Elective Courses for Bachelor and Master Students:

“2 Minute Madness”
Applied computer science
replaces what was formerly known as Numerisches Rechnen

extremely helpful (if not essential) for Machine Learning, Computer Graphics, Pattern and Speech Recognition, Computational Science and Engineering, High-Performance Parallel Computing, ...

driven by model calibration / regression; e.g. Modern Family ...

focus on Algorithms and Implementation rather than exhaustive discussion of mathematical details

essential item in tool box of modern computer scientists

1D story (pictures) $\Rightarrow$ nD story
Numerical Methods and Software
V3Ü2, 6 ECTS

▶ Einführung in Numerische Methoden und Software / Introduction to Numerical Methods and Software

▶ lecture
  ▶ methods → every Tuesday, 10:30-12:00 in AH III (starts 9. April 2019)
  ▶ software → every second Wednesday, 8:30-10:00 in AH I (starts 10 April 2019)

▶ tutorial
  ▶ practice methods and use of software → every Thursday, 10:30-12:00 in AH III (starts 11. April 2019)

▶ exam
  ▶ 120min written exams in July/September 2019
  ▶ optionally, up to three short intermediate tests to collect bonus points (to be announced 2 weeks prior)

Looking forward to seeing you next Tuesday!
Designing Interactive Systems 2

- Input Devices
- Window Systems for the Desktop and Beyond
- Multimedia & Multimodality
- Hardware & Software Prototyping
Designing Interactive Systems 2

- Input Devices
- Window Systems for the Desktop and Beyond
- Multimedia & Multimodality
- Hardware & Software Prototyping

Starts Wednesday, Apr 3, 8:30–11:00, room 2222, for Master students

Prof. Jan Borchers • Summer Semester 2019
Current Topics in HCI

Research Methods

Scientific Publishing

Current Research

Prof. Jan Borchers • Summer Semester 2019
Current Topics in HCI

- Research Methods
- Scientific Publishing
- Current Research

Prof. Jan Borchers • Summer Semester 2019
Current Topics in HCI

Research Methods
Scientific Publishing
Current Research

Starts Wednesday, Apr 3, 12:30–14:00, room 2222, for Master students
Learning Technologies – Summer Semester 2019
LearnTech – Overview

Models
- Learning Theories
- LMS & MOOCs
- Learning Analytics
- Assessment & Feedback

Trends
- Mobile Learning & Cross Platform
- Game-based Learning & Gamification
- Open Educational Resources
- Collaborative Learning & Learner Modelling

Project
- Learning Analytics
- Data preparation
- Data models
- Indicator implementation
LearnTech – Summer Semester 2019

- Lecture Tuesdays (10:30-12:00, 5054) and Thursdays (14:30-16:00, 5056)
- Practical Sessions Mondays (10:30-12:00, 5056) → obligation to attend

- Integrated Learning Analytics Project (in groups)
- Offered to:
  - M.Sc. Computer Science,
  - M.Sc. Media Informatics,
  - M.Sc. Software Systems Engineering,
  - M.Ed. Computer Science,
  - M.A. Technik-Kommunikation,
  - see RWTHonline

- Language: English
- 6 ECTS
- Oral Exams

Starts on:

April 4th, 2019
14:30 - 16:00
in Room 5056
Language, Culture, Cognition  
(V2/Ü1, Brozdowski/Jarke/Mittelberg)  
Master  

Lecture: Thursday, 12:00 – 14:00  
Room: 0.109 (B-IT Building, Bonn)  

• Cognitive science related to linguistic relativity  
  • Descriptive linguistics and linguistic anthropology  
  • Experimental and cognitive psychology  
• Topics  
  • Color terms and categorical perception  
  • Spatial language and navigation  
  • Language genesis and memory  
• Scientific reading and writing  
  • Responding to journal articles  
  • Optional data collection and analysis
Advanced Techniques in Physically-Based Animation

Multibody systems

Collision handling

Fluids

Deformable solids

Fracturing
Lecture: Advanced Techniques in Physically-Based Animation (Master)

- Lecturer: Prof. Dr. Jan Bender
- Credits: 6 ECTS credits
- Dates:
  - Lecture: Tuesday, 10:30 - 12:00 E2 Room 5052
  - Lecture/Exercise: Thursday, 14:30 - 16:00 E2 Room 5054
- First lecture: 09.04.2019
• Lecture: *Computer Vision*
  – Place & Time:       Mon 10:30 – 12:00    TEMP2
                  Tue 14:30 – 16:00    H03
  – First lecture Monday, 08.04.

