

BIOE 210: Linear Algebra for Biomedical Data Science Fall 2024

Instructor: Yuan Yang yuany@illinois.edu

Class time and place: MWF 9:00 am – 9:50 am, 1306 Everitt Laboratory.

Teaching assistant: Junxi Yi junxiyi2@illinois.edu

Office hours with professor are scheduled after class by appointment. TA will hold office hours on Wednesdays from 3-4 pm in Room 3213 Everitt Lab. For those need more help with Matlab, this is an opportunity to catch up.

Grader: Divya Bendigeri divya5@illinois.edu

Prerequisites: MATH 231 (calc II), courses in scientific programming & differential eqs (Co-req)

Required Textbooks:

(1) *Linear Algebra: Foundations of Machine Learning* by P.A. Jensen is available free of charge at Canvas course page.

(2) Matlab is required for the course and can be found in webstore (<https://webstore.illinois.edu/shop/product.aspx?zpid=4105>). Off-campus users of Matlab may require a VPN connection. Working with Python on HW assignments is acceptable.

Course Contents and Objectives: BIOE 210 is a core course required for all bioengineering undergraduates. The goal is to introduce students to essential analytical and computational tools from linear algebra. In addition to describing vector and matrix arithmetic, students will solve systems of linear equations. These methods can be applied to analyze large, multivariable datasets to quantify relationships between variables; decompose complex datasets into simpler representations; solve common problems in classification and image processing; and develop a geometric view of high-dimensional data spaces. Course topics include definitions of vector spaces; linear systems; solvability; rank; basis; transformation matrices; and vector & matrix decompositions (eigenanalysis, SVD, PCA). The course focuses on mathematical and computation aspects of problem solving, and consequently requires students to access Matlab. Completing assignments with other array-based scientific computing software, e.g., Python, is acceptable.

Assessments:

Two in-class paper exams (midterm) and one final exams.

Homework sets are assigned through Canvas every week or two. Due dates and times are listed on Canvas. Assignments may include both analytical problems and Matlab-based exercises. Written answers to the analytical problems and your Matlab solutions (including code) must be uploaded to Canvas. Additional details and demonstrations of homework submission will be provided during the first week of class.

Late Homework:

Any work submitted after the deadline will be penalized. The penalty is 50% if submitted within 24 hours of the deadline. Homework submitted more than 24 hours after the deadline will not be scored. Exceptions may be granted if the instructor is informed of the reason for a late submission before the due date and an extension is granted. The submission time for an assignment is the time of the latest submission.

Attendance: Attendance is required (10% of final credit). Late attendance over 15 mins will be considered as missing the class. Numerous problem-solving and coding examples are provided during lectures, which inform the subsequent homework assignments. Each week, after a homework due date, the assigned problems will be worked out during scheduled class time and all questions will be answered.

Grading: Homework 10%, Attendance: 10%, Midterms: 20% x 2, Final: 40%.

A+ >97%	B+ >87%	C+ >77%
A > 93%	B > 83%	C > 73%
A- >89.5%	B- >79.5%	C- >67%

Homework grades are posted on Canvas.

Course Policies

- **Attendance:** Students are expected to attend every class with the exception of pre-authorized absences or unavoidable emergencies. For students who miss the class without a reasonable request or explanation, the final score will be reduced by 1 point per class, up to 10 pts. For students who join the class after the start, the final score will be reduced by 0.5 point per late as well, up to 10 pts. If the late or absent due to an emergency, please reach out to instructor by email before or after the class hours, please don't send any email during the class hours, since that will interrupt the class and other students.
- **Course-related communications:** Course announcements will be sent out to via email or canvas; please check your email and canvas (<https://canvas.illinois.edu/>) regularly. For general course questions and information, please first consult the syllabus. If your question/issue is still not answered/addressed, please email the course instructor at yuan@illinois.edu .
- **Laptops and mobile devices:** Laptops may be used for course-related tasks only (e.g., to take notes or investigate relevant topics, answer polling questions). Mobile phones should be silent and out of sight during class.

Expectations for Students

- Participate throughout each week.
- Consider and respect others' opinions.
- Complete all assignments on time.
- Discuss concerns privately with the instructor.

Expectations for Instructors

- Be available for face-to-face discussion.
- Respond promptly to students' concerns.
- Grade objectively and promptly return graded assignments.
- Endeavor to accommodate differences in students' learning ability.

