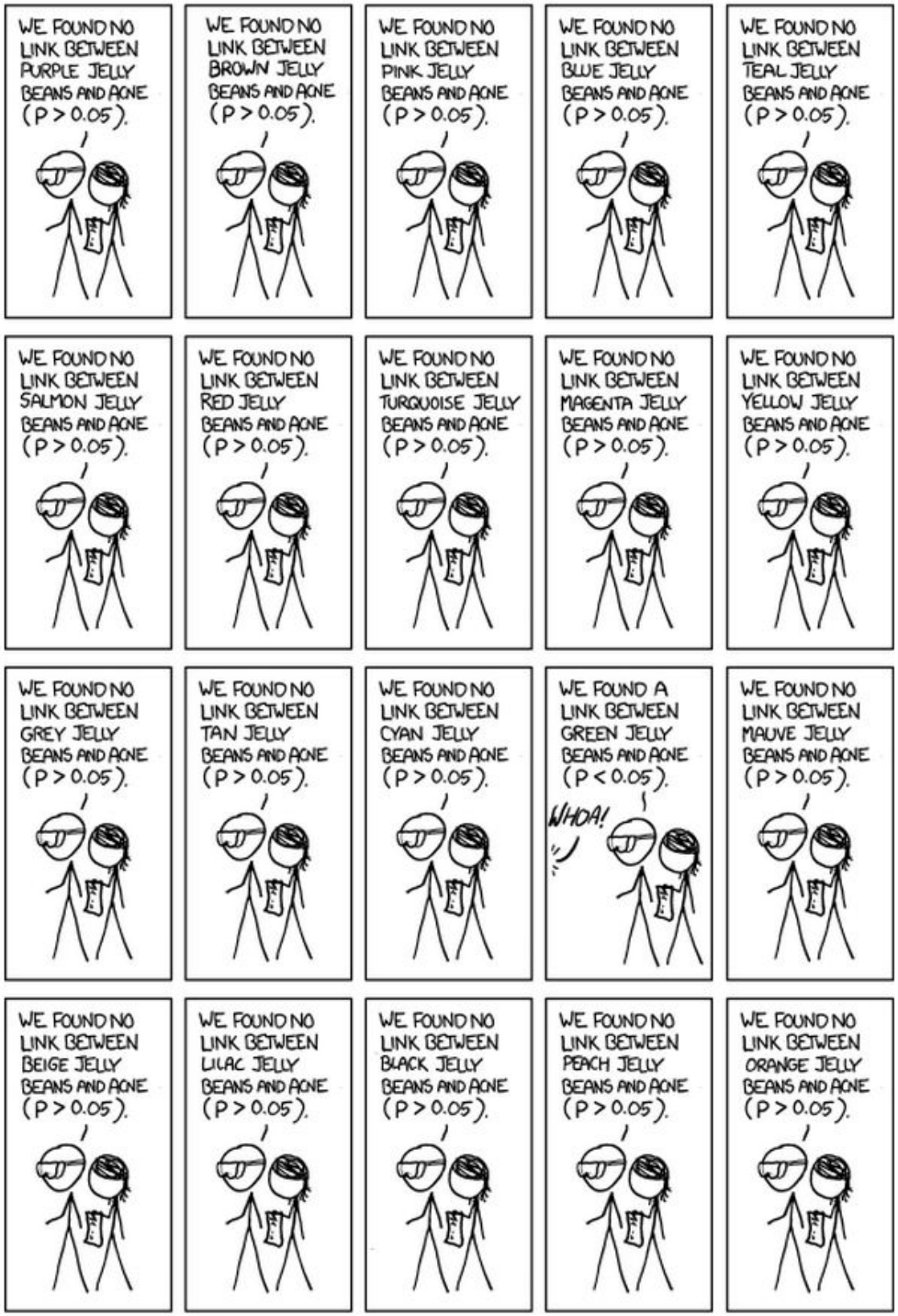
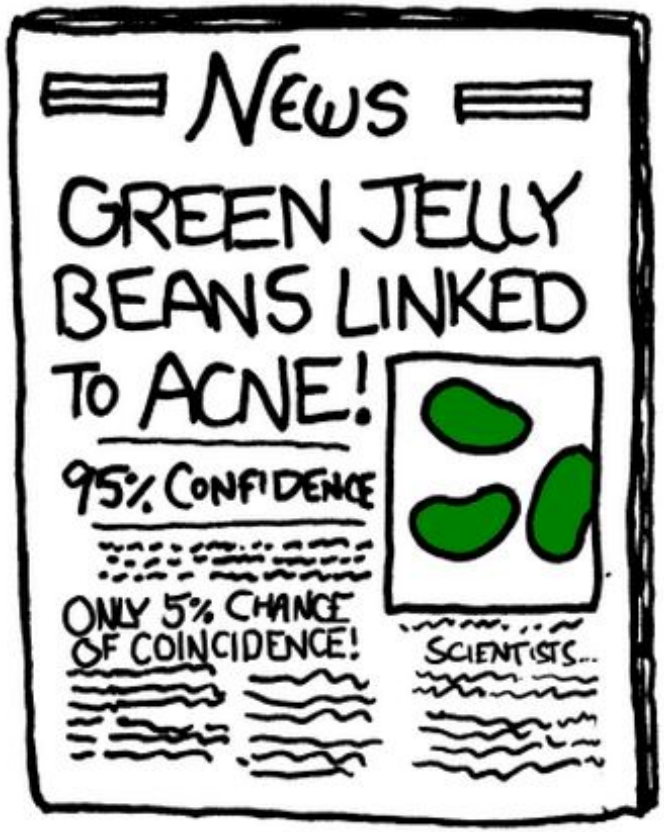


