Presentation of Courses in Computer Science

Winter Term 2017/18
Presentation of Courses WiSe 17/18

• Overview of all elective courses for Bachelor / Master

• Sorted according to 4 areas of Computer Science
  1. Theoretische Informatik (Theoretical Computer Science)
  2. Software & Kommunikation (Software & Communication)
  3. Daten- & Informationsmgmt. (Data- & Information-Management)
  4. Angewandte Informatik (Applied Computer Science)

• Presentation Rule
  • Each professor gets 2 minutes
Bereich 1:
Theoretische Informatik
Institute for Computer Science I

Prof. Dr. Peter Rossmanith:
• Analysis of Algorithms

Prof. Dr. Walter Unger:
• Effiziente Algorithmen
• Algorithmische Kryptographie
General Information

This course belongs to our Master in Computer Science program.

Objective
To study mathematical methods and models used in the analysis of algorithms.

Lectures will be held in English in Room 5054 on
- Wednesdays: 10:15 till 11:45 (starts on October 18th)
- Thursdays: 10:15 till 11:45

A Tutorial session will be held in Room 5052 on
- Tuesdays: 10:15 till 11:45 (starts on October 24th)

Requirements
Homework exercises and passing the final exam.
Course Outline (Representative Topics)

- Kirchhoff’s Laws.
- Recurrence Relations: Techniques for solving first- and higher-order recurrences.
- Generating Functions: Techniques for solving ordinary, exponential and bivariate generating functions.
- Asymptotic Approximations: Euler-Maclaurin summation, analysing singularities.

Homepage:
http://tcs.rwth-aachen.de/lehre/Analyse/WS2017/
Effiziente Algorithmen

Sprache: Deutsch    Start: Do. 12.10.    Credits: 6

Probleme:
- Maximale Flüsse
- Matchings
- Touren
- Überdeckungen
- LPs
- Scheduling

Algorithmen:
- Effiziente
- Online
- Approximation
- Randomisierte
- .......
Algorithmische Kryptographie

- Geschichte (Babbage bis Enigma)
- Symmetrische Verfahren (Enigma bis AES)
- Public Key-Systeme (RSA bis Pallier)
- Beweise zur Sicherheit von Verfahren
- Diverse Protokolle (Unterschriften und mehr)
- Zero-Knowledge Proof (Maximale Sicherheit)
- Elektronisches Geld
- Elektronische Wahlen
- Sprache: Englisch, ggf. Deutsch
- Beginn: 11.10. um 10:15 im AH I
Prof. Dr. Joost-Pieter Katoen
- Theoretical Foundations of the UML
- Concurrency Theory
- Semantics and Verification of Software

Prof. Dr. Erika Ábrahám
- Satisfiability Checking
The Unified Modeling Language

MSC

HMSC

Statecharts

Figure 2. Statecharts representation of an equipment with a repairer.
What do these diagrams really mean? How to analyze their elementary properties?

✓ Attend lecture on

Theoretical Foundations of the UML

✓ When? Start: Oct 09, 10:15.

✓ Where? 9U10

✓ Who? Prof. Dr. Joost-Pieter Katoen.

✓ What needed? Logics, automata, complexity theory, algorithms.
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
Course *Concurrency Theory*

### Organisation

- **Topic:** formal models of concurrency
- **Lecturers:**
  - Joost-Pieter Katoen
  - Thomas Noll
- **Mon/Thu 14:15-15:45 (9U10)**
- **Initial lecture:** Monday, October 9
- **Prerequisites:** system programming, automata, algorithms, enthusiasm!

### Invitation

You are all most welcome to participate!
Why Semantics?

What if \( p == NULL \) in the following program?

\[
\text{while (p != NULL && p->key < val) \{ ... \}}
\]

Goal

Formal definition of meaning of computer programs: \( \text{Program Semantics} \rightarrow \text{“Behavior”} \)

Organisation

- Lecturer: Thomas Noll
- Tue/Thu 10:15-11:45 (AH 1/6)
- Initial lecture: Tuesday, October 10
- Prerequisites: programming, formal languages, automata
Course *Semantics and Verification of Software*

(Complementary) Techniques

- **Operational semantics:**
  
  \[
  (\sigma') \xrightarrow{c, \sigma} (\sigma''')
  \]

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

- **Axiomatic semantics:**
  \[
  (\sigma') \xrightarrow{c_1 ; c_2} (\sigma''')
  \]

