Link to the slides:

(Video will be available from the Video AG Website)
Daten- und Informationsmanagement
Introduction to Data Science – Powered by PADS

- Focus of PADS is on the interplay between Process Science and Data Science
- The leading Process Mining group in the world
- Rapidly growing interest in industry (30+ software vendors based on Process Mining research done before)
- Scientifically challenges & huge practical relevance
- Where you can make a difference (many HiWi,BSc,MSc,PhD positions)
- IDS has a much broader focus: An advanced introduction to DS
Introduction to Data Science - Topics

infrastructure
- "volume and velocity"
  - big data infrastructures
  - distributed systems
  - data engineering
  - programming
  - security
  - ...  

analysis
- "extracting knowledge"
  - statistics
  - data/process mining
  - machine learning
  - artificial intelligence
  - visualization
  - ...

effect
- "people, organizations, society"
  - ethics & privacy
  - IT law
  - operations management
  - business models
  - entrepreneurship
  - ...
The course starts 9-10-2019.

Lectures are on Wednesdays and Thursdays from 8.30 to 10.00 in AH IV (2354|030).

Instructions are on Fridays from 8.30 to 10.00 in AH IV (2354|030).

Involves using software and real data covering the whole Data Science spectrum.

Examination: Two more practical assignments and a written final exam.

6 ECTS Master level (Data Science, Informatik, Media Inf., Software Syst.).
Angewandte Informatik
Basic Techniques in Computer Graphics

Informatik 8 – Prof. Dr. Leif Kobbelt
3D Geometry
Rendering
Perspective
Textures
Light & Shadow

1st Pass
2nd Pass
3rd Pass
16th Pass
Basic Techniques in Computer Graphics

Lecture
• Tuesdays, 12:30, AH V
• Thursdays 10:30, AH V

Tutorial
• Tuesdays, 14:30, AH III

More Information
• graphics.rwth-aachen.de/course/173/
• Weekly assignments: theoretical & programming
• This lecture is the basis for all our advanced courses
Real-Time Graphics - Content (1)
Real-Time Graphics - Content (3)
Real-Time Graphics - Organization

- **Lecture**
  - Fri, 10:30 – 13:00 (2.5 hours) in AH V, starting 11.10.19
  - 6 ECTS

- **Exercise**
  - Tue, 14:30 – 16:00 in 2359|118 (i8 seminar room, building E3), starting 15.10.19
  - Weekly assignments, theoretical and practical (C++, OpenGL)

- ≥ 75% of practical exercise points for exam bonus

- **Exam**
  - 120 minutes, 19.02.20 (first), 02.03.20 (second)
  - ≥ 50% of practical exercise points required
Computer Vision Group
Prof. Bastian Leibe
Visual Computing Institute

• Lecture: *Machine Learning*
  – Place & Time: Wed 08:30 – 10:00 room HG Aula
    Thu 14:30 – 16:00 room TEMP2
  – First lecture Thursday, 11.10.

• Lecture: *Computer Vision 2*
  – *Unfortunately, we won’t be able to teach CV2 this semester*
    (I need to teach a basic Bachelor-level lecture instead)
Lecture *Machine Learning* (3V+1Ü)

• **Goal**
  – *Build machines that learn to perform a task from experience*

• **Lecture**
  – What does it mean to learn?
  – How can we make this computational?
  – Focus on statistical machine learning techniques
  – Deep Learning

• **Many important real-world applications**
  – Intelligent machines
  – Visual scene understanding
  – Autonomous driving
Deep Learning
Lecture *Machine Learning* (3V+1Ü)

- **Fundamentals**
  - Bayes Decision Theory
  - Probability Density Estimation

- **Classification Approaches**
  - Linear Discriminants
  - Support Vector Machines
  - Ensemble Methods & Boosting
  - Randomized Trees, Forests & Ferns

- **Deep Learning**
  - Foundations
  - Convolutional Neural Networks
  - Recurrent Neural Networks
Interested in how all of this works?