Statistics with R

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

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Prof. Dr. Jens Dittrich

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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++)

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Prof. Dr. Mario Fritz

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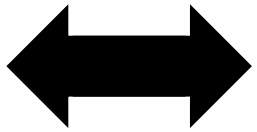
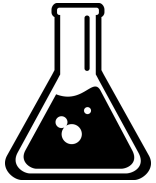
Machine Learning in Cybersecurity (Advanced Lecture) - Prof. Dr. Mario Fritz

CISPA HELMHOLTZ CENTER FOR INFORMATION SECURITY

- 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/

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Prof. Dr. Sebastian Hack

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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`

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Courses WS2020/21
Telecommunications Lab

Prof. Dr.-Ing. Thorsten Herfet

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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.sulb.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

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Prof. Dr. Jörg Hoffmann

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FAI Group Spezialized Course: AI Planning

Tue 14:00–16:00 + Wed 10:00–12:00; 9 ECTS

"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)

  $\rightarrow$ 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:

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  $\rightarrow$ 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.

FAI Group — Spezialized Course: AI Planning

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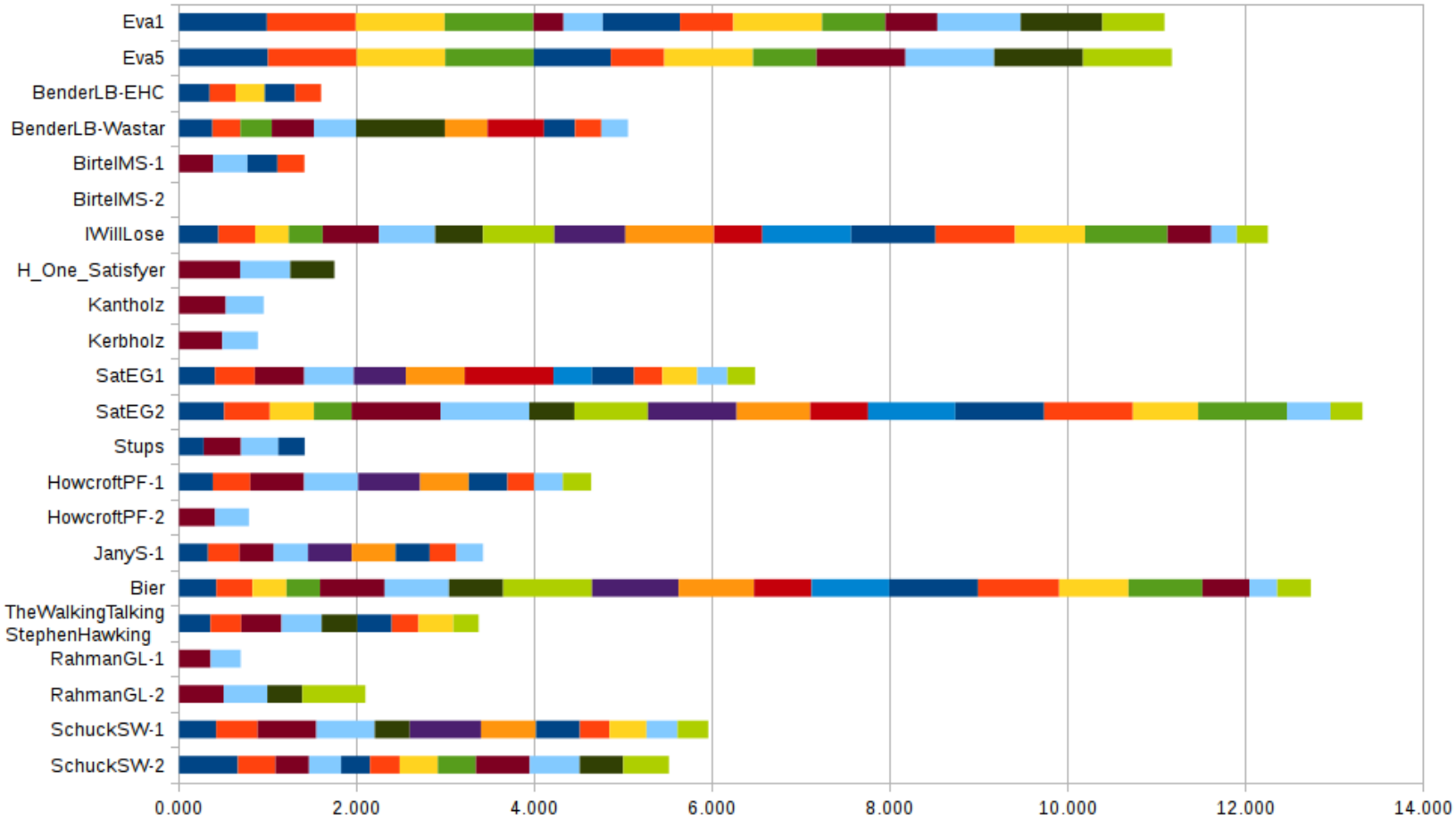
- Pruning: Partial-order reduction.

