

Math 317 - Numerical Analysis

Tiago Salvador

McGill University

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Welcome to Math 317 - Numerical Analysis

Instructor Info:

- ▶ *Instructor*: Tiago Salvador
- ▶ *Office*: Burnside 1036
- ▶ *Office Hours*: Mon 4:30-5:30pm, Wed 1-2pm or by appointment
- ▶ *Email*: tiago.saldanhasalvador@mail.mcgill.ca (Put "Math 317: ..." in the subject)
- ▶ *Couse Website*: Login to MyCourses

Course TA Matlab

- ▶ *Tutorial TA*: Chris Finlay
- ▶ *Tutorial Hours/Location*: TBA (There will a total of 3 tutorials throughout the semester. More details soon.)

Grading scheme

- ▶ *Assignments*: 20% = 4 assignments \times 5%
 - ▶ submit hard copies only in class
 - ▶ late assignment = zero grade
- ▶ *Midterm*: 20% (Closed book)
 - ▶ Oct 27 during class time
- ▶ *Final*: 60% (Closed book)

Textbook: (Optional)

- ▶ Burden & Faires, *Numerical Analysis*, 9th Edition

Computing resources:

- ▶ MATLAB or other programming languages
(download MATLAB from <https://mcgill.onthehub.com>)

Introduction to Numerical Analysis

Q: What is the course about?

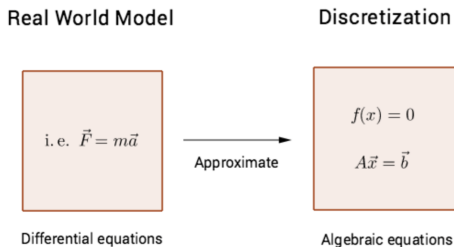
In the real world, many phenomena in science and engineering are modelled by differential equations:

- ▶ Newton's laws of motion ($\vec{F} = m\vec{a}$)
- ▶ Heat equation ($u_t = \alpha \Delta u$)
- ▶ Navier-Stokes equation (fluid mechanics)
- ▶ Maxwell's equations (electromagnetism)
- ▶ many more...

Except for special cases, we often can't find their exact solutions by hand... but we can represent numerically these solutions using computers.

Big Picture

Since computers have finite resources, we can't replicate these models in nature with infinite precision...



Instead, we approximate or "discretize" these models on computers.

Q: What is the course about?

A: Choosing discretization with "good" properties (accuracy, efficiency, stability) is the main theme of the course.

We will discuss:

- ▶ floating point numbers, error propagation
- ▶ approximate solutions to (linear/nonlinear) algebraic equations
- ▶ approximate functions by interpolation
- ▶ approximate derivatives and integrals
- ▶ solving ODEs (initial and boundary value problems)
- ▶ solving PDEs (if time permits)

Real world disaster

On June 4 1996, the Ariane 5 rocket manufactured by European Space Agency exploded 37 seconds after lift off. The cause was a software error which converted a 64-bit floating point number to a signed 16-bit integer.