Come to our lecture!

Lecture:  *Machine Learning*

- **Wed**  08:30 – 12:00, room HG Aula
- **Thu**  14:30 – 16:00, room TEMP2

First lecture Wednesday, 09.10.!
Lecture: Physically-Based Animation

- Lecturer: Prof. Dr. Jan Bender
- Credits: 6 ECTS credits
- Dates:
  - Lecture: Tuesday, 14:30 – 16:00 E2 Room 056
  - Lecture/Exercise: Thursday, 10:30 - 12:00 E2 Room 056
Lecture: Physically-Based Animation

- Hair
- Cloth
- Soft Bodies
- Rigid Bodies
- Fluids
- Collision Handling
Applications

- Medical Simulation
- Robotics
- Virtual Prototyping
- Games
- Animation Movies
- Special Effects
Lecture VR I: Introduction to Virtual Reality (V3Ü1)

• **Goal:**
  - Learn the basics of Virtual Reality and its use in scientific & technical applications!

• **Contents:**
  - Characteristics & History of VR
  - 3-D User Interfaces
  - Immersive Displays: Head-Mounted Displays & CAVEs
  - Stereoscopic, egocentric projections
  - Virtual Reality Graphics
  - *A little bit of classical Computer Graphics*  
    (⇐ VR I is held for multiple study programs)
  - Motion Tracking
  - Collision Detection
  - Demos in our VR lab
Overview

Lecture: 
Tuesday, 08:30-10:00, AH V
Thursday, 14:30-16:00, AH VI

Exercise: 
replacing lectures in a bi-weekly manner

Start: 
Tuesday, October 15

Teachers: 
Torsten W. Kuhlen, Sebastian Pape, Jonathan Ehret

Credits: 
Master CS, SSE, MI
Written Exam (90 minutes, Feb 11 and Mar 30)
Chair for Computational Social Sciences and Humanities

Prof. M. Strohmaier    F. Lemmerich    S. Sikdar    J. Wachs

http://cssh.rwth-aachen.de
Understanding **social systems** and modeling **human social behavior** via computational methods and new kinds of data.

**Data about social systems and human social behavior**

- **textual data**
  - structured textual data
  - unstructured textual data

- **relational data**
  - (social) network data
  - sequential data

**algo. methods**
- machine learning
- Modeling & simulation
- (natural) experiments
- (social) data science

**social theories**
- social behavior
- socio demographics
- social issues
- social dynamics

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Chair for Computational Social Sciences and Humanities

Prof. Dr. Markus Strohmaier

http://cssh.rwth-aachen.de
Course on Text Mining

• **Topics:**
  - Language models
  - Tagging & parsing
  - Vector semantics and embeddings
  - Text clustering & classification
  - Probabilistic models
  - Deep Learning models (RNN, CNN, Seq-2-Seq)

• **Course logistics:**
  - Organisation: 3h lectures + 2h exercises
  - Time: Tue 16.15-18.30, Thu 10.30-12.00
  - Location: Ahornstr. 55, Aula 2
  - URL: [http://cssh.rwth-aachen.de/courses/](http://cssh.rwth-aachen.de/courses/)
Course on Social Data Science

**Topics:**

Computational methods for big data including:
- Regression and causal inference
- Topic models and networks
- Simulations, experiments

To understand *social phenomena* such as:
- Inequality
- Discrimination
- Wisdom of the crowds

**Course logistics:**
- Organisation: 3h lectures + 2h exercises
- Time: Tue 14.30-16.30, Thu 14.30-17.00
- Location: Ahornstr. 55, Eilfschornstr. 18
- URL: [http://cssh.rwth-aachen.de/courses/](http://cssh.rwth-aachen.de/courses/)
Designing Interactive Systems I

- Human–Computer Interaction (HCI)
- Usability
- People!
Flipped Classroom

- Watch lecture material videos at home
- In class: Design Studio, work on group projects with individual feedback

http://hci.rwth-aachen.de/dis
Designing Interactive Systems I

Flipped Classroom

- Watch lecture material videos at home
- In class: Design Studio, work on group projects with individual feedback