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



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Prof. Dr. Antoine Joux

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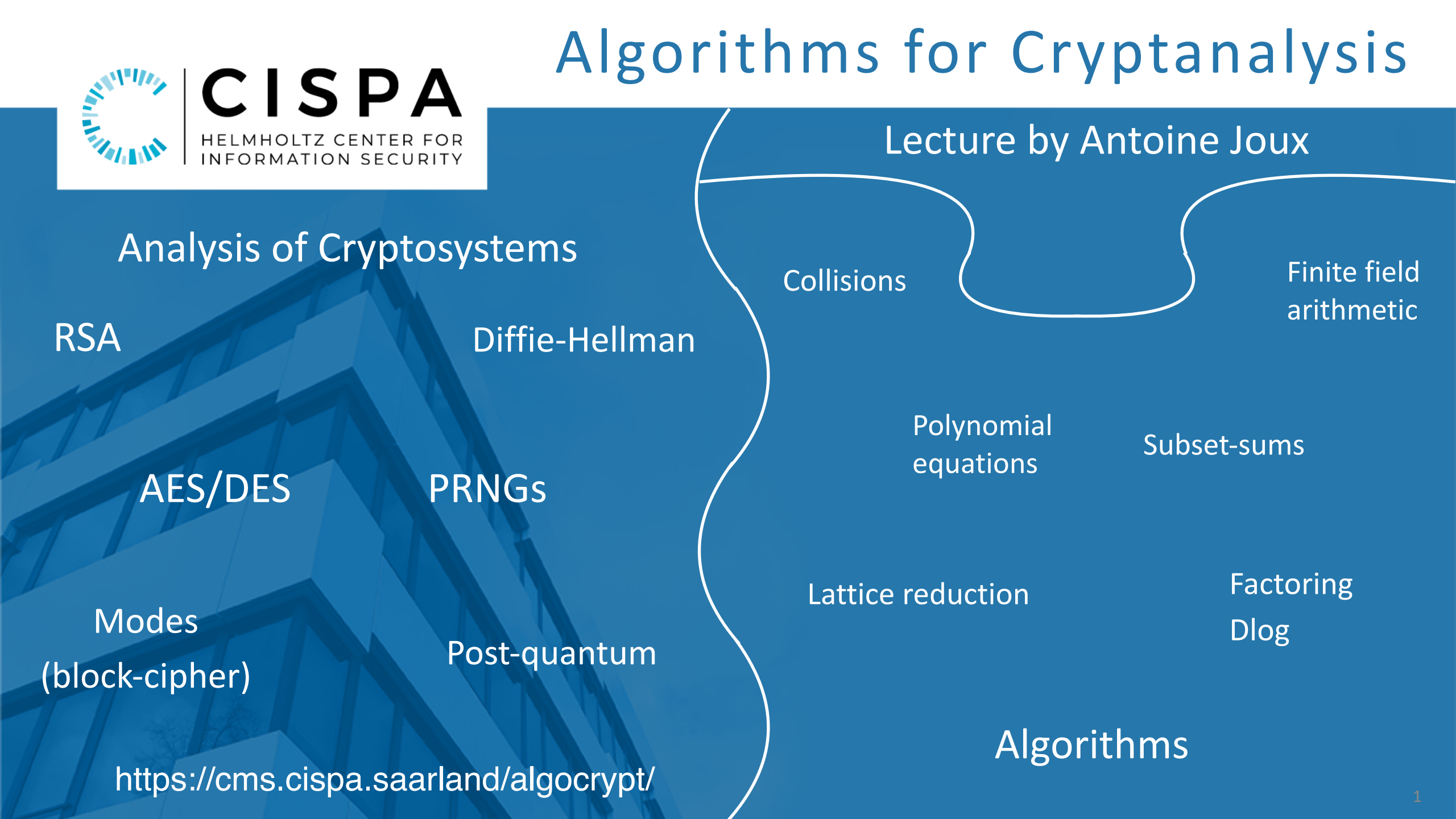
CISPA
HELMHOLTZ CENTER FOR INFORMATION SECURITY
Algorithms for Cryptanalysis
Lecture by Antoine Joux
Analysis of Cryptosystems
RSA
Diffie-Hellman
AES/DES
PRNGs
Modes
(block-cipher)
Post-quantum
https://cms.cispa.saarland/algocrypt/
Collisions
Finite field
arithmetic
Polynomial
equations
