Numerical Linear Algebra (Math 442/642)

Instructor: Dr. Scott Sarra
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Textbook: *Numerical Analysis* (2nd Edition) by Tim Sauer, ISBN: 0321783670

Supplemental reading:

- Numerical Linear Algebra, L. N. Trefethen and D. Bau, ISBN 089871487
- Numerical Linear Algebra and Applications, B. Datta. ISBN 978-0-898716-85-6
- Accuracy and Stability of Numerical Algorithms, N. Higham, ISBN 0898715210
- Matrix Analysis and Applied Linear Algebra, C. Meyer, ISBN 0-89871-545-0

Course Learning Outcomes:

After completing the course the student will 1) have gained a deeper understanding of basic concepts from numerical linear algebra that were introduced in MTH 443/643 such as the conditioning of problems and backward error analysis, 2) will be introduced to an important part of more advanced numerical linear algebra - orthogonal numerical linear, 3) will understand how severely ill-conditioned problems can be solved more accurately by using regularization techniques, 5) will have learned how symmetries and other structure of mathematical problems can be used to develop more efficient algorithms, 6) will be exposed to and complete a project in a current research area in numerical analysis, 7) will have gained experience in doing a literature search, 8) will have written a paper that was typeset using LaTeX, 9) will have had the experience of giving a presentation on a mathematical topic, 10) will have gained experience in using mathematical software, and 11) will have experience writing mathematical software.

Prerequisites: MTH 331.

Grading: 70% homework and 30% final project

Class Attendance:

In 400/600 level classes, attendance at every class is expected. Borderline grades will be decided by class attendance and participation.

Homework:

Approximately 6 homework sets will be given in 2 to 3 week intervals. Details of the format in which to submit HW will be given in class.

Computer Programming:

An essential part of Numerical Mathematics is implementing algorithms on a computer. The HW sets and the final project will require some (relatively) simple computer programs to be written. Computer languages that are appropriate for and that are commonly used in scientific computing include Fortran, C/C++, Python, Matlab, and Julia. Python will be the language that is primarily used in class examples. Python is also suggested for use in HW problems and projects since you should be familiar with it from CS 205 (or CS 110) which is a prerequisite to this class. However, any other (appropriate) language of your choice may be used.

Collaboration policy:

Collaboration on HW sets is not only allowed, but is encouraged**.**

Final Project:

The final project is to write a 8 to 25 page paper (typed using LaTeX), surveying an interesting numerical algorithm/topic not covered in the course. The paper should be written for a target audience of your classmates in the course. The paper should include the following: 1) numerical results (produced from computer code that you write) from applying the algorithm to a model problem, 2) proofs of theoretical properties (stability, convergence rate, etc.) of the algorithm and numerical examples illustrating and verifying the properties, 3) a comparison to a competing algorithm for solving the same problem, 4) references (in a bibliography) to published literature (journal articles, books, etc.) that document the development of the method as well as subsequent improvements of the method. The paper will be summarized in a 10 to 15 minute presentation to the class. The project should not be started on until a one page proposal that outlines the work to be done in the project has been approved. The proposal should be submitted and approved no later than the end of the fourth week of class.

Instead of picking a numerical algorithm, the subject of the final project may instead be the subject of a peered reviewed journal publication in the area of numerical linear algebra.

University Policies

By enrolling in this course, you agree to the University Policies listed below. Please read the full text of each policy by going to www.marshall.edu/academic-

affairs and clicking on “Marshall University Policies.” Or, you can access the policies directly by going to http://www.marshall.edu/academic-affairs/?page_id=802