Starts next Wednesday, Oct 10, 10:00–12:00, room 5053.2a/b
Only 120 seats!

http://hci.rwth-aachen.de/dis
iOS Application Development

Lecture + Seminar + Project
iOS Application Development

Starts next Tuesday, Oct 8, 10:30-12:00, room 2222

Only 42 seats!
Lecture: Statistical Methods in Natural Language Processing

- Text and document classification
  - including information retrieval
- Information extraction
  - including tagging and semantic annotation
- Machine translation of natural languages
  - alignment and lexicon models
  - training methods
  - generation process
  - grammar-based approaches
Statistical Methods in Natural Language Processing

Lectures:
Mon 10.30 – 12.00 AH 6 (2356|051)  Start: 14.10.2019
Mon 16:30 – 18:00 AH 6 (2356|051)  (specific schedule will be presented in the first lecture)
Tue 12.30 – 14.00 AH 6 (2356|051)

Exercises:
Tue 17.15 – 18.45 5056 (2356|056)  Start: 15.10.2019

• Teaching language: English
• Study programs:
  • Bachelor Informatik (V3/Ü2, 6 Credits)
  • Master Informatik, Media Informatics and Software Systems Engineering (V4/Ü2, 8 Credits)
  • Master Data Science (V4/Ü2, 8 Credits)

www.hltp.rwth-aachen.de/web/Teaching/
State-of-the-art statistical approach to convert speech audio into written text

Automatic speech recognition system typically consists of four parts:

- **Signal Analysis:** extracts time-dependent features from acoustic signal
- **Acoustic Model:** establishes link between features and words/phonemes
- **Language Model:** covers syntactic and semantic constraints of the language
- **Search Process:** determines maximum probability word sequence
Automatic Speech Recognition

Lectures:
Tue 10.30 – 12.00 AH 6 (2356|051) Start: 08.10.2019
Wed 08.30 – 10.00 AH 6 (2356|051)

Exercises:
Thu 10.30 – 12.00 BS 2 (2131|102) Start: 10.10.2019

• Teaching language: English
• Study programs (upon others):
  • Bachelor Informatik (V3/Ü2, 6 Credits)
  • Master Informatik, Media Informatics, Software Systems Engineering and Data Science (V4/Ü2, 8 Credits)

www.hltpr.rwth-aachen.de/web/Teaching/
Computational Differentiation

Function given as C code:

```c
double f(double x) {
    double y = 5 * x * x;
    return y;
}
```

Algorithmic differentiation:

```c
double df_ad(double x, double dx) {
    double dy = 5 * 2 * x * dx;
    return dy;
}
```

Computer Science:
Source transformation
C++ operator overloading
Data flow graphs

Numerical Computation:
Numerical Optimization
Adjoint methods
Differential equations
Computational Differentiation

Outlook:
Adjoint mode allows to get full gradient at a cost independent of number of parameters n.

Let \( f : \mathbb{R}^n \to \mathbb{R}^m \) with \( y = f(x) \), \( x \in \mathbb{R}^n \), and \( y \in \mathbb{R}^m \)

\[
\begin{pmatrix}
  x(1) \\
  y
\end{pmatrix} = f(1) \begin{pmatrix}
  y(1), x
\end{pmatrix} = \begin{pmatrix}
  \nabla f(x)^T \cdot y(1) \\
  f(x)
\end{pmatrix}
\]

Efficient and accurate derivatives needed for:
- Numerical Optimization
- Machine Learning
- Monte Carlo Applications (e.g. in Finance)

Sensitivity map of Sonnenwagen
Computational Differentiation

Prof. Dr. Uwe Naumann, Dr. Markus Towara

**Lecture:** Tuesday 10:30 - 12:00  AH I (2350|028)
**Tutorial:** Thursday 08:30 - 10:00  AH I (2350|028)

Beginning: 08.10.2019 (12.10.2019)