Subset-sums
Lattice reduction
Factoring
Dlog
Algorithms

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Prof. Dr. Dietrich Klakow

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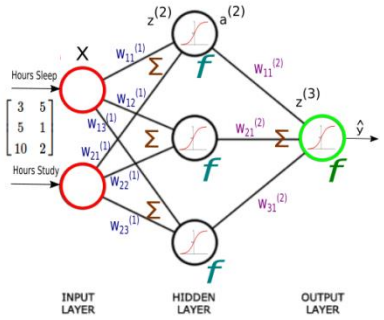
Neural Networks: Theory and Application

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

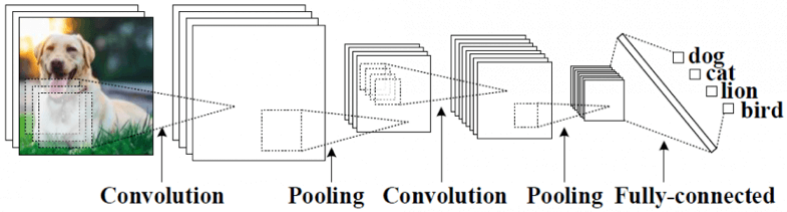


Location: MS Teams

Lecture: Tuesday 14:15-15:45

Starts: 10.11

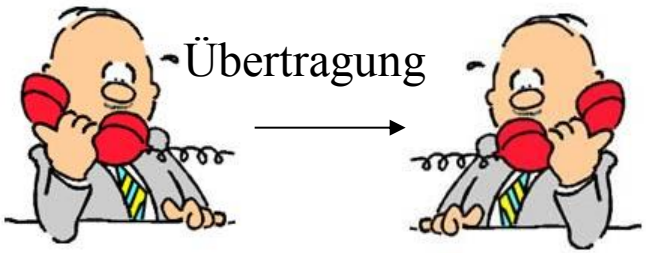
Registration for participation: see web page