• Lecture: *Advanced Machine Learning*
  – Place & Time:      Wed 10:30 – 12:00    H06
                      Thu 10:30 – 12:00    H04
  – First lecture Wednesday, 03.04.
Images and Video Are Everywhere…

- Personal photo albums
- Movies, news, sports
- Surveillance and security
- Mobile and consumer applications
- Medical and scientific images

Internet services:
- Google Image Search
- Picasa
- flickr
- webshots
- picsearch
- YouTube
- kooaba
Lecture *Computer Vision* (3V + 1Ü)

- Image Processing Basics
- Segmentation
- Local Features & Matching
- Object Recognition and Categorization
- 3D Reconstruction
- Deep Learning

First lecture: Monday, 08.04.!
Interested in how all of this works?

Come to our lecture!

Lecture: Computer Vision
Mon 10:30 – 12:00, room TEMP2
Tue 14:30 – 16:00, room H03

First lecture Monday, 08.04.!
Extending lecture *Machine Learning* from last semester…

- **Regression Techniques**
  - Regularization (Ridge, Lasso)
  - Bayesian Regression

- **Probabilistic Graphical Models**
  - Bayesian Networks
  - Markov Random Fields
  - Inference (exact & approximate)

- **Deep Generative Models**
  - GANs
  - VAEs

- **Deep Reinforcement Learning**
Interested in how all of this works?

Come to our lecture!

Lecture: Advanced ML

Wed 10:30 – 12:00, room H06
Thu 14:30 – 16:00, room H04

First lecture Wednesday, 03.04.!
Lecture Topic: „How to get this into the computer? And what to do with it there?“
Geometry Processing – Pipeline

Scanning

Real world object → Pointcloud
Geometry Processing – Pipeline

Scanning

Real world object → Pointcloud → Mesh

Mesh extraction

Printed object
Many possible processing steps:

- repair & hole filling
- parametrization
- obtain different „resolutions“
Geometry Processing – Pipeline

Scanning
- Real world object
  → Pointcloud

Mesh extraction
- Mesh

Mesh processing
- Processed meshes

Many possible processing steps:

- repair & hole filling
- parametrization
- obtain different "resolutions"
- shape analysis
Geometry Processing – Pipeline

Scanning → Mesh extraction → Mesh processing → Printed object

Real world object → Pointcloud → Mesh → Processed meshes → Printed object

(exemplary use-case)

DON’T BE SCARED ABOUT MATH!
Geometry Processing – Pipeline

Real world object → Pointcloud → Mesh → Processed meshes → Printed object

Tuesday, 10:30 at AH V
Thursday, 12:30 at AH V

Starting this Thursday – see you there!
Contents:

- (Advanced) Interaction Techniques for VR
- Acoustic Virtual Reality
- Haptic Interfaces
- Formal User Studies in VR
- Avatars and Virtual Agents
- Algorithms of Immersive Visualization
- Presence, Latency and Motion Sickness

Participation at VR I not mandatory, but basic knowledge of VR and Math is recommended
Lecture VR II: Special Topics of Virtual Reality (V3Ü1)

Lecture:  
Tuesday, 08:30-10:00, Seminar Room 5052  
Thursday, 16:30-18:00, Seminar Room 5054

Exercise:  
About every two weeks instead of lecture

Start:  
Tuesday, April 09

Teachers:  
Prof. Dr. Torsten W. Kuhlen,  
Jonathan Wendt, Sebastian Pape et al.

Credits:  
Master CS, SSE, MI  
Oral Exam (20 minutes, individual appointment Sep/Okt 2019)
Chair for Computational Social Sciences and Humanities

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

http://cssh.rwth-aachen.de
Chair for Computational Social Sciences and Humanities

Understanding **social systems** and modeling **human social behavior** via computational methods and new kinds of data.