Bachelor Informatik (also CES Ba, SiSc Ma)
SWS: 4 / ECTS Credits: 6
Language: English
Prof. Dr. Matthias Müller

Chair for High Performance Computing (Informatik 12)
www.hpc.rwth-aachen.de
contact@hpc.rwth-aachen.de

Dr. C. Terboven
J. Miller
S. Schwitanski
Dr. S. Wienke
Aim: faster execution
High Performance Computing

Simulation results

need time

Aim: faster execution

Quad-Core

4x

270x

50x

Simulation results
double CalcPi (int n){
    const double fH = 1.0 / (double) n;
    double fSum = 0.0;
    double fX;
    int i;

    for (i = 0; i < n; i++) {
        fX = fH * ((double)i + 0.5);
        fSum += f(fX);
    }
    return fH * fSum;
}
double CalcPi (int n){
    const double fH = 1.0 / (double) n;
    double fSum = 0.0;
    double fX;
    int i;

    #pragma omp parallel for private(fX,i) reduction(+:fSum)
    for (i = 0; i < n; i++) {
        fX = fH * ((double)i + 0.5);
        fSum += f(fX);
    }
    return fH * fSum;
}
Lecture: Introduction to High Performance Computing (HPC)

• Content WS 2019/20
  – Parallel computer architectures
  – Parallelization strategies
  – Parallel algorithms
  – Parallel programming

• Outlook SS 2020
  – Lecture: Concepts and Models for Parallel and Data-centric Programming
  – Lecture: Performance & correctness analysis of parallel programs
  – Seminar: Current Topics in High Performance Computing
  – Software Lab: Parallelprogrammierung von Many-Core Architekturen mit OpenMP

www.hpc.rwth-aachen.de
contact@hpc.rwth-aachen.de
Daten- und Informationsmanagement
Algorithmic Cryptography

- History (Babbage to Enigma)
- Symmetrical Methods (Enigma to AES)
- Public Key-Systems (RSA to Pallier)
- Proofs to show secure systems
- Manifold Protocols (signatures and more)
- Zero-Knowledge Proof (Maximal Security)
- Electronic Money
- Electronic Elections
- Language: English, ggf. Deutsch
- Start: 9.10. at 12:30 in AH V
Einführung in Webtechnologien

Lehr- und Forschungsgebiet Informatik 9
René Röpke & Svenja Noichl
Webtechnologien sind überall...

- Kommunikation (E-Mail, Soziale Netzwerke,...)
- Informationen suchen
- Spiele
- Musik
- Reisen buchen
- Einkaufen/Verkaufen
- Filme
Webtechnologien

Lernen Sie die Grundlagen der Webtechnologie kennen...

...und entwickeln Sie eigene dynamische Web-Applikationen!
Konzept & Inhalt

Vorlesung
- Allgemeine Grundlagen der Kommunikation im Web
- Client- und Serverseitige Technologien und Entwicklungswerkzeuge
- Sicherheitsaspekte

Übung
- Aktive Beteiligung und Anwesenheit
- Wenden Sie das Erlernte direkt in einem Beispielprojekt an

Projektphase
- Kombinieren Sie selbst gewählte Technologien in einem eigenen kleinen Web-Projekt
Einführung in Webtechnologien [V3Ü2, 6 ECTS]

- Zielgruppe: Bachelor
- Sprache: Deutsch
- Maximale Teilnehmerzahl: 80 Studierende

Termine:
- **Vorlesung**: Di. 16:30 – 18:00 AH II
- **Vorlesung**: Mi. 16:30 – 18:00 AH I
- **Übung**: Do. 10:30 – 12:00 AH V

Erste Vorlesung & Organisatorisches: 10.10.2019 in AH V
Angebot: JavaScript-Online-Kurs