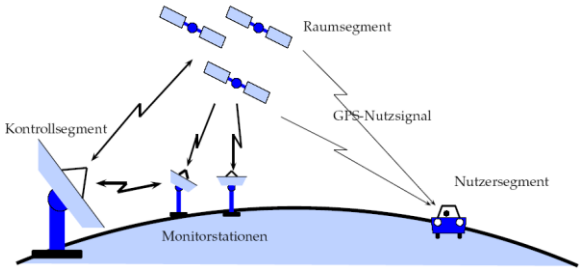


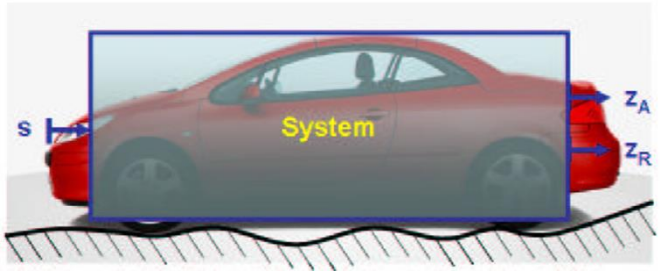
Grundlagen der Signalverarbeitung

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: 9.11
Übung: Montag 12:00-13:30
6 CP

To participate **register** on the course home page

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Dr. Pieter Kleer

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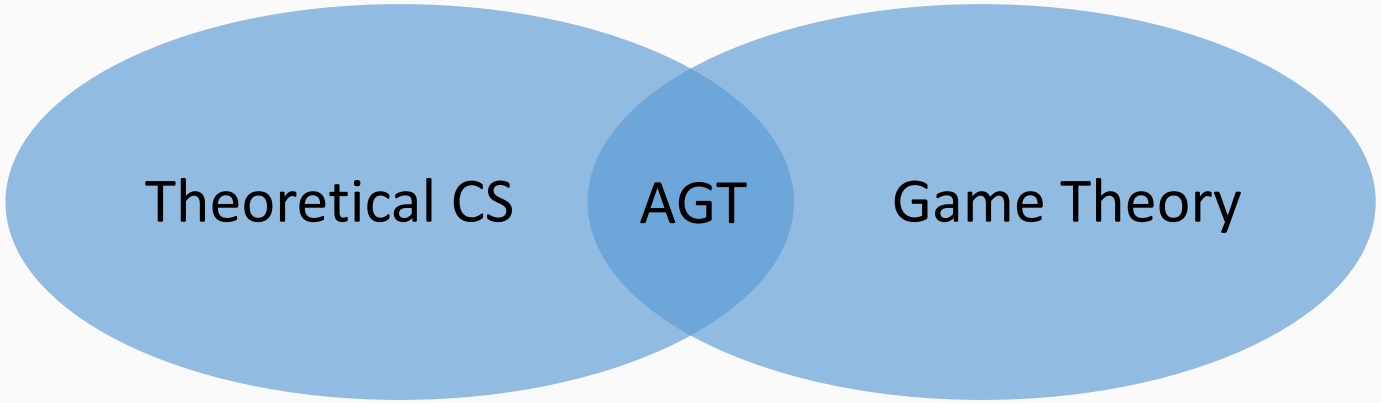
Topics in Algorithmic Game Theory and Economics

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
Register to the mailing list: https://lists.mpi-inf.mpg.de/listinfo/agt2020.