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

- **Data about social systems and human social behavior**
  - **textual data**
    - structured textual data
    - unstructured textual data
  - **relational data**
    - (social) network data
    - sequential data

- **social theories**
  - social behavior
  - socio demo-graphics
  - social issues
  - social dynamics
Course on Web Mining

- **Topics:**
  - How can we analyze the web?
  - Fundamental Algorithms and Methods for
    - Web content mining
    - Web structure mining
    - Web usage mining
  - Recent developments, e.g.,
    - Representation Learning
    - Mining Massive Datasets

- **Course logistics:**
  - Organisation: 3h lectures + 2h exercises
  - Time: Tue 14.30-16.00, Thu 14.30-17.00
  - Location: Ahornstr. 55, Republikplatz 6
  - URL: [http://cssh.rwth-aachen.de/courses/](http://cssh.rwth-aachen.de/courses/)
Course on Social Networks

• **Topics:**
  – What are social networks and how do we quantify them?
  – Regularities of empirical networks, small worlds
  – Models of networks
  – Emergent properties of networks
  – Dynamics on networks
  – Social network theories and hypotheses

• **Course logistics:**
  – Organisation: 3h lectures + 2h exercises
  – Time: Tue 10.30-12.00, Thu 10.30-13.00
  – Location: Ahornstr. 55, Eilfschornstr. 18
  – URL: [http://cssh.rwth-aachen.de/courses/](http://cssh.rwth-aachen.de/courses/)
Lecture / Exercise: Advanced Topics in Human Language Technology and Machine Learning

Advanced discussion of the following topics:

- Bayes decision rule revisited
- Deep learning
- Training criteria
- Recurrent neural networks and attention modelling
- Sequence-to-sequence modelling
Advanced Topics in Human Language Technology and Machine Learning

Lecture / Exercise:

Mon  10.30 – 12.00   AH 6  
     14.30 – 16.00   5056  
Wed  10.30 – 12.00   5056  

Start:  08.04.2019

Weekly schedule might vary - to be announced during lecture.

- **Advanced level**, good knowledge from Lecture Statistical Classification and Machine Learning strongly recommended
- **Study programs**: Master Informatik, Media Informatics, Data Science, Software Systems Engineering, Simulation Sciences, and Mathematik
- V3/Ü1, 6 Credits
- Teaching language: English

www.hltp.rwth-aachen.de/web/Teaching/
Concepts and Models for Parallel and Data-centric Programming (PDP)

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

Dr. C. Terboven, J. Miller, S. Schwitanski
High Performance and Big Data Computing

Simulation results

need time

→ Aim: faster execution
Summary

• Lecture Contents PDP SS 2019
  – Parallelism for shared and distributed memory
  – Parallelism for accelerators (GPUs)
  – Parallelism for data-centric problems
  – Selected parallel algorithms

• Bachelor / Master course: 6 ECTS credits
  – MON 12:30 – 14:00 MeT P11
  – WED 10:30 – 12:00 (biweekly) MeT P11
  – FRI 10:30 – 12:00 (biweekly) MeT P11
  – Starts on Monday, April 8th

www.hpc.rwth-aachen.de
contact@hpc.rwth-aachen.de
Performance and Correctness Analysis of Parallel Programs (PCA)

Prof. Dr. Matthias Müller

Dr. C. Terboven
Dr. S. Wienke
J. Protze
B. Wang
J. Miller
S. Schwitanski

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

- Metrics and Benchmarks
- Performance Modeling

![Graph]

- Performance Analysis Tools

<table>
<thead>
<tr>
<th>Call Stack</th>
<th>CPU Time: Total by Utilization</th>
</tr>
</thead>
<tbody>
<tr>
<td>a.cg</td>
<td>46.7%</td>
</tr>
<tr>
<td>m matvec</td>
<td>40.8%</td>
</tr>
<tr>
<td>m xpay</td>
<td>1.4%</td>
</tr>
<tr>
<td>m axpy</td>
<td>1.4%</td>
</tr>
<tr>
<td>m vectorDot</td>
<td>1.2%</td>
</tr>
<tr>
<td>m axpy</td>
<td>1.1%</td>
</tr>
<tr>
<td>m vectorDot</td>
<td>0.5%</td>
</tr>
</tbody>
</table>

