MATH471 — Introduction to Numerical methods

Syllabus

Ailin & Manuel — GC (Fall 2025)

1 Presentation

The focus of this course will be the understanding of numerical analysis, that is the study of techniques for solving problems from mathematical analysis using numerical approximations.

In order to fully benefit from this course, students are expected to only conduct and submit their own, personal work.

2 Teaching team

Contact details for the instructor and Teaching Assistants (TAs).

- Manuel (charlem@sjtu.edu.cn)
- Ailin (ailin.zhang@sjtu.edu.cn)
- Zhiyuan (zhiyuan_wang@sjtu.edu.cn)

For information on office hours, refer to Canvas.

3 Schedule

The Fall semester is 14 weeks long, including one week for the finals and one for the national holidays.

Lectures:

- Monday 14:00 – 15:40
- Wednesday 14:00 – 15:40

4 Syllabus

This course splits into two parts, each having been tailored with two main goals in mind:

- Numerical Analysis
  - Become familiar with the rigorous analysis of the most common methods
  - Get solid mathematical foundations to tackle harder problems

- Numerical Methods
  - Understand how to apply numerical methods to solve problems
  - Be able to connect numerical analysis to numerical methods

Hence, at the end of this course, students should be provided with a solid basis for any further study in the field of Numerical Analysis and Numerical Methods; In particular they should have developed the necessary skills to decide on the validity and efficiency of some given solution to a problem, or even formulate a new solution.

These goals are fulfilled through the following course outcomes:

- Understand the mathematics behind numerical analysis (chap. 2)
- Be proficient at using all the basic numerical methods (chap. 3-7)
- Be able to assess the quality of a method (chap. 3,4)
- Know how to perform function interpolation (chap. 3)
- Know the common methods for numerical integration (chap. 4)
- Solve various nonlinear equations numerically (chap. 5)
- Solve various nonlinear optimization problems numerically (chap. 5)
- Solve systems of linear equations numerically (chap. 6)
- Solve eigenvalue problems numerically (chap. 6)
- Find various matrix decomposition numerically (chap. 6)
- Solve various ordinary differential equations numerically (chap. 7)

The first part of the course, instructed by Manuel, will introduce the mathematical tools necessary to address the "Why" and clarify the mathematical roots of Numerical Analysis. The second part of this course, taught by Ailin, focuses on Numerical Methods and explains "How" problems can be solved without considering "Why it works" and "Why an approach is to be preferred over another one".

The detailed organization of this course is given as follows:

Weeks 1–6	**Weeks 7–12**
0. Course information	5. Nonlinear equations
1. (re)view	6. Linear systems
2. A glimpse at pure mathematics	7. Differential equations
3. Polynomial interpolation	
4. Numerical quadrature	
Midterm exam	**Final exam**

5 Grading policy

The final average will be composed of four "sub-grades", apportioned as follows:

- Homework: 20%
- Projects: 25%
- Final exam: 27.5%
- Midterm exam: 27.5%

Any late submission will result in a 10% deduction per day from the grade of the corresponding work. After three days no submission will be accepted.

Any work submitted before the deadline and fully written in LaTeX will be awarded a 10% bonus. Extra marks resulting from this bonus cannot lead a to grade larger than a full grade. This is not the case for other bonuses resulting from extra work, spotting major issues in the slides or assignments.

Algorithms must be written following the guidelines provided during the lectures. Any submission not respecting them will be ignored.

6 Honor code

It is of a major importance for any submitted work to be the result of one own research and understanding. In particular it is not acceptable to reuse the work from another student, or downloaded from the internet. Students can however help each others in an up-building way by sharing ideas and understanding on the course.

If in any case code or details from a textbook or internet is reused, the source should be clearly stated such as not to induce any possible confusion.

According to JI Honor Code copying the work of others will result in **severe penalties**

Exams

Only a single A4 paper sheet with original handwritten notes about the lectures content as well as a simple calculator are allowed during the exams.

Any document, material, or mean of information and communication not explicitly listed above is strictly prohibited. In particular a **non-exhaustive** list of forbidden materials is as follows.

- Lectures slides;
- Homework (questions and answers);
- Notebooks or separate files containing notes;

Group works

Students are fully responsible for the work they submit. In particular in case of plagiarism the whole group will be sent to Honor Council, not only the student who did plagiarize.

Additional notes and remarks

Carefully read and understand the following points.

- Honesty and trust are important. Students are responsible for familiarizing themselves with what is considered as a violation of honor code.

- Assignments/projects are to be solved by each student individually. You are encouraged to discuss problems with other students, but you are advised not to show your written work to others. Copying someone else work is a very serious violation of the honor code.
- Students may read resources on the Internet, such as articles on Wikipedia, Wolfram MathWorld or any other forums, but you are not allowed to post the original assignment question online and ask for answers. It is regarded as a violation of the honor code.
- Since it is impossible to list all conceivable instance of honor code violations, the students has the responsibility to always act in a professional manner and to seek clarification from appropriate sources if their or another students conduct is suspected to be in conflict with the intended spirit of the honor code.

7 General information

Course related materials and tools:

- Course materials: Canvas;
- Software development system: Gitea;
- Software collaboration platform: Mattermost;

The following references and links can be used to find information relevant to the course.

- *Numerical Analysis*, by Burden and Faires.
- *Fundamentals of Engineering Numerical Analysis* by P. Moin, *Introduction to Algorithms* by H. Cormen, C. Leiserson, R. Rivest, and C. Stein;
- *Numerical Methods using MATLAB*, from J. Mathews, and K. Fink, and *Numerical Recipes*, by W. Press, S. Teukolsky, W. Vetterling, and B. Flannery;
- Useful reference related to algorithms: *The Art of Computer Programming*, by D. Knuth.
- The use of meta-search engines and English are highly recommended when searching information online;

To improve communication, please observe the following guidelines.

- Carefully comply with the course communication policies
- Ensure your Canvas email address is set to your SJTU address, **do not change it**.
- When sending an email related to this course include the tag "[MATH471]" in the subject (e.g. `Subject: [MATH471] test email`).
- Never attach a large file ($>$ 2 MB) to an email, use SJTU NetDisk service instead and only include the corresponding link in the email;
- Any student facing a special situation likely to impact his studies, such as serious illness or full time work, is expected to contact the teaching team as early as possible in order to discuss it and see if any solution can be found;
- When contacting a TA for a grade issue or any other major problem send a carbon copy (`cc`) to the instructor. Not doing so might result in omissions, not up-to-date grades etc...If such problem occurs and there is no record of the issue the request will be **automatically rejected**;
- Keep in touch with the teaching team, feedback and suggestions are much appreciated;