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Prof. Dr. Jana Köhler

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Prof. Jana Koehler: Architectural Thinking for Intelligent Systems

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

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Dr. Robert Künnemann

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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

Robert Künnemann

Marco Vassena

Hamed Nemati

https://cms.cispa.saarland/fms/

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Dr. Giancarlo Pellegrino
Dr. Nils Ole Tippenhauer

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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/

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Prof. Dr. Jan Reineke

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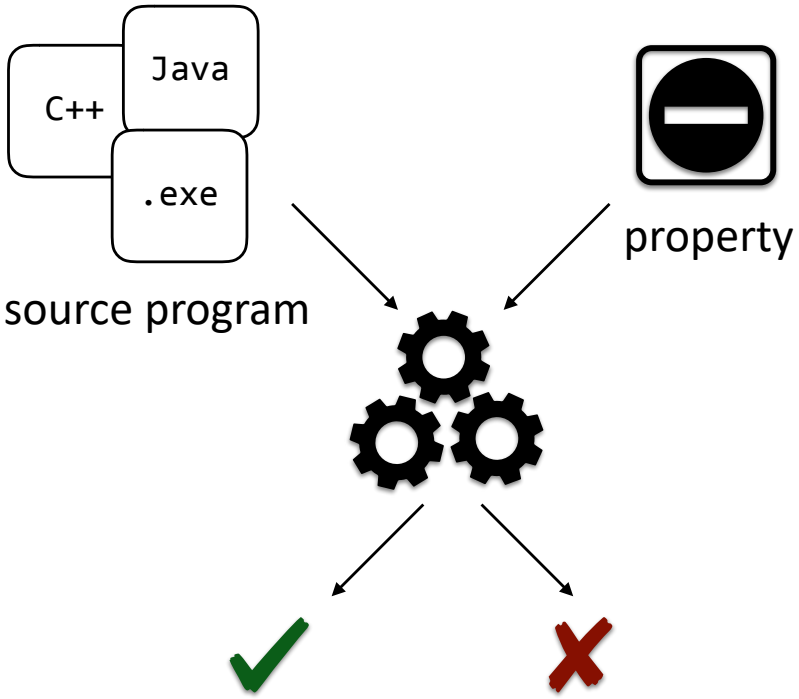
Program Analysis (Advanced Course, 6 CP)

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/

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Prof. Dr. Frank-Olaf Schreyer

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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

Goal: To work through the first chapters of the text book Michael A. Nielsen and Isaac L. Chuang: *Quantum Computation and Quantum Information*, Cambridge University Press, 2010 second edition.

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Prof. Dr. Slusallek

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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

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Prof. Dr. Maria Isabel Valera Martinez

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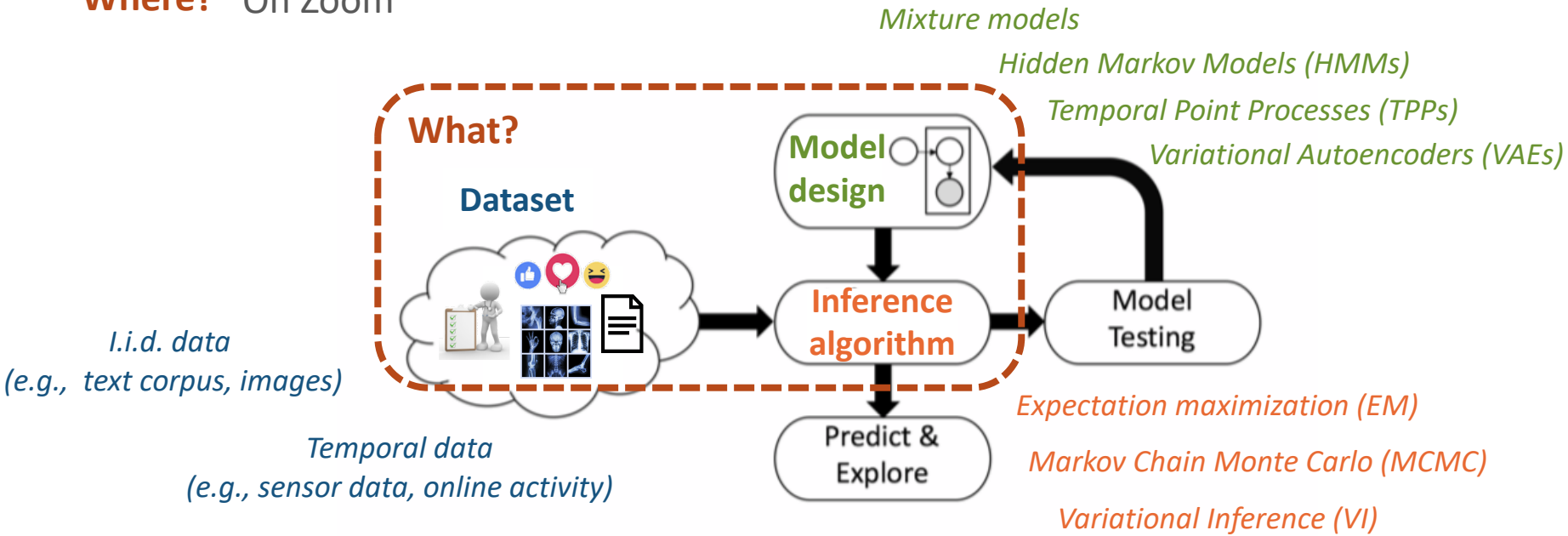
Probabilistic Machine Learning – Prof. Isabel Valera