Applications

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

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

- **Software verification** (mathematical proofs of program properties)
Satisfiability Checking

Prof. Erika Ábrahám (and Gereon Kremer)

How to automatically check whether a formula of a given logic is satisfiable?
\[(a \lor b) \land (a \lor \neg b)\]

\[(f(x) = a \land x = y) \implies f(y) = a\]

\[2x + y > 5 \land x + 2y < 5 \quad (x, y \in \mathbb{R})\]

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

\[x^2 + y^2 = z^2 \quad (x, y, z \in \mathbb{R})\]

\[\implies \text{SMT solving}\]
Aspects of SMT solving

Logical foundations
Uninterpreted functions
Bitvectors
Integer problems
Reasons for unsatisfiability
Model generation

SAT solver
Linear arithmetic
Nonlinear arithmetic
Full automation
Applications
Organization

Lectures:
   Monday, 14:15 – 15:45, AH I
   Wednesday, 10:15 – 11:45, AH II
   Starting October 9th

Exercises:
   Usually second half of lecture on Wednesday
   Weekly, not mandatory

Exam requirements:
   At least 50% from five eTests in $L^2P$

Exams:
   First exam: February 21st
   Second exam: March 21st
Bereich 1: Theoretische Informatik

Institute for Computer Science 7

Prof. Dr. Erich Grädel
• Mathematische Grundlagen der Informatik

Prof. Dr. Martin Grohe
• Foundations of Data Science
• Recursion Theory

Dr. Christof Löding
• Infinite Computations and Games
Mathematical Logic II (V4, Ü2)

E. Grädel

Set Theory and Foundations of Mathematics
Gödel's Incompleteness Theorems
Elements of Model Theory
Fixed-Point Logics

Mon  12:15 – 13:45,  I
Wed  12:15 – 13:45,  AH V       Start:  11.10

More Information:
https://logic.rwth-aachen.de/Teaching/MaLo2-WS17
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, Oct.13, AH II

**Further Info:** L2P
Recursion theory (a.k.a Computability Theory) studies the limits of computability in the realm of the uncomputable.

Topics
- Models of Computation and how they relate to one another
- Reductions
- The structure of recursively enumerable (and even less computable) sets
- Computability with objects of higher type (like sets, functions and not just numbers or strings)

First lecture:
Tuesday, Oct.11, 5056

Course will be taught in German!
Course about **automata theory for infinite objects.**

**Topics**

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

**First Lecture**

*Wednesday, Oct. 12, 10:15, (5052 or BS312; see announcements in L2P)*
Bereich 2:

Software und Kommunikation
Prof. Dr. Bernhard Rumpe

- Software Engineering
- Applied Software Engineering within the life cycle of Automotive Electronics
- Practice Workshop

Prof. Dr. Horst Lichter

- Object Oriented Software Construction
Improving software-intensive systems development by identifying...

methods, concepts, tools and infrastructures for

• developing software systems better and faster,
• in order to achieve a high quality product
• in less time while
• incorporating constantly changing requirements in an agile way.

Producing evidence through the development of complex software/systems in different problem domains.
Applied Software Engineering within the life cycle of Automotive Electronics  (V1Ü1, 3 or 6 ECTS with Practice Workshop)

- Dr. Ansgar Schleicher, DSA
- Fr. 08:30 - 10:00 (room 5052)
- **First lecture** on October 13th
- Modern **automotive electronics architecture**: bus systems, control devices, software and their development
- Lifecycles of automotive electronics
- Challenges of service stations
Practice Workshop

- **Practical experience** in the area of Software Engineering
- Workshop + written report (~ 2-3 ECTS)
- For example:
  - Architecting for the Cloud
  - Explanatory videos in MBSE

- Practice Workshop + report can be combined with these lectures:
  - Applied Software Engineering within the life cycle of Automotive Electronics
  - Further lectures (summer term)
  - ... to 6 ECTS modules

- Further information:
Much **more** than programming!
Object Oriented Software Construction

How to apply and combine core object oriented concepts?

How to identify classes based on a systematic analysis?

How can we improve the design of existing applications?

How to model an application domain?

What are components and component models?

