Linear Algebra and Random Processes

Dept. of Bioengineering, CMC Vellore

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Course Web-page: Please refer to this page for the up-to-date lecture notes and assignments.
https://siva82kb.github.io/teaching/larp/larp.html

What is the course about?

- Introduction to applied linear albegra (LA) and random processes (RP).
- First half of the course focuses on applied linear algebra and matrix theory.
- Second half of the course focuses on fundamental probability theory, statistics and random processes.
- A basic understanding of LA and RP allows one to solve a wide range practical problems that are multi-dimensional and stochastic in nature; LA and/or RP are fundamental to many field of engineering: signal processing, control theory, robotics, machine learning etc.

What to expect from the course?

- Important concepts in applied linear algebra.
- Introduction to probability theory, statistics, and random processes

Course Scoring and Grading

Course Activities

- **Homework assignment** 25%
  Assignments will be provided to the student by the instructor and will be due one week after the assignments are provided. Late submissions will not be evaluated. Assignments will include both regular paper-and-pencil and programming problems. The student is free to use any programming language to solve the problems. You are encourged to work in groups to solve these problems, and learn from each other. But write down your own solutions and do not copy. You are allowed