



# Potential Theory in the Complex Plane

Lecture in the Summer Term 2020

Potential theory is concerned with the study of *harmonic functions*, namely solutions  $f$  of *Laplace's equation*  $\Delta f \equiv 0$ . The origins of this field lie in mathematical physics of the 19th century when it was noticed that harmonic functions play an important role in modeling gravitation and electrostatics. Conceptually, potential theory is very similar to complex analysis where holomorphic functions are the objects of interest. In fact, harmonic and holomorphic functions have equally strong properties, however, the techniques used to study them are often substantially different and each of those theories exhibits its own phenomenas.

There are nonetheless close connections between these important classes of functions, which become visible in the particular case of the complex plane. On the one hand, this makes appear some results about harmonic functions as reflections of corresponding statements about holomorphic functions. On the other hand, these relations shed a new light on complex analysis and give access to new powerful tools, which had some great impact on developments in that area. Among others, this applies to questions about orthogonal polynomials and polynomial approximations of holomorphic functions.

In this lecture, which can be seen as a continuation of the core course *Funktionentheorie*, we want to give an introduction to potential theory with an eye towards its connections to and applications in complex analysis.

**Time and Place: Mondays, 14–16, SR 10, Building E2 4**

The lecture will be accompanied by a bi-weekly exercise session (the date will be fixed later), so that 4.5 ECTS points can be earned.

For further information, please contact Tobias Mai ([mai@math.uni-sb.de](mailto:mai@math.uni-sb.de), room 225 in building E2 4). See also:

<https://www.math.uni-sb.de/ag/speicher/lehre.html>