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



https://cms.sic.saarland/pml/

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Prof. Dr. Maria Isabel Valera Martinez
Prof. Dr. Jilles Vreeken

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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/

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Prof. Dr. Joachim Weickert

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Differential Equations in Image Processing and Computer Vision

Four teaching awards (2003, 2006, 2009, 2015)

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

original

shadow removal

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`

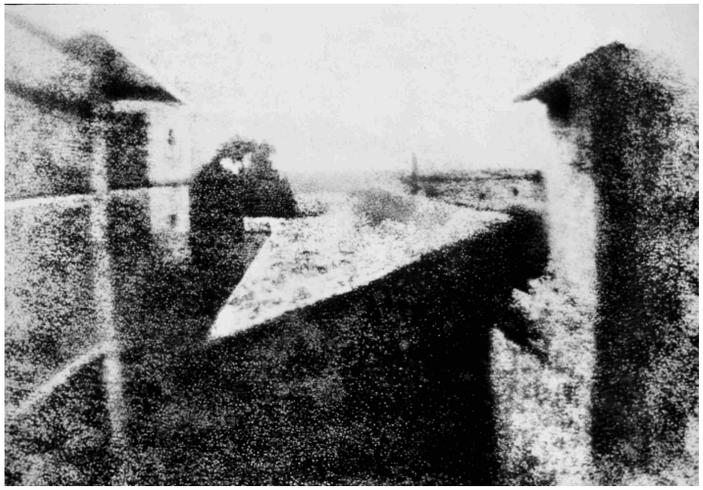
Image Acquisition Methods

Two computer science teaching awards (2014, 2018)

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

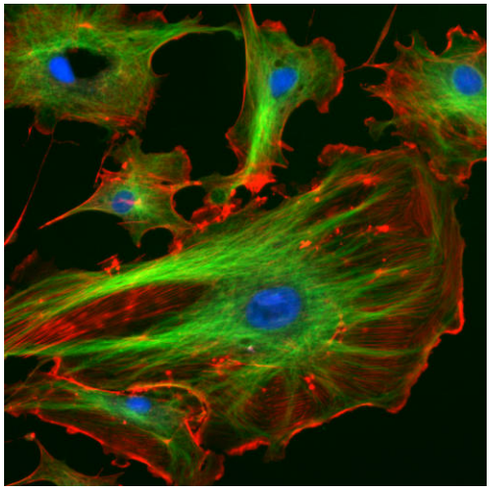
- **Lecturer:** Dr. Pascal Peter
- **Type:** advanced class, 2h+2h, 6 CP
- **Requirements:** undergraduate mathematics
- **Virtual Lectures:** pre-recorded videos + live discussions, Friday, 12-14 c.t.
- **Interactive Tutorials**: Wednesday, 8:30-10 s.t. and 10-12 c.t.
- broad overview of image acquisition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