Correctness

- Parallel Debugging
- Data Races and Deadlocks

\[x = 5\]

\[x = 42\]

\[x = ?\]

Correctness Analysis Tools

WARNING: ThreadSanitizer: data race (pid=14436)
Write of size 8 at loc1 by thread T2:
#0 f1 pi-omp.c:64:14 (pi+0x00000049956b)
Previous write of size 8 at loc1 by main thread:
#0 f1 pi-omp.c:64:14 (pi+0x00000049956b)
Summary

• Lecture PCA SS 2019
  – Bachelor / Master course: 6 ECTS credits
  – TUE 12:30 – 14:00  Sem 5056
  – THU 12:30 – 14:00  Sem 5056
  – Starts on Thursday, April 4th
  – Prerequisites: Mastery of essential concepts of parallel processing, e.g., *High Performance Computing* (Prof. Müller, WS 2018/19)

• Outlook WS 2019/20
  – Lecture: *High Performance Computing (HPC)*
  – Seminar: *Current Topics in High Performance Computing*
  – Software Lab (Bachelor): *HPC Cluster Challenge*

www.hpc.rwth-aachen.de
contact@hpc.rwth-aachen.de
Software and communication
• **Software Language Engineering** (3VL + 2Ü, 6 ECTS)
  - Prof. Rumpe
  - First lecture on April 3rd, 12:30 - 15:00 AH V
  - Develop your own software language
    ▪ Understand DSL’s and their tools
    ▪ Develop or extend an SLE-tool

• **Digitalization** (3VL, 3 ECTS)
  - Prof. Rumpe and various guest lectures
  - First lecture on April 3rd, 18:15 – 19:45 AH I
  - Investigate fundamentals of the terms digitalization, digitization and digital transformation
    ▪ Discussions will stimulate a critical examination of the terms
    ▪ Lecturers from industry will discuss current developments advancing the digitalization of their economic sector
• **Processes and Methods of Software Tests** (V2, 3 ECTS or 6 ECTS with workshop)
  – Dr. Stefan Kriebel, BMW Group
  – Lecture block in July 2019
  – Industrial Software/Systems Engineering
  – Know-How-Transfer from industry

• Practical experience in the area of Software Engineering
• Workshop + written report (~ 2-3 ECTS)
• For example:
  – Explanatory videos in “Digitalization Trends”

• Practice Workshop + report can be combined with the lecture:
  – Processes and Methods of Software Tests
  – Further lectures (winter term)
  … to 6 ECTS modules

• Further information:  [http://www.se-rwth.de/teaching/ss19/practice-workshops/](http://www.se-rwth.de/teaching/ss19/practice-workshops/)
Mobile Internet Technology (3+1 SWS)

- Wireless networks and mobility support
  - Basics of wireless communication
    - Modulation, error coding
    - Signal propagation
    - Medium access
Wireless networks and mobility support

- Basics of wireless communication
  - Modulation, error coding
  - Signal propagation
  - Medium access

- Wireless networking
  - Data networks: Wi-Fi
  - Telecommunication networks: GSM/UMTS/LTE

300 Mbit/s
Wireless networks and mobility support

- Basics of wireless communication
  - Modulation, error coding
  - Signal propagation
  - Medium access

- Wireless networking
  - Data networks: Wi-Fi
  - Telecommunication networks: GSM/UMTS/LTE

- Mobility and Internet protocols
  - Mobile IP, HIP
  - Transport layer extensions
Mobile Internet Technology Schedule

- **Lecture**
  - Wed 10:30 – 12:00, AH 1
  - Thu 10:30 – 12:00, AH 1 (biweekly)

- **Exercise**
  - Thu 10:30 – 12:00, AH 1 (biweekly)

