MSE | MASTER OF SCIENCE IN ENGINEERING

Autumn Semester 23/24

Module: **Numerical Analysis (FTP_CompAlg)**

In charge of module: **Bernhard Zgraggen, Prof. Dr.**

Location: **Zurich**

Lecturers:

Surname	First Name	FH / UAS	E-mail	Phone	Mobile
Zgraggen	Bernhard	OST	bernhard.zgraggen@ost.ch		

Classroom aids

Required Textbooks (Title & ISBN)	Required Software	Laptop required?
	None required, *Mathematica* may help (optionally)	Not required but maybe helpful

Planning:

Block	Lecturer	Topics
1	Zgraggen	Polynomial Interpolation I-II: Newton's Method of Divided Differences
2	Zgraggen	Polynomial Interpolation I-II cont: An Interpolation Error Formula, The Runge Phenomenon
3	Zgraggen	Polynom-Interpolation III: Hermite Polynomial Interpolation, The Method of Divided Differences with Repeated Arguments, The Interpolation Error Formula rev., Multivariate Polynomial Interpolation
4	Zgraggen	Spline Interpolation I: Natural Splining (cubic), Multi-dimensional Splining (bi-cubic)
5	Zgraggen	Spline Interpolation II: Bernstein-Bézier-Spline-Curves (BB), BB-Surfaces

6	Zgraggen	Linear Least Squares Approximation I: Discrete Data, The Design Matrix & The Normal Equations, Smoothing Data and Numerical Differentiation (-> Savitzky-Golay Filters)
7	Zgraggen	Linear Least Squares Approximation II: Orthogonal Basis, The Gram-Schmidt Procedure, The QR-Matrix Decomposition, The Singular Value Decomposition SVD
8	Zgraggen	Linear Least Squares Approximation III: Orthogonal Polynomial Bases cont., Continuous Linear Least Squares Approximation, Chebyshev Polynomials, Legendre Polynomials, Multivariate Approximation
9	Zgraggen	Error Propagation and Differentials I: Multivariate Differentials and Taylor-Approximation
10	Zgraggen	Error Propagation and Differentials II: Jacobi-Matrix/Determinant (The Jacobian), Computation of a Navigation Error (Example)
11	Zgraggen	Ordinary Differential Equations I (ODE): Initial Value Problems of 1st Order, Explicit Methods by Euler and Higher-Order Taylor Methods , The Global Error, The Local Error, Consistency and Convergence
12	Zgraggen	Ordinary Differential Equations II: The Runge-Kutta Methods, The Butcher Tableau Adaptive explicit Runge-Kutte Methods (e.g. Heun-Euler, Fehlberg, Cash-Karp, Dormand-Prince, Bogacki-Shampine a.s.o.)
13	Zgraggen	Ordinary Differential Equations III: Adaptive Runge-Kutta Methods cont., A-Stability Analysis (Dahlquist), Stiffness Handling
14	Zgraggen	Ordinary Differential Equations IV: Stiffness Handling cont., Systems of ODE, Higher Order ODE, Vector ODE