- **Zielgruppe:** Für alle die nicht an WebTech teilnehmen (können), aber dennoch JavaScript lernen möchten
- **Zeitraum:** 18.10.-17.11.2019
- **Sprache:** Englisch

  https://kurzelinks.de/exwf

- Teilnahme an wissenschaftlicher Studie
  - Gewinnspiel 2x20€ Amazon-Gutschein
- **Registrierung:** 30.9.-17.10.2019
- **Kursbeginn:** 18.10.2019

https://kurzelinks.de/exwf
Einführung in Webtechnologien [V3Ü2, 6 ECTS]

- Zielgruppe: Bachelor
- Sprache: Deutsch
- Maximale Teilnehmerzahl: 80 Studierende

Termine:
- **Vorlesung**: Di. 16:30 – 18:00 AH II
- **Vorlesung**: Mi. 16:30 – 18:00 AH I
- **Übung**: Do. 10:30 – 12:00 AH V

Anmeldung in RWTHonline über die Übung

Erste Vorlesung & Organisatorisches: 10.10.2019 in AH V

https://kurzelinks.de/exwf
Large-Scale Heterogeneous Information Integration

- Games and Social Software for Societal Challenges

- Integration Infrastructures

- Formal Models & Methods for Integration

- Big Data and NoSQL Database Systems
# Semantic Web

**(V2/Ü1, Decker)**

**Master**

<table>
<thead>
<tr>
<th>Days</th>
<th>Time</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fridays</td>
<td>10.00 – 11.30</td>
<td>(bi-weekly, start: Oct. 11)</td>
</tr>
<tr>
<td>Tuesdays</td>
<td>16:15 – 17:45</td>
<td>(start: Oct. 15)</td>
</tr>
<tr>
<td>Room</td>
<td>5053.1</td>
<td>(seminar room B-IT RS, opposite to AH 6)</td>
</tr>
</tbody>
</table>

## Topics

- Knowledge Graphs and Linked Data
- Ontologies, Vocabularies and the Semantic Web
- Web Standards: URIs, HTTP, RDF, OWL, PROV
- Query Processing and Reasoning with Linked Data
- Open Data
- Application Areas: Life Sciences, Cultural Data

## You will learn

- The Nuts and Bolts of Linked Data
- Concepts for the Development of Applications
- Application of Linked Data and Semantic Web
Web Science
(V3/Ü1, Klamma)
Master

Lecture: Monday, 14.30-16.00 (start: Oct. 14)
         Friday, 14.30-16.00  (bi-weekly, start: Oct. 11)
Exercises: Friday, 14.30-16.00 (bi-weekly, start: Oct. 25)

Room 5053.2 (seminar room B-IT RS, opposite to AH 6)

Topics
• How to analyze and understand complex networks?
• What is the PageRank algorithm?
• What is (mobile) cloud computing and Map-Reduce?
• What is XMPP and the real-time web?

You will learn
• Large & real graph data structures & algorithms
• Advanced Web engineering techniques
PETs4DS: Privacy Enhancing Technologies for Data Science
(V2/Ü1, Decker/Heitmann )

Master
Tuesdays, 16:30 – 18:00 Room 5053.2 (starts 15.10.)
Thursdays, 16:30 – 18:00 Room 5053.2 (check RWTH Online for schedule)

Topics
• Definitions of privacy and security.
• Modelling of privacy threats.
• Approaches to anonymization and de-anonymization of data.
• Computation data without full access to the data.
• Privacy by design when engineering a system.

You will learn
• Analyzing use cases to identify privacy threats
• Anonymisation of data sets
• Applying privacy preserving approaches to a whole system architecture

Privacy
Maximum utility
Intro. to Artificial Intelligence

The course introduces basic concepts found in many AI systems:

• Agent architectures
• Heuristic Search
• Playing games (like chess)
• Knowledge Representation and Reasoning
• Planning a course of actions
Intro. to Artificial Intelligence

• Reasoning under uncertainty
• Learning: Decision trees and Neural Networks
• Robotics

Prerequisites: none
Starts Wednesday, October 9, 08:30h, AH II
IT-Security 1: Topics

