Student seminar:
Introduction to Partial Differential Equations

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What is a Partial Differential Equation?

Definition

We call a *k*-th order *partial differential equation* an expression of the form

$$F\big(D^k u(x), D^{k-1} u(x), \ldots, Du(x), u(x)\big) = 0$$

for $x \in U \subset \mathbb{R}$, where $F : \mathbb{R}^{n^k} \times \mathbb{R}^{n^{k-1}} \times \cdots \times \mathbb{R}^n \times \mathbb{R} \times U \to \mathbb{R}$ is a given function and

$$u : U \to \mathbb{R}$$

is the *unknown*.

We can divide this topic into two big "subgroups":

- linear PDE $\rightsquigarrow$ e.g. Laplace, Heat, Schrödinger equations;
- non-linear PDE $\rightsquigarrow$ e.g. Navier-Stokes, Gross-Pitaevskii, Monge-Ampère equations.

Goal: find (or describe) solution of a PDE $\rightsquigarrow$ there is no general rule!

Structure of the seminar

We will follow the books

- Lawrence C. Evans
  Partial Differential Equations
  Graduate Studies in Mathematics,
  AMS

- Walter A. Strauss
  *Partial Differential Equations: An
  Introduction*
  John Wiley & Sons, 2007
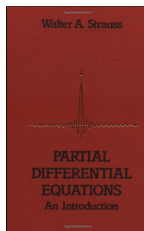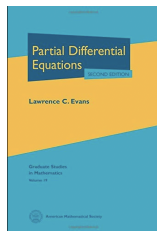
The material covered will be (most likely)

- Important examples of linear PDE's: transport, Laplace, Heat and Wave equations.
- Some topics on non-linear PDE's

Objectives

As a result of the seminar, it would be desirable for the following points to be learned

- How to study a selected topic on PDEs;
- How to present a topic at the blackboard in front of an audience;
- How to organize material from a known topic and prepare a talk;
- How to produce a LaTeX math manuscript from the content studied.

Practical information

- Prerequisites: **Analysis I, II, III**
- **Bachelor and Master** students are welcome!
- Written part: draft a **LaTeX-typed manuscript** to be handed in within 3 weeks of the oral presentation
- Presentation at the **blackboard** in **English**
- **Time and place**: TBA most likely Monday 8.00-10.00
- **Contact** for info: cristina.caraci@math.uzh.ch

Thank you and see you in February!