oldest existing photograph



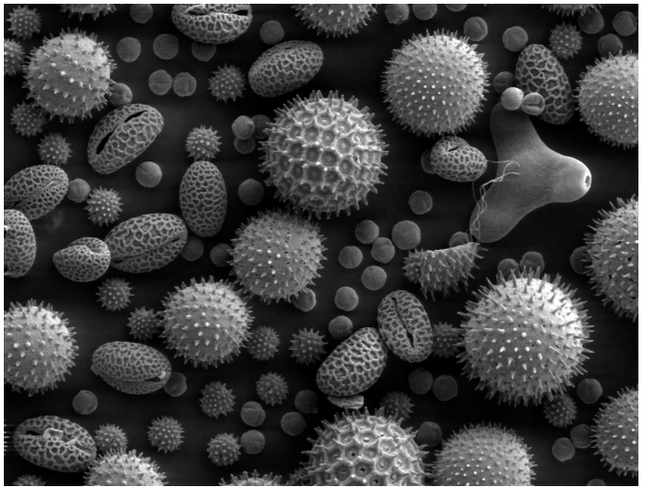
(Joseph Nicéphore Niépce, 1826)

confocal microscopy



(ImageJ Data Set)

electron microscopy



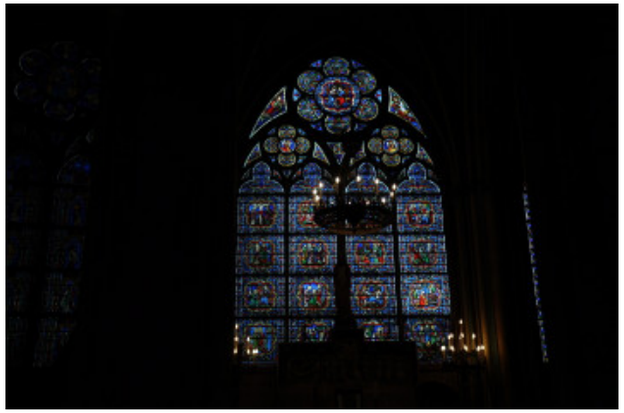
(Dartmouth EMF)

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`

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Dr. Rhaleb Zayer

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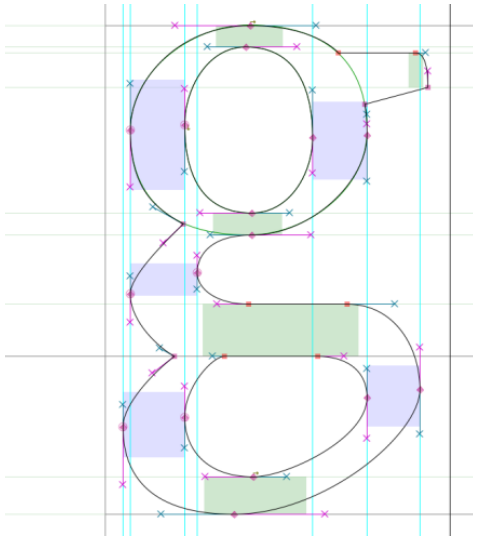
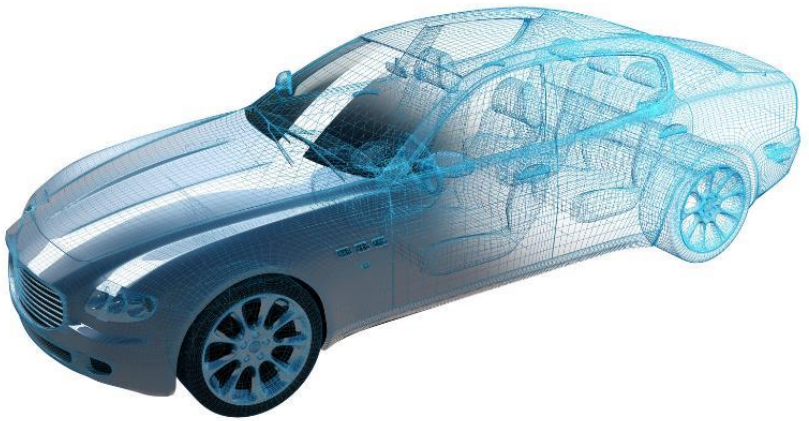
Geometric Modeling

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/**
  - **Mail:** rzayer@mpi-inf.mpg.de

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Prof. Dr. Andreas Zeller

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Campus

Automated Debugging

Andreas Zeller + Konstantin Kuznetsov

CISPA
HELMHOLTZ CENTER FOR INFORMATION SECURITY

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