- **First lecture**
  - Wed 3\textsuperscript{rd} April

- **For...**
  - Bachelor & Master students
Security & Privacy Lunch

- Not an official course, but informal meetings
  - [https://www.comsys.rwth-aachen.de/teaching/ss-19/security-and-privacy-lunch/](https://www.comsys.rwth-aachen.de/teaching/ss-19/security-and-privacy-lunch/)
  - Bring your lunch and watch current scientific talks with us!
  - Each Thursday, 12:30 - 13:15 (Start: 4th April)
  - 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!
Informatik 11 – Embedded Software
Prof. Dr.-Ing. Stefan Kowalewski
Course schedule

<table>
<thead>
<tr>
<th>Summer</th>
<th>Winter</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Introduction to) Embedded Systems</td>
<td>Control and Perception in Networked and Automated Vehicles</td>
</tr>
<tr>
<td>Functional Safety and System Dependability</td>
<td>Formal Methods for Logic Control Software</td>
</tr>
<tr>
<td>Advanced Microcontroller Programming and Debugging</td>
<td></td>
</tr>
</tbody>
</table>
(Introduction to) Embedded Systems

- **Language:** German
  - English slides
  - Bilingual exam

- **Contents:**
  - Platforms for embedded systems
    - Microcontrollers
    - PLCs
  - Embedded communication
    - Basics
    - I²C, CAN, FlexRay, Profibus
  - Real-time
  - Simulink & Model-based development
  - Embedded software development & design
Introduction to (Introduction to) Embedded Systems

- V3/Ü1 (6 ECTS)
- Bachelor and Master CS
- Schedule:
  - Monday, 14:30-16:00, AH III (2350|314.1)
  - Tuesday, 14:30-16:00, AH III (2350|314.1)
- Begin: 08.04.2019
Functional Safety and System Dependability

- **Language:** English

- **Contents:**
  - Design and analysis methods supporting the dependability and safety of embedded systems
  - Dependability/safety modelling
  - Dependability/safety measures and analyses
  - Software faults, software failure
  - Mechanisms of HW/SW fault tolerance
  - Risk analysis, risk acceptance criteria
  - Safety norms

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Informatik 11 – Embedded Software
Prof. Dr.-Ing. Stefan Kowalewski
Functional Safety and System Dependability

► V3/Ü1 (6 ECTS)
► Master CS
► Schedule:
  ▪ Monday, 16:30-18:00, AH III (2350|314.1)
  ▪ Thursday, 12:30-14:00, AH III (2350|314.1)
► Begin: 08.04.2018
Adv. Microcontroller Programming and Debugging

**Language:** English

**Contents:**
- Compiler tool-chain and assembler
- Programming language C
- Coding Guidelines
- Synchronous languages
- Debugging
- Best Practices
- System Descriptions and model-based software development
- Testing and Verification
Adv. Microcontroller Programming and Debugging

► V3/Ü1 (6 ECTS)
► Master CS
► Schedule:
  ▪ Monday, 10:30-12:00, 2202 (2350|202)
  ▪ Wednesday, 10:30-12:00, 2202 (2350|202)
► Begin: 03.04.2019
Software is the **most complex thing** humans ever built!

*Project Management is a must!*

**Standish Group’s 2011 CHAOS Report**
Software Project Management

- How to plan a project?
- Which are the most important risks?
- How can we measure the progress?
- How to estimate the effort?
- How to manage all stakeholders?
- How to setup a project?
Flugausfälle wegen Softwareproblemen bei der Flugsicherung

Aktuelle Stunde | 25.03.2019 | 01:56 Min. | UT | WDR | Von Claudia Weber

Software Quality Assurance

What is software quality?

Which QA measures should we take?

Which qualities are important?

When is a program tested appropriately?

Why is testing not enough?

How much does “good” quality cost?

Can we measure quality?

