Topics for exam

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Exam

- 30 min
- all the chapters are relevant
  (auch FF. mit einigen Stichwörtern)
- style: answering questions + writing down mathematical details
  prepare small presentation of every topic, so you can talk freely for some minutes
  - try to explain ideas to other students
- rather no complete proof but keywords and know how to use it

"Must-knows"

PDE theory

- Classification of PDEs (elliptic, hyperbolic, parabolic) + examples (Poisson eq, wave eq, heat eq)
- Wellposedness (existence, uniqueness, stability)
  - Solving techniques (sep. of variables, meth. of charact)
    how does this work? Not reproducing/computing

first question

how solvable?
what is wellposed?
how consider eq in numerical sense?
go into detail either or
→ Präsentation, die Methode erklärt vorbereiten
Keine Stichwörter einwerfen, zu denen man nichts zu sagen weiß!

FDM derivation of linear system in 1D/2D

- consistency + stability ⇝ convergence
  know roughly how proof works
- convergence results
  which assumptions on u for convergence?
  Compare assumptions between FDM (C^4) to FEM (H^2)
  $\|\cdot\|_\infty$ ↑ max error $\|\cdot\|_{L^2}$ ↑ average error
- Implementation of Dirichlet/Neumann BC
  how to, rather not how it looks like exactly

besser die nahen funktionswerte wichtiger als Max-Norm

sup norm ≈ max norm for continuous fcts

FEM

- classical vs weak solution
- what is/how do you get a weak formulation, derivative
  know exp hat fct: no classical deriv but weak one
  Sobolev space
  fundamental lemma of calculus of variations
  nice to have: know concept of proof
- derivation of linear system from weak derivation
- error analysis: Lemma of Lax-Milgramm

Lemma of Cea, ‘unique solvability → well posedness
Galerkin orthogonality
Interpolation operator

know what these things mean
→ keywords: what, why, advantage
what for, how used

Generally: application of FDM / FEM to easy examples like $-u'' = f$

solving linear systems

- solvers (Jacobi, Gauss-Seidel, CG-Method)
  - ↝ compare them regarding: ↖ picture: geometrical interpretation numerical problem
    - Ansatz / idea of method
    - requirements (e.g. sym)
      - Which methods give matrices, that fulfill these requirements
        - ↝ which solver works for which method, applications
    - computational cost

Proofs: Lemma of Cea
not to technical proofs
know main ideas, keywords (e.g. Taylor)
statements that have a name and that are not too long