

## **MAS 5145/4990 Applied Linear Algebra/Intro to Matrix Theory** **Class Number 54762, Summer A 2021**

**Book:** G. Strang, *Linear Algebra and learning from data*, ISBN 978-0-692-19638-0

### **Synopsis of the course**

The importance and usefulness of Linear Algebra (LA) in learning and studying abstract math can not be overestimated. Concepts and constructions developed in LA can be traced in almost all other areas of math: Abstract Algebra, Algebraic Topology, Functional Analysis, Differential Equations, Differential Geometry, Optimization Theory, ... The list is long. It is a no surprise than that Linear Algebra is ubiquitous in applications of math to Natural Science, Engineering, and Computer Science. One can approach studying LA abstractly (as they should) developing the theory of vector spaces and linear maps. This approach reveals the astonishing beauty of the subject and prepares the audience to forge their ways into studying abstract math. Applications of LA are usually related to dealing with particular situations: particular vector spaces and linear maps. These situations look much clearer if one knows the abstract setup, but as a rule can be understood quite effectively using particular rather than abstract methods. This leads to a second approach to LA where the vector spaces considered are special, endowed with inner product (dot product), and with preselected (orthonormal) bases in them. Following this approach is attractive for at least two reasons: first, it leads one directly to studying the properties of the linear maps, leaving aside the questions of existence and choice of bases, and second many of the abstract LA construction look much simpler in these particular cases, and having them understood well, one can almost directly generalize them to the abstract cases. This is the approach we are following in our course.

MAS 5145 Applied Linear Algebra presents the theory of matrices (of real and, occasionally, of complex entries) from the point of view of their presentations as products of two or three special matrices (upper and lower triangular, symmetric, orthogonal, non-negative, etc.) or, alternatively, as a sum of several "rank-one" matrices (also with restrictions on their entries). Many of these presentations, in their abstract math disguise are very important in Algebra, Geometry and Topology. But several have striking applications in studying data. Examples of the latter will be given along the way. Traditionally, in undergrad math education matrices, and LA, are related to solving systems of linear equations. In this course too we will pay respect to this topic. Knowledge of, and efficiency in using, basic techniques of getting to the appropriate echelon form of a matrix will be assumed. We will use these to factor out matrices. We will also introduce and discuss the pseudo-inverse of a matrix, so important in numerous applications. In our considerations, we will widely use the fact that a matrix is not just a matrix, but a linear map between vector spaces with chosen bases in them. This will give us the true nature of the matrices, and will allow us give interpretation of the respective matrix presentations (products or sums). The course will closely follow the book cited above in its chapters I-III.

### **Assessment of the progress of the students**

The overall grade will be based on the results from two Turn-in Homework Assignments and a Final Exam. Active participation in class (during lectures and discussions) will affect the overall grade positively as well.

### **Academic Misconduct Statement**

Florida International University is a community dedicated to generating and imparting knowledge through excellent teaching and research, the rigorous and respectful exchange of ideas and

community service. All students should respect the right of others to have an equitable opportunity to learn and honestly to demonstrate the quality of their learning. Therefore, all students are expected to adhere to a standard of academic conduct, which demonstrates respect for themselves, their fellow students, and the educational mission of the University. All students are deemed by the University to understand that if they are found responsible for academic misconduct, they will be subject to the Academic Misconduct procedures and sanctions, as outlined in the Student Handbook.

Academic Misconduct includes: **Cheating** – The unauthorized use of books, notes, aids, electronic sources; or assistance from another person with respect to examinations, course assignments, field service reports, class recitations; or the unauthorized possession of examination papers or course materials, whether originally authorized or not. **Plagiarism** – The use and appropriation of another’s work without any indication of the source and the representation of such work as the student’s own. Any student who fails to give credit for ideas, expressions or materials taken from another source, including internet sources, is responsible for plagiarism.

To learn more about the academic integrity policies and procedures visit [integrity.fiu.edu](http://integrity.fiu.edu) (Links to an external site.)

### **Accessibility and Accommodation**

The Disability Resource Center collaborates with students, faculty, staff, and community members to create diverse learning environments that are usable, equitable, inclusive and sustainable. The DRC provides FIU students with disabilities the necessary support to successfully complete their education and participate in activities available to all students. If you have a diagnosed disability and plan to utilize academic accommodations, please contact the Center at 305-348-3532 or visit them at the Graham Center GC 190.

**Important remark:** The Instructor reserves the right to make any changes he considers academically advisable. Any such changes will be announced in advanced in class or by posting them to the e-mail accounts of the students. The students are responsible to be aware of the changes announced this way.