How can we combine design patterns and frameworks?
Institute for Computer Science 4

Prof. Dr. Klaus Wehrle
- Advanced Internet Technology
- Communication Systems Engineering

Prof. Dr. Ulrike Meyer
(Bereich 3: Daten und Informationsmanagement)
- IT Security I
- IT Security II
• **Advanced Internet Technology (BSc, MSc Inf./SSE/MI)**
  ▶ Lecture: Tue 12:15 – 13:45 AH 1 + Thu 10:15 – 11:45 AH 1
  ▶ Exercise: Thu 16:15 – 17:45 AH 3 (biweekly)
  ▶ First lecture: Tue 17th October

• **Communication Systems Eng. (BSc, MSc Inf./SSE/MI)**
  ▶ First lecture: Wed 18th October
Lecture: Advanced Internet Technology (AIT)
Lecture: Advanced Internet Technology (AIT)

- Reliability
- Mobility
- Security
- Scalability
- Performance
- Adaptability
Lecture: Advanced Internet Technology (AIT)

Reliability
Mobility
Security
Adaptability

Peer-to-Peer Systems
Scalability
Performance
Quality of Service

Cloud Computing
Cyber-Physical Systems
Internet of Things
Software Defined Networking

Cyber-Physical Systems
Internet of Things
Software Defined Networking
Lecture: Advanced Internet Technology (AIT)

- First lecture on 17th October
- Bachelor & Master
Communication Systems Engineering (CSE)

- **Content of the lecture (3+1 SWS)**
  - Foundations and technologies for the engineering of modern communication systems
    - Communication systems implementation
    - Protocol design patterns, verification and testing
    - Performance Evaluation: local evaluation, simulations, Internet-scale evaluation
• Content of the lecture (3+1 SWS)
  ▶ Foundations and technologies for the engineering of modern communication systems
  - Communication systems implementation
  - Protocol design patterns, verification and testing
  - Performance Evaluation: local evaluation, simulations, Internet-scale evaluation

Lecture: Communication Systems Engineering
- First lecture on 18th October
- Bachelor & Master
Security & Privacy Lunch

- **Extracurricular course**
  - No exam, no credits…
  - … but if you are interested in network security & privacy, just drop in
  - Concept:
    - Bring your own lunch
    - Watching videos of presentations on high-ranked conferences
      (security/privacy) over lunch break
    - Discussing and brainstorming about the contents afterwards

**Each week Thursdays, 12:30-13:15h**

- COMSYS seminar room (Room 9007, E3 Building)
- Starting 12th October 2017
Prof. Dr. Stefan Kowalewski

- Dynamic Systems for Computer Scientists
- Formal Methods for Logic Control Software
Informatik 11 – Embedded Software
Prof. Dr.-Ing. Stefan Kowalewski
<table>
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<tr>
<th>Winter</th>
<th>Dynamic Systems for Computer Scientists</th>
<th>Formal Methods for Logic Control Software</th>
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<td>Summer</td>
<td>(Introduction to) Embedded Systems</td>
<td>Functional Safety and System Dependability</td>
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Dynamic Systems for Computer Scientists (MSc.)

Language: English or German
- English slides
- English exam

Contents:
- Basics from continuous-time systems theory
- Analysis of linear dynamic systems
- Modelling of dynamic systems (mechanical / electrical)
- Basics of control theory
  - Stability
  - Control loop design
- Simulation methods
- Examples in MATLAB/Simulink

First lecture: 16.10.2017

V3/Ü1, 6 ECTS, Master CS

Schedule:
- Monday, 16:15 - 17:45, AH III (2350|314.1)
- Tuesday, 14:15 - 15:45, AH III (2350|314.1)
Formal Methods for Logic Control Software (MSc.)

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

- **Contents:**
  - Introduction to PLCs
  - Dataflow Analysis
  - Abstract Interpretation
  - SAT/SMT-Encodings
  - Software Model Checking
  - Concolic Testing

- **First lecture:** 11.10.2017

- **Schedule:**
  - Wednesday, 14:15 - 15:45, AH VI (2356|051)
  - Friday, 10:15 - 11:45, AH V (2350|050)
Bereich 3:

Daten und Informationsmanagement
Prof. Dr. Ralf Klamma
• Web Science

Prof. Dr. Decker
• Semantic Web
• Big Data Engineering
• Data Driven Medicine
• Technologies for Data Science

Prof. Dr. T. Rose
• eBusiness

Prof. Dr. Jarke
• Implementation of Databases

Prof. Dr. Gerhard Lakemeyer
• Artificial Intelligence
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
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
Implementation of Databases

(V3/Ü1, Jarke/Quix)

Bachelor/Master

Lecture: Tuesdays, 10.15-11.45 (start: Oct. 10)
Thursdays, 14.15-15.45 (bi-weekly)