Network Security
- DNSSec
- HTTPS
- PGP/SMIME
- OTR
- Kerberos
- TLS/SSL
- IPsec

Cryptographic Basics
- Authentication and Key Agreement
  - Certificates and PKIs
  - Passwords
  - Challenge-Resp. Authentication
  - Diffie-Hellman

- Symmetric Encryption
  - DES
  - AES

- Integrity Protection
  - MD5
  - SHA-3

- Asymmetric Crypto
  - RSA
  - DSS
IT-Security 2: Topics

- Malware
  - Types of Malware
  - Spreading
  - Exploits
  - Examples

- ... and Defenses
  - AV-Products
  - Honeypots
  - Malware Analysis
  - Access control
  - Firewalls
  - Intrusion Detection

- Privacy
  - Anonymous Communication
  - Payment Systems
  - Secure Multi-Party Computation
  - E-Voting
  - Biometrics
Google stellt Chrome-Nutzer testweise auf DNS-over-HTTPS um

Google will DNS-over-HTTPS (DoH) in seinem Chrome-Browser testen. Der verwendete DNS-Provider soll bleiben, nur das Protokoll ändert sich. Auch Mozilla testet.
11. September 2019, 12:18 Uhr 116 heise online

Nach DDoS-Angriff: Wikipedia bekommt Millionenspende für IT-Sicherheit

11. September 2019, 09:17 Uhr 34 heise online

- IT Security 2 does not require IT Security 1
- Both lectures can be attended in the same semester
Software und Kommunikation
Object Oriented Software Construction (3+2)

Much more than programming!

RESTful API
GET PUT POST DELETE

Refactoring for Software Design Smells
Managing Technical Debt

Microservices

OSGi Alliance

Prof. H. Lichter - https://www.swc.rwth-aachen.de/
Object Oriented Software Construction (3+2)

- How to apply and combine core object oriented concepts?
- How to identify classes based on a systematic analysis?
- How to improve the design of existing applications?
- How to model an application domain?
- What are components and component models?
- How to combine design patterns and frameworks?

Prof. H. Lichter - https://www.swc.rwth-aachen.de/
Compact Course Prof. Nagl WS 2019/2020 in English and German

Modelling Software Architectures

March 2020

You learn about the importance of software architectures, how they are designed, how architectures look for “standard” systems, and why there is not only one architecture.

Informatik (B.Sc.)
Informatik (M.Sc.)
Software Systems Engineering (M.Sc.)
Technik-Kommunikation (M.Sc.)

Anmeldung über RWTHonline: WS 2019/2020
There you see details of place and time:
https://se-rwth.de/teaching/ws1920/pig/

Kontakt bei Interesse / Please contact
Sebastian Stüber
stueber@se-rwth.de
Start 2020, March 16, 09:00
Room AH I
Advanced Internet Technology (3+1 SWS)

- Reliability
- Mobility
- Security
- Scalability
- Performance
- Adaptability
Advanced Internet Technology (3+1 SWS)

- Reliability
- Mobility
- Security
- Adaptability
- Scalability
- Performance
- Peer-to-Peer Systems
- Cloud Computing

Internet
Advanced Internet Technology (3+1 SWS)

- Reliability
- Mobility
- Security
- Adaptability
- Scalability
- Performance
- Peer-to-Peer Systems
- Cloud Computing
- Cyber-Physical Systems
- Internet of Things
Advanced Internet Technology (3+1 SWS)

- Reliability
- Scalability
- Security
- Performance
- Mobility
- Adaptable

- Peer-to-Peer Systems
- Cloud Computing
- Cyber-Physical Systems
- Internet of Things
- Software Defined Networking
- Quality of Service

Internet
Advanced Internet Technology Schedule

- **Lecture**
  - Thu 10:30 – 12:00, AH 1
  - Fri 10:30 – 12:00, AH 1

- **Exercise**
  - Wed 10:30 – 12:00, AH 1

- **First lecture**
  - Thu 10th October

- **For...**
  - Bachelor & Master students
• RFC: Concept and Operations
  ▶ Introduction by COMSYS lecturers/staff – basics
  ▶ Focus on current hot topics
  ▶ Talks and discussions prepared by students
  ▶ Real research project
• **RFC: Concept and Operations**
  - Introduction by COMSYS lecturers/staff – basics
  - Focus on current hot topics
  - Talks and discussions prepared by students
  - Real research project

