

Computational Mathematics

Gebhard Böckle

Universität Heidelberg

Interdisciplinary Center of Scientific Computing

Im Neuenheimer Feld 368, 69120 Heidelberg

Email: gebhard.boeckle@iwr.uni-heidelberg.de

Master Scientific Computing

Presentation of areas of specializations

Themes of my research group

1. **Number Theory:**

Galois representations, modular forms, deformation theory.
Computations in commutative algebra and number theory

2. **Algebraic Curves and Arithmetic:**

Function field arithmetic, Drinfeld modular forms, L-functions.
Computations with algebraic curves (L -functions, class fields).

3. **Characteristic p cohomology theories**

(so far) no computational projects

4. **Simplicial topological complexes and group actions:**

Bruhat Tits trees and buildings and their quotients by
arithmetic group (in positive characteristic)

⇒ E.g. effective computations of certain elliptic curves;
computation of invariants in number theory (\mathcal{L} -invariant)

All computations are based on computer algebra packages.

We mainly use Magma, Sage.

Optimal background from Bachelor

1. Abstract Linear Algebra, Basic Topology, Complex Analysis.
2. A one year course in Abstract Algebra:
groups, rings, modules, fields, Galois theory, central simple algebras, representations
3. One of the courses Algebraic Number Theory, Algebraic Curves, Algebraic Geometry.
4. preferably some basic experience with computer algebra systems.

Suggestion for courses in upcoming Winter Term:

- ▶ **Mathematics** (depending on background/interest/language):
Algebraische Geometrie I, Galoiskohomologie, Automorphic Forms.
- ▶ **Computer Science:**
Parallel High-Performance Computing
- ▶ **Seminar:**
Drinfeld modules and class field theory over function fields.
- ▶ **Minor subject in applied Sciences:**
theoretical physics; but other choices are possible.

Prof. Anna Wienhardt; Geometry, geometric structures and visualization

Suggestion for courses in upcoming Winter Term:

- ▶ **Mathematics** (depending on background/interest/language):
Differential Geometry, Geometric Group Theory
- ▶ **Computer Science:**
Formale Sprachen und Automatentheorie
- ▶ **Seminar (one of):**
Differential forms and their use, Lie Algebras
- ▶ **Minor subject in applied Sciences: Physics** E.g. Quantum Field Theories.