Exercises: Thursdays, 14.15-15.45 (bi-weekly)

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

- Architectures for DBMS and Big Data Systems
- Query Evaluation and Optimization
- Queries in Big Data & Integrated Systems
- Integrity Checking
- Advanced Transaction Management
- Information Management in the Internet
Web Science
(V3/Ü1, Klamma)
Master

Lecture: Mondays, 14.15-15.45 (start: Oct. 9)
Mondays, 16.00-17.30 (bi-weekly)

Exercises: Mondays, 16.00-17.30 (bi-weekly, start: Oct. 16)

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
Specialization Classes

• Semantic Web
  – Decker, b-it 5053.2, Tuesday 16:15-17:45

• Privacy-Enhancing Techniques for Data Science
  – Decker/Heitmann, b-it 5053.2

• Data-Driven Medicine
  – Decker/Spreckelsen/Beyan, Uniklinik Hörsaal 5, Tuesday, 17:00-18:30

• eBusiness
  – Rose, b-it Building Bonn, Tuesday 9:30-11:00
  – NOTE: offered in Aachen in summer term!

• Some b-it lectures in Bonn not listed here
Research Topics

• Knowledge Representation
  representing and reasoning about action and change

• Cognitive Robotics
  High-level control of mobile robots using logic-based action languages

Applications: Service robotics, Logistics
Service Robotics
Robocup Logistics League
Lecture: Artificial Intelligence

• Introduces basic methods found in AI systems, among them:

• Search, Games, Knowledge Representation, Planning, Uncertainty, Learning, Robotics.

• **Prerequisites:** none.

• Lecture starts Thursday, **October 12, 16:15h**
Bereich 3: Daten und Informationsmanagement

Institute for Computer Science 9

Prof. Dr. Ulrik Schroeder
• Einführung in die Webtechnologien
Learning Technologies
LuFG Informatik 9
Prof. Dr. Ulrik Schroeder

Einführung in Webtechnologien (WebTech1) (V3 Ü2, 6 ECTS)

V:  
  Di. 10:15 – 11:45  AH II
V:  
  Do. 10:15 – 11:45  AH II
Ü:  
  Di. 16:15 – 17:45  9U10

Start V: 12.10.2017
Start Ü: 17.10.2017

Vorlesung: Deutsch
Das Internet ist überall...

Kommunikation (E-Mail, Soziale Netzwerke,...)

Informationen suchen

Spiele

Musik

Reisen buchen

Einkaufen/Verkaufen

Filme
Diverse Webtechnologien ermöglichen im Zusammenspiel dynamische Webapplikationen!
Webtechnologien

...und entwickelt eure eigenen dynamischen Web-Applikationen!

Lernt die Grundlagen der Webtechnologie kennen...
Konzept & Inhalt

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

- Übung
  - Wende das Erlernte direkt in einem kleinen Beispielprojekt an

- Projekt
  - Kombiniere selbst gewählte Technologien in einem eigenen kleinen Web-Projekt
Bereich 4:

Angewandte Informatik
Institute for Computer Science 6

Prof. Dr. Hermann Ney
• Statistical Classification and Machine Learning

Dr. Ralf Schlüter
• Automatic Speech Recognition
Lecture: Statistical Classification and Machine Learning

- Introduction to
  - statistical pattern recognition
  - artificial neural networks and their relation to statistical classifiers
- Main topics:
  - statistical training and machine learning
  - model-free approaches
  - artificial neural networks and discriminative training
  - error integrals: properties and estimation
  - mixture densities and cluster analysis
  - expectation maximization algorithm and hidden Markov models
  - feature extraction and linear transformations
Statistical Classification and Machine Learning

Lectures:
Mon 12.15 – 13.45 Aula 2 Start: 09.10.2017
Wed 10.15 – 11.45 BS 312

Exercises:
Fri 08.30 – 10.00 5055 Start: 13.10.2017

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

www.hltp.rwth-aachen.de/web/Teaching/
Lecture: Automatic Speech Recognition

- **Aim**: extract spoken word sequence from acoustic signal
- 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 10.15 – 11.45 BS 312    Start: 10.10.2017
Thu 10.15 – 11.45 5056

Exercises:
Mon 10.15 – 11.45 5056    Start: 16.10.2017

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

www.hltp.rwth-aachen.de/web/Teaching/
Institute for Computer Science 8

Prof. Dr. Leif Kobbelt
- Basic Techniques in Computer Graphics
- Real-Time Graphics