• **Cyber-Physical System Security**
  - Industrial Devices get connected to the Internet
    - Visions like the Internet of Production show: Trend unstoppable
    - Traditional security mechanisms usually not applicable

• **Details on Content, Dates, Registration and Organization**
Research Focus Class: Cyber-Physical System Security

- RFC: Concept and Operations
  - Introduction by COMSYS lecturers/staff – basics
  - Focus on current hot topics
  - Talks and discussions prepared by students
  - Real research project

- Cyber-Physical System Security
  - Industrial Devices get connected to the Internet
  - Visions like the Internet of Production show: Trend unstoppable
  - Traditional security mechanisms usually not applicable

- Details on Content, Dates, Registration and Organization
Security & Privacy Lunch

- **Not an official course, but informal meetings**
  - Bring your lunch and watch current scientific talks with us!
  - Each Thursday, 12:30 - 13:15 (Start: 10th October)
  - Mailing list: [https://lists.comsys.rwth-aachen.de/listinfo/sp-lunch](https://lists.comsys.rwth-aachen.de/listinfo/sp-lunch)

- **Who can join?**
  - Bachelor & Master students
  - No credits, thus you cannot take it as kind of elective…
  - … but if you are interested in current Security & Privacy research, just step in!
## Course schedule

<table>
<thead>
<tr>
<th>Winter</th>
<th>Summer</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1.png" alt="Robot" /></td>
<td><img src="image2.png" alt="Robot" /></td>
</tr>
<tr>
<td><strong>Control and Perception in Networked and Automated Vehicles</strong></td>
<td><strong>Formal Methods for Logic Control Software</strong></td>
</tr>
<tr>
<td><img src="image3.png" alt="Microcontroller" /></td>
<td><img src="image4.png" alt="Microcontroller" /></td>
</tr>
<tr>
<td><strong>Embedded Systems</strong></td>
<td><strong>(Introduction to) Embedded Systems</strong></td>
</tr>
<tr>
<td><img src="image5.png" alt="Functional Safety" /></td>
<td><img src="image6.png" alt="Functional Safety" /></td>
</tr>
<tr>
<td><strong>Functional Safety and System Dependability</strong></td>
<td><strong>Advanced Microcontroller Programming and Debugging</strong></td>
</tr>
</tbody>
</table>
Control and Perception in Networked and Automated Vehicles (M.Sc.)
Dr.-Ing. Bassam Alrifaee

Language: English or German
- English slides
- Oral exam

Contents:
- Dynamic vehicle models
- Control and optimization
- Perception
- Network and distribution
- Software-architecture and testing concepts
- Lab: Application on real model-scale vehicles
V2/Ü2 (6 ECTS)

Master CS, CES, AT

Schedule:
- Thursday, 10:30-12:00, 2202 (2350|202)
- Lab: four days in Feb/Mar 2020

Begin: **10.10.2019**
Language: English or German
  - English slides
  - English exam

Contents:
  - Introduction to PLCs
  - Dataflow Analysis
  - Abstract Interpretation
  - SAT/SMT-Encodings
  - Software Model Checking
  - Concolic Testing
Formal Methods for Logic Control Software (M.Sc.)