How to measure the quality of development processes?
Software Project Management (2+1)

- **Master**
- **Start** April 4
  8:30 - 10:00 (AH III)
- **Lectures** (1. half of semester)
  Thu., 8:30 - 10:00 (AH III)
  Fri., 8:30 - 10:00 (AH III)
- **Exercises** (2. half of semester)
  Thu., 8:30 - 10:00 (AH III)

Software Quality Assurance (3+2)

- **Bachelor / Master**
- **Start** April 3
  10:30 - 12:00 (AH III)
- **Lectures**
  Tue., 16:30 – 18:00 (AH II)
  Wed., 10:30 - 12:00 (AH III)
- **Exercises**
  Thu., 10:30 - 12:00 (AH VI)
Theoretical computer science
Modeling and Analysis of Hybrid Systems
Erika Ábrahám, Stefan Schupp

discrete

hybrid

System
Formal model

Requirements
Formal specification

Verification engine
Satisfied
Violated
Unknown

continuous
Organization

Lectures:
  Monday, 14:30–15:15, AH V
  Tuesday, 10:30–12:00, AH VI
  Starting: 8 April 2019

Exercises:
  Monday, 15:15–16:00, AH V
  Weekly, not mandatory

Exam requirements:
  At least 50% from five eTests

Exams:
  Written
  First exam: 06 August 2019 14:30–16:30
  Second exam: 07 September 2019 10:30–12:30
Algorithmic Game Theory

AGT: Research area at intersection of game theory and CS

Focus: design and analysis of models and algorithms in strategic environments

Content of lecture and exercises:

▶ Algorithms and complexity for equilibrium computation
▶ Congestion games and price of anarchy
▶ Mechanism design: how to design the rules of the game so that selfish behaviour leads to desirable outcomes?
▶ Fair and stable cost sharing methods

Start: Monday, 8th of April, 10:30–12:00 in MetP11

Lectures: Mo+Tue, 10:30–12:00 (Britta Peis),

Exercises: Thursday, 12:30–2pm (Vipin Vijayalakshmi, Christoph Grüne)
Distributed and Parallel Systems

Unger, Fischer

- Distributed: Connected Computers
- Parallel: CPUs connected to Memory
- V3 (6 credits)
- Start: 3.4. (Wednesday)
- Dates: Wednesday 16:30-18:00, Thursday 16:30-18:00
- Contents: colorings, independent set, routing, communications, networks, distributed hash tables, and more
- Typically an oral examination
Master course: Combinatorial Graph Theory

Lecture: Gerhard Woeginger (E1, room 4024)
Instructions: Tim Hartmann (E1, room 4020)

Lecture times:
- Mon, 12:30-14:00, room AH3
- Fri, 12:30-14:00, room AH3
- First lecture: Friday, April 5

**Theory course**, with lots of mathematics and lots of proofs
- Example: Given a graph, find the number of spanning trees
- Example: Which sequences are degree sequences of graphs?
- Example: The cube of every connected graph is Hamiltonian
Imperative Program

- sequence of instructions

Functional Program

- sequence of equations
- specifies *what* should be computed, not *how* it is computed

\[
\text{srt} \ [\ ] = [\ ] \\
\text{srt} \ (x:xs) = \text{srt} \ xs1 \ ++ \ [x] \ ++ \text{srt} \ xs2 \\
\text{where} \ xs1 = [y \mid y < -xs, y < x] \\
xs2 = [y \mid y < -xs, y \geq x]
\]

Advantages

- shorter and clearer programs
- programs have less bugs
- fast development
- better reusability and modularity
**Imperative Program**

- sequence of instructions

```java
static void srt(int[] a, int lo, int hi) {
    int h, l, p, t;
    if (lo <= hi) { l = lo; h = hi;
        p = a[hi];
        do { while ((l < h) && (a[l] <= p))
            l = l+1;
        while ((h > l) && (a[h] >= p))
            h = h-1;
        if (l < h) {  t = a[l];
            a[l] = a[h]; a[h] = t;     }
    } while (l < h);
    t = a[l]; a[l] = a[hi]; a[hi] = t;
    srt( a, lo, l-1);
    srt( a, l+1, hi); } }
```

**Functional Program**

- sequence of equations

```haskell
srt []     = []
srt (x:xs) = srt xs1 ++ [x] ++ srt xs2
            where xs1 = [y | y <- xs, y < x]
            xs2 = [y | y <- xs, y >= x]
```

**Advantages**

- shorter and clearer programs
- programs have less bugs
- fast development
- better reusability and modularity
# Functional Programming