Prof. Dr. Jan Bender
- Physically-Based Animation

Prof. Dr. Bastian Leibe
- Machine Learning
- Einführung in die Informatik

Prof. Dr. David Bommes
- Discrete Differential Geometry
Basic Techniques in Computer Graphics

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

1st Pass

2nd Pass

3rd Pass

16th Pass
Basic Techniques in Computer Graphics

Lectures
• Tuesdays 10:15, AH V
• Thursdays 12:15, AH III

Tutorial
• Tuesdays 18:15, PPS H2

More Information
• graphics.rwth-aachen.de/course/146/
• This lecture is the basis for all of our advanced courses
Real-Time Graphics - Content (1)
Real-Time Graphics - Content (3)
Real-Time Graphics - Organization

- **Lecture**
  - Tue & Thu, starting 24.10.17
  - 14:15 - 15:45 in AH V
  - 6 ECTS

- **Exercise**
  - Wed, starting 25.10.17
  - 11:45 - 13:15 in AH I
  - Weekly 2-student practical assignments, C++ and OpenGL

- **Exam**
  - 120 minutes, 19.02.18 in Aula 2
  - ≥ 50% of exercise points required
  - ≥ 75% of exercise points for small grade bonus
Lecture: Physically-Based Animation

- Lecturer: Prof. Dr. Jan Bender
- Credits: 6 ECTS credits
- Dates:
  - Lecture: Tuesday, 10:15 – 11:45  E3 Room 9222
  - Lecture/Exercise: Tuesday, 14:15 - 15:45  E3 Room 9222
Physically-Based Animation

- Hair
- Cloth
- Soft Bodies
- Rigid Bodies
- Fluids
- Collision Handling
Computer Vision Group
Prof. Bastian Leibe
Visual Computing Institute

- **Lecture: Machine Learning**
  - Place & Time: Mon 10:15 – 11:45 room UMIC 025
    Thu 14:15 – 15:45 room UMIC 025
  - First lecture Thursday, 12.10.

- **Lecture: Einführung in die Informatik (Service)**
  - Place & Time: Tue 08:30 – 10:00 room AH II
    Tue 15:00 – 16:30 room 5052
    Fri 08:30 – 10:00 room 5054
  - First lecture Tuesday, 10.10.
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
Lecture *Machine Learning* (3V+1Ü)

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
- Mon 10:15 – 11:45, room UMIC 025
- Thu 14:15 – 15:45, room UMIC 025

First lecture Thursday, 12.10.!
[Informationen für die Übergangsfolie]

• [Dozent]: Prof. Dr. David Bommes

• [Name der Lehreinheit]:
  Mesh Generation and Optimization Group

• [Daten der Veranstaltung]:
  Lecture Discrete Differential Geometry (V3Ü1)
    Tuesday  08:30 – 10:00, Rogowski R115
    Thursday 08:30 – 10:00, Rogowski R115 (bi-weekly)

• Exercise:
  Thursday  08:30 – 10:00, Rogowski R115 (bi-weekly)

• Start: Tuesday, October 10th
Mesh Generation and Optimization Group

Prof. Dr. David Bommes
Lecture: **Discrete Differential Geometry**

- Digital Geometry

**Simulation**

**Animation**

[© ANSYS]

[© Pixar]
Lecture: Discrete Differential Geometry

- Digital Geometry
- **Smoothing**
Lecture: **Discrete Differential Geometry**

- Digital Geometry
- Smoothing
- Vector Fields
Lecture: Discrete Differential Geometry

- Digital Geometry
- Smoothing
- Vector Fields
- Parametrization

$f: 3D \rightarrow 2D$
Lecture: Discrete Differential Geometry

- Digital Geometry
- Smoothing
- Vector Fields
- Parametrization
- Distance
Lecture: Discrete Differential Geometry

- Digital Geometry
- Smoothing
- Vector Fields
- Parametrization
- Distance
- Differential Geometry
Lecture: **Discrete Differential Geometry**

- Digital Geometry
- Smoothing
- Vector Fields
- Parametrization
- Distance
- Differential Geometry
- Exterior Calculus
Lecture: Discrete Differential Geometry

- Digital Geometry
- Smoothing
- Vector Fields
- Parametrization
- Distance
- Differential Geometry
- Exterior Calculus
- Discrete
• Come to our lecture if you want to …

• … learn how to correctly work with discrete geometry
• Come to our lecture if you want to …
• … learn how to correctly work with discrete geometry
• … implement the algorithms
• Come to our lecture if you want to …

