Introduction to interval computation and numerical verification

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Interval computation means, roughly speaking, solving problems with interval input data. Interval data naturally appear in many practical situations and they range from very tiny intervals (caused by roundoff errors), via medium-sized intervals (e.g., measurement errors, various kinds of uncertainty) to very large intervals (constraint programming or global optimization). In contrast to the stochastic or the fuzzy approach, the paradigm of interval computations is to take into account all possible values from the intervals and to provide mathematically rigorous and numerically safe bounds and various properties checking.

In our lecture, we give some motivating examples first. Then, we introduce the particular problems of interval computation:

(1) Range of a function: enclosures by interval arithmetic, mean value form, slopes.
(2) Interval linear equations: concepts of solutions and their characterization, methods for obtaining enclosures of the solution set.
(3) Other problems from interval linear algebra: regularity testing and others.
(4) Verification: rigorous bounds for the numerically calculated solutions of the standard linear algebraic problems. In particular, we focus on solving linear and nonlinear systems of equations.