<table>
<thead>
<tr>
<th>Course</th>
<th>Days</th>
<th>Time</th>
<th>Location</th>
<th>Instructor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lecture</td>
<td>Mon</td>
<td>14:30 - 16:00</td>
<td>AH 4</td>
<td>Prof. Dr. Jürgen Giesl</td>
</tr>
<tr>
<td></td>
<td>Fri</td>
<td>08:30 - 10:00</td>
<td>AH 4</td>
<td></td>
</tr>
<tr>
<td>Exercise</td>
<td>Wed</td>
<td>14:30 - 16:00</td>
<td>AH 1</td>
<td>Marcel Hark</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Program</th>
<th>Course Type</th>
<th>Credits</th>
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<tbody>
<tr>
<td>Bachelor Inform.</td>
<td>Wahlpflicht Theorie</td>
<td>V3 + U2</td>
</tr>
<tr>
<td>Master Inform.</td>
<td>Theorie</td>
<td>V3 + U2</td>
</tr>
<tr>
<td>Master Math.</td>
<td>Informatik Anwendungs fach</td>
<td>V3 + U2</td>
</tr>
<tr>
<td>Master SSE</td>
<td>Theory (Core)</td>
<td>V3 + U2</td>
</tr>
</tbody>
</table>

Begin: **Friday, April 5** *(this week)*
Why Semantics?

Are the following assignments to b equivalent?

```java
boolean f(int x, int y) { return (x==0) && (y==0); }
boolean b = f(1, 2/0);
boolean b = (1==0) && (2/0==0);
```

Goal

Formal definition of meaning of computer programs:

Program $\xrightarrow{\text{Semantics}}$ “Behaviour”

Organisation

- Lecturer: Thomas Noll
- Mon 14:00–15:30 AH 6, Thu 10:00–11:30 5056
- Initial lecture: Thursday, April 4
- Prerequisites: programming, formal languages, automata
(Complementary) Techniques

- **Operational semantics:**
  \[
  \langle c_1, \sigma \rangle \rightarrow \sigma' \quad \langle c_2, \sigma' \rangle \rightarrow \sigma'' \\
  \langle c_1; c_2, \sigma \rangle \rightarrow \sigma''
  \]

- **Denotational semantics:**
  \[
  c[.] : Cmd \rightarrow (\Sigma \rightarrow \Sigma) \\
  c[c_1 ; c_2] := c[c_2] \circ c[c_1]
  \]

- **Axiomatic semantics:**
  \[
  \{ A \} c_1 \{ C \} \quad \{ C \} c_2 \{ B \} \\
  \{ A \} c_1 ; c_2 \{ B \}
  \]

Applications

- **Design and implementation of programming languages**
  (standardisation, development of compilers/interpreters)

- **Correctness** of compilers and optimising transformations
  (comparison of [semantics of] source and target code)

- **Software verification** (mathematical proofs of program properties)
# Outlook on Winter Semester

## i2 Courses in WS 2019/20

- Introduction to Model Checking
- Concurrency Theory
Logics for Reasoning about Uncertainty (V2)

Lecture: Start 8.04.
Mon 12:30 - 14:00, AH I

Content:

▶ description of logical systems for reasoning about issues related to uncertain, unknown or unreliable data/events
▶ logical reasoning about knowledge, dependence and independence, imperfect information, randomness

More Information:
https://logic.rwth-aachen.de/Teaching/LRU-SS19/index.html.en
Algorithmic Foundations of Data Science

Course about the theoretical, mainly algorithmic foundations of data science.

**Topics**
- Theoretical aspects of machine learning
- Information theory
- The curse of dimensionality and dimension reduction

**First lecture:**
Thursday, Apr. 4, 8:30, AH V

**Further Info:** Moodle
Theory of Constraint Satisfaction Problems

- Constraint Satisfaction Problems (CSPs) give a general framework for modelling computational problems
- Topic of the course are algorithms for CSPs and the complexity of CSPs

First lecture: Thursday, April 4, 14:30, 5055

Further Info: Moodle

- Wide range of methods from different areas of theoretical computer science and mathematics
Advanced Automata Theory (B.Sc./M.Sc.)

