CPSC 303
Numerical Approximation and Discretization

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CS/ICICS 223

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Tentative course outline

1. Numerical algorithms (Chapter 1)   [Sept. 4, 6]

    (a) Scientific computing

    (b) Roundoff, discretization and convergence errors

    (c) Algorithm properties

2. Roundoff errors (Chapter 2)   [Sept. 9, 11]

    (a) Floating point word and rounding unit

    (b) Roundoff error propagation, rough appearance

3. Polynomial interpolation (Chapter 10)   [Sept. 13, 16, 20, 23, 25, 27]

    (a) General approximation and interpolation

    (b) Monomial and Lagrange forms

    (c) Newton's form and divided differences

    (d) Chebyshev interpolation

    (e) Interpolating also derivative values

4. Piecewise polynomial interpolation (Chapter 11)   [Sept. 30, Oct. 2, 4, 7, 9]

    (a) Broken line and piecewise cubic Hermite

    (b) Cubic spline

    (c) Hat functions and B-splines

    (d) Parametric curve, Bezier polynomials

    (e) * Multidimensional interpolation

5. Orthogonal polynomials and Fourier transform (Chapters 12, 13)   [Oct. 18, 21, 23, 25]

   (a) Orthogonal polynomials

   (b) Continuous and discrete Fourier transform

   (c) Fast matrix-vector multiplication: fast Fourier transform (FFT)

6. Numerical differentiation and integration (Chapters 14, 15)   [Oct. 28, Nov. 1, 4, 6, 8, 13]

   (a) Deriving differentiation formulas

   (b) Roundoff and data errors in numerical differentiation

   (c) Basic quadrature

   (d) Composite numerical integration

   (e) Gaussian quadrature

   (f) Adaptive quadrature

   (g) Richardson extrapolation and Romberg integration

7. Initial value ordinary differential equations (Chapter 16)   [Nov. 15, 18, 20, 22, 25, 27, 29]

   (a) Differential equations

   (b) Euler's method

   (c) Runge-Kutta and multistep methods

   (d) Absolute stability and stiffness

   (e) More advanced concepts and methods