Academic Integrity

The University of Illinois at Urbana-Champaign Student Code should also be considered as a part of this syllabus. Students should pay particular attention to Article 1, Part 4: Academic Integrity. Read the Code at the following URL: <https://studentcode.illinois.edu/>.

Academic dishonesty will result in a sanction proportionate to the severity of the infraction, with possible sanctions described in 1-404 of the Student Code (<https://studentcode.illinois.edu/article1/part4/1-404/>). Every student is expected to review and abide by the Academic Integrity Policy as defined in the Student Code:

<https://studentcode.illinois.edu/article1/part4/1-401/>. As a student it is your responsibility to refrain from infractions of academic integrity and from conduct that aids others in such infractions. A short guide to academic integrity issues may be found at <https://provost.illinois.edu/policies/policies/academic-integrity/students-quick-reference-guide-to-academic-integrity/>. Ignorance of these policies is not an excuse for any academic dishonesty. It is your responsibility to read this policy to avoid any misunderstanding. Do not hesitate to ask the instructor(s) if you are ever in doubt about what constitutes plagiarism, cheating, or any other breach of academic integrity.

Anti-Racism and Inclusivity

The Grainger College of Engineering is committed to the creation of an anti-racist, inclusive community that welcomes diversity along a number of dimensions, including, but not limited to, race, ethnicity and national origins, gender and gender identity, sexuality, disability status, class, age, or religious beliefs. The College recognizes that we are learning together in the midst of the Black Lives Matter movement, that Black, Hispanic, and Indigenous voices and contributions have largely either been excluded from, or not recognized in, science and engineering, and that both overt racism and micro-aggressions threaten the well-being of our students and our university community.

The effectiveness of this course is dependent upon each of us to create a safe and encouraging learning environment that allows for the open exchange of ideas while also ensuring equitable opportunities and respect for all of us. Everyone is expected to help establish and maintain an environment where students, staff, and faculty can contribute without fear of personal ridicule, or intolerant or offensive language. If you witness or experience racism, discrimination, micro-aggressions, or other offensive behavior, you are encouraged to bring this to the attention of the course director if you feel comfortable. You can also report these behaviors to the Bias Assessment and Response Team (BART) (<https://bart.illinois.edu/>). Based on your report, BART members will follow up and reach out to students to make sure they have the support they need to be healthy and safe. If the reported behavior also violates university policy, staff in the Office for Student Conflict Resolution may respond as well and will take appropriate action.

Disability Related Accommodations

To obtain disability-related academic adjustments and/or auxiliary aids, students with disabilities must contact the course instructor and the Disability Resources and Educational Services (DRES) as soon as possible. To contact DRES, you may visit 1207 S. Oak St., Champaign, call 333-4603, e-mail disability@illinois.edu or go to <https://www.disability.illinois.edu>. If you are concerned you have a disability-related condition that is impacting your academic progress, there are academic

screening appointments available that can help diagnosis a previously undiagnosed disability. You may access these by visiting the DRES website and selecting "Request an Academic Screening" at the bottom of the page.

Family Educational Rights and Privacy Act

Any student who has suppressed their directory information pursuant to Family Educational Rights and Privacy Act (FERPA) should self-identify to the instructor to ensure protection of the privacy of their attendance in this course. See <https://registrar.illinois.edu/academic-records/ferpa/> for more information on FERPA.

Religious Observances

Illinois law requires the University to reasonably accommodate its students' religious beliefs, observances, and practices in regard to admissions, class attendance, and the scheduling of examinations and work requirements. You should examine this syllabus at the beginning of the semester for potential conflicts between course deadlines and any of your religious observances. If a conflict exists, you should notify your instructor of the conflict and follow the procedure at <https://odos.illinois.edu/community-of-care/resources/students/religious-observances/> to request appropriate accommodations. This should be done in the first two weeks of classes.

Sexual Misconduct Reporting Obligation

The University of Illinois is committed to combating sexual misconduct. Faculty and staff members are required to report any instances of sexual misconduct to the University's Title IX Office. In turn, an individual with the Title IX Office will provide information about rights and options, including accommodations, support services, the campus disciplinary process, and law enforcement options.

A list of the designated University employees who, as counselors, confidential advisors, and medical professionals, do not have this reporting responsibility and can maintain confidentiality, can be found here: <https://wecare.illinois.edu/resources/students/#confidential>.

Other information about resources