Topics:
- Quotients and Minimization of NFAs
- Learning algorithms for DFAs
- Automata and logic
- Automata for trees
- Algorithms for pushdown-systems
- Undecidable problems in automata theory

First Lecture: Wed, April 3, AH I

Required knowledge:
Basics from automata theory (FoSAP), computability and complexity (BuK), logic (MaLo)
Data and information management
Informatik 5
Information Systems & Databases

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
Fraunhofer Institute for Applied Information Technology FIT

Life Science Informatics (Prof. Dr. T. Berlage)
- High content analysis and software-intensive instruments
- Scientific data management
- Biomolecular optical systems
- Intra-operative molecular diagnostics
- Adaptive scanning in automated microscopy

Cooperation Systems (Prof. W. Prinz, PhD)
- Computer supported cooperative work
- Social computing in business communication
- Personalized and collaborative learning environments
- Mixed and augmented reality solutions

Media Informatics / Media Processes (Prof. Dr. T. Rose)
- IT support for emergency management
- Impact assessment of financial legislation
- Sustainable financial information management
Social Computing
(V3/Ü1, Klamma)
Master

Lecture: Monday 14.30-16.00
Friday 14.30-16.00 (start: April 5, bi-weekly)

Excercise: Friday 14.30-16.00 (start: April 26, bi-weekly)

Room: 5053.2 (B-IT Research School, opposite to AH 6)

Topics

• The Web as Social Computing Platform (Infrastructures)
• The Social Computing Development Process (Engineering)
• Computational Social Science (Algorithms)
• Social Bots, Fake News, Filter Bubbles
• Social Augmented and Virtual Reality
• Gamification, Serious Games, Science 2.0
Process Management
(V2/Ü1, Rose)
Master

Lecture: Wednesday, 10:30 – 12:00 (start: April 3)
Exercises: tba
Room: 5053.2 (B-IT Research School, opposite to AH 6)

The course will be also offered in Bonn.

• Process management requirements, concepts and approaches
• Modelling languages and patterns
• Execution support
• Maturity models
• Flexibility and customisation
Language, Culture, Cognition
(V2/Ü1, Brozdowski/Jarke/Mittelberg)

Master Lecture: Thursday, 12:00 – 14:00
Room: 0.109 (B-IT Building, Bonn)

• Cognitive science related to linguistic relativity
  • Descriptive linguistics and linguistic anthropology
  • Experimental and cognitive psychology
• Topics
  • Color terms and categorical perception
  • Spatial language and navigation
  • Language genesis and memory
• Scientific reading and writing
  • Responding to journal articles
  • Optional data collection and analysis
Business Process Intelligence – Powered by PADS

- New research group, chaired by prof. Wil van der Aalst
- Interplay between Process Science and Data Science
- Rapidly growing interest in industry (25+ software vendors)
- Combine scientific challenges & a huge practical relevance
- A young area where you can make a difference (also many HiWi positions)

Chair of Process and Data Science (PADS) / Informatik 9
prof.dr.ir. Wil van der Aalst
Business Process Intelligence

- Process discovery
- Conformance checking
- Performance analysis
- Predictive analytics

Real processes
Real data
The course starts with a lecture on Friday in AH II (2350|111).
Lectures are on Tuesdays and Wednesdays from 8.30 to 10.00.
Instructions are on Fridays from 8.30 to 10.00.
Involves using commercial software (open-source and commercial) and real data.
Examination: Two practical assignments and a written final exam.
6 ECTS for Bachelor (Informatik) and Master (Informatik, Media Inf., Software Syst.).
Advanced Process Mining (12.25111)

- Advanced Algorithms for:
  - Process Discovery;
  - Conformance Checking;
  - Process Enhancement;
  - BIG Event Data;
  - ...

Event data to VALUE

Bottleneck Detected
Advanced Process Mining (12.25111)

• Lectures
  • Wednesday; 12.30 – 14.00; AH V (Starting April 3th!!!)
  • Thursday; 12.30 – 14.00; AH VI

• Instructions
  • Thursday; 14.00 – 16.00; AH VI

Dr.ir. Sebastiaan J. van Zelst
Lisa Mannel MSc.