

Study the past if you would divine the future (Confucius)

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Timetable: 12 hrs. First lecture on April 5th, 2023, 10:00 (dates already fixed, see Calendar of Activities at <https://dottorato.math.unipd.it/calendar>), Torre Archimede, Room 2BC30.

Course requirements: None

Examination and grading: Reading and analysis of an historical paper (only for PhD students that need credits).

SSD: MAT

Aim: This course is devoted to the study of the historical roots of some ideas and methods used in analysis, numerical analysis and applied mathematics. The themes addressed will also serve as an introduction to research topics.

Course contents:

The scientific context in which some specific methods used in analysis, numerical analysis and applied mathematics appeared will be described and the original works of the mathematicians involved will be studied. Since a mathematical discovery could not be separated from its social and cultural environments, the epoch of each of them will be evoked. Since the life of a mathematician also plays a role in her/his work, we will also present their biography.

The topics covered will be

- A panorama of numerical analysis during the 20th century: Runge-Kutta method, Remez algorithms, Monte-Carlo method, splines, the simplex algorithm, Romberg method, finite elements, QR-algorithm, fractals and chaos, A-stability, fast Fourier transform, singular value decomposition, wavelets, GMRES, etc. (3 hours).
- The method of Cholesky: its origin, Gauss decomposition, the methods of Banachiewicz and others, the discovery of the original manuscript, the family and the life of André Louis Cholesky (1 hour).
- The history of continued fractions: definition and properties, the antiquity and the first steps, the works of Bombelli, Cataldi, Euler, Lambert, Lagrange, Stieltjes and others will be reviewed (2 hours).
- Padé approximants: their history before Henri Padé, his life and his work, the transcendence of the numbers e and π by Hermite and Lindemann, their developments by Borel, Hilbert, and others (1 hour).

- Extrapolation methods from Archimedes to the present days: Snellius, Huygens, Richardson (an independent mind who is the father of fractals), Romberg, Aitken, Steffensen, Shanks, Wynn among others (2 hours).
- The Stein-Rosenberg theorem for relaxation methods: the theorem of Perron and Frobenius, the convergence of the methods of Jacobi and Gauss-Seidel, the lives of Perron, Frobenius, Stein and Rosenberg (1 hour).
- The history of projection methods for solving linear systems: their approaches by linear algebra and by orthogonal polynomials, Krylov subspaces, Lanczos method, the conjugate gradient algorithm, the implementation of the methods, and the lives and work of Lanczos, Hestenes, Stiefel and Fletcher (2 hours).

Claude Brezinski is Professor Emeritus at the University of Lille, France, where he had been the head of the *Laboratory of Numerical Analysis and Optimization* for 30 years. He is the founder and Editor-in-Chief of the journal *Numerical Algorithms*. He was the advisor of 60 Ph.D. thesis in France and in foreign countries. He is the authors of 22 books and 250 research papers. In 1988, he received the Special Prize of the Jury Seymour Cray for his work and, in 2002, he was elected as a foreign member of the Royal Academy of Sciences of Zaragoza, Spain.