► V2/Ü2 (6 ECTS)
► Master CS, SSE, AT
► Schedule:
  - Tuesday, 12:30-14:00, AH III (2350|314.1)
  - Friday, 12:30-14:00, AH III (2350|314.1)
► Begin: 08.10.2019

Unreachable Code
Press 'F7' for focus
Theoretische Informatik
Algorithmic Model Theory

<table>
<thead>
<tr>
<th>Time</th>
<th>Place</th>
<th>Start</th>
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<tbody>
<tr>
<td>Mo 10:30 – 12:00</td>
<td>AH III</td>
<td>14.10.</td>
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<tr>
<td>Tue 8:30 – 10:00</td>
<td>AH I</td>
<td>8.10.</td>
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<td>Tue 10:30 – 12:00</td>
<td>AH III</td>
<td>15.10.</td>
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<td>(exercise)</td>
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→ Decidable and undecidable theories
→ Finite model property
→ Descriptive complexity
→ Locality of first order logic, 0-1 laws
→ Fixed-point logics

https://logic.rwth-aachen.de/Teaching/AMT-WS19/
Effiziente Algorithmen
Sprache: Deutsch    Start: Di 8.10. um 16:30 in AH V

- Probleme:
  - Maximale Flüsse
  - Matchings
  - Matroide
  - Matrix Multiplikation
  - LPs
  - .......

- Algorithmen:
  - Effiziente
  - Approximation
  - Randomisierte
  - Heuristiken
  - .......
Model Checking

```
requirements
  └── Formalizing
      └── property specification

system
  └── Modeling
      └── system model

Model Checking
  └── satisfied
      └── insufficient memory
  └── violated + counterexample
      └── Simulation
          └── location error

```

“not biased towards the most probable scenarios”
Concurrent Systems

Concurrency everywhere
- Operating systems
- Multi-core computers
- Embedded systems, ...

Problems everywhere
- Deadlocks
- Mutual exclusion
- Starvation, ...

Solutions
- Rigorous description of concurrent systems
- Well-founded semantic models
- Formal reasoning about behaviour
### Introduction to Model Checking
- Lecturer: Joost-Pieter Katoen
- Date: Thu 10:30–12:00 (AH 2), Fri 14:30–16:00 (AH 3)
- Initial lecture: Thursday, October 10
- Prerequisites: algorithms, automata, logic, complexity, enthusiasm!

### Concurrency Theory
- Lecturers: Joost-Pieter Katoen, Thomas Noll
- Date: Mon/Tue 14:30–16:00 (AH 1)
- Initial lecture: Monday, October 7
- Prerequisites: system programming, algorithms, automata, enthusiasm!

### Invitation
You are all most welcome to participate!
Outlook on Summer Semester

i2 Courses in Summer 2020

- Theoretical Foundations of the UML
- Static Program Analysis
How to automatically check whether a formula of a given logic is satisfiable?
Propositional logic
+
Theory
$\rightarrow$
SMT solving

Uninterpreted functions
$(f(x) = a \land x = y) \Rightarrow f(y) = a$

Linear arithmetic
$2x + y > 5 \land x + 2y < 5 \ (x, y \in \mathbb{R})$

Non-linear arithmetic
$x^2 + y^2 = z^2 \ (x, y, z \in \mathbb{R})$

Integer problems
$j = 0 \land 2i + j = 5 \land j^2 < i \ (i, j \in \mathbb{N})$
Contents

- Logical foundations
  - CNF, DNF, DPLL, CDCL, ...

- Reasons for unsatisfiability
  \[ j = 0 \land 2i + j = 5 \land j^2 < i \quad (i, j \in \mathbb{N}) \]

- Model generation
  \[ x^2 + y^2 = z^2 \quad (x, y, z \in \mathbb{R}) \text{ is satisfiable} \]
  with \( x = 3, \ y = 4, \ z = 5 \)

- Applications
Organization

- Lectures:
  Monday, 08:30 – 10:00, AH III
  Tuesday, 08:30 – 10:00, AH III
  Starting October 7th

- Exams:
  First exam: February 22nd
  Second exam: March 26th
Course about **automata theory for infinite objects.**

**Topics**

- Automata on infinite words and infinite trees
- How to solve two-player games of infinite duration
- Decision procedures for different logics and their use in automatic verification and synthesis

**First Lecture**
Tuesday, Oct. 8, 10:30, AH II
Link to the slides:

(Video will be available from the Video AG Website)