• … learn how to correctly work with discrete geometry

• … implement the algorithms

• … get an applied and intuition driven introduction to the fascinating world of differential geometry
Institute for Computer Science 10

Prof. Dr. Jan Borchers

- Designing Interactive Systems I
- iOS Application Development
- FABAcademy
Human–Computer Interaction (HCI)

Usability

People!
Designing Interactive Systems I

- Design Thinking
- UI Design
- UI Prototyping
- UI Evaluation

NEW

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

- Design Thinking
- UI Design
- UI Prototyping
- UI Evaluation

Starts next Wednesday (11.10.), 10:00–11:45, room 5053.2a/b

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

Lecture + Seminar + Project

NEW
iOS Application Development
Lecture + Seminar + Project
Starts next Tuesday (10.10.), 10:15–11:45, room 2222
Limited Seats!
Hands-On Personal Digital Fabrication

3D printing, lasercutting, microcontrollers,…

Learn how to make almost anything

In collaboration with M.I.T.

Very limited seats!
Contact: lahaye@cs.rwth-aachen.de
Institute for Computer Science 12

Dr. Christian Terboven
• High Performance Computing

Prof. Dr. Uwe Naumann
• Computational Differentiation

Prof. Dr. Torsten Kuhlen
• Introduction to Virtual Reality
Christian Terboven

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

Simulation results

Quad-Core

need time

Aim: faster execution

270x

50x

Aim: faster execution
Parallel Programming

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 2017/18
  – Parallel computer architectures
  – Parallelization strategies
  – Parallel algorithms
  – Parallel programming

• Outlook SS 2018
  – Lecture: Concepts and Models for Parallel and Data-centric Programming
  – Seminar: Current Topics in High Performance Computing
  – Software Lab: Parallelprogrammierung von Many-Core (geplant)

www.hpc.rwth-aachen.de
contact@hpc.rwth-aachen.de
Computational Differentiation V3/Ü1

Lecture: Friday 10:15 – 11:45 2350|314.1 (AH III)
Tutorial: Tuesday 12:15 – 13:45 2350|056 (5056)
Function given as C code:

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

Numerical differentiation (approximation):

```c
double df_fd(double x) {
    return ((f(x + h) - f(x)) / h);
}
```

Algorithmic differentiation (exact):

```c
double df_ad(double x) {
    double dy = 5 * 2 * x;
    return dy;
}
```
Computational Differentiation V3/Ü1

Computer science

Applied mathematics

Source transformation

C++ operator overloading

Data flow graphs

Numerical optimization

Adjoint methods

Differential equations

LuFG Informatik 12:
Software and Tools for Computational Engineering
Prof. Dr. Uwe Naumann
LuFG i12 Virtual Reality & Immersive Visualization

Lecturers: Prof. Dr. Torsten W. Kuhlen, Dr. Tom Vierjahn

Lecture VR I: **Introduction to Virtual Reality (V3Ü1)**

- **Tuesday** 12:15 - 13:00, AH II
- **Thursday** 12:15 - 13:45, AH VI

**Exercise:** Thursday 15:15 - 16:00, AH VI

**Start:** Tuesday, October 17, 12:15 AH II
• **Goal:**
  – Learn the basics of Virtual Reality and its use in scientific & technical applications!

• **Contents:**
  – Characteristics & History of VR
  – Immersive Displays: Head-Mounted Displays & CAVEs
  – Stereoscopic, egocentric projections
  – Motion Tracking & 3-D User Interfaces
  – Navigation in virtual environments
  – Collision Detection
  – *Computer Graphics* (← VR I is held for multiple study programs)
  – VR in Simulation Science & Medicine
  – Demos in our VR lab
Institute for Computer Science 13

Prof. Dr. Paolo Bientinesi
• Parallel Programming
Objectives

1) Programming shared-memory architectures
2) Programming distributed-memory architectures

- Performance metrics
- Review of computing architectures
- Message Passing Interface (MPI)
- OpenMP
- Patterns of parallel programming

\[ S_p = \frac{T(1)}{T(N)} = \frac{1}{s + \frac{1-s}{N}} \]

Start: **Wednesday, October 11, 12:15**

Programming: \( \pi \), , , , ... Languages: C, English

Followups:
- “High-performance Matrix Computations”
- “Languages for Scientific Computing”
The End

(For a complete view on all lectures this semester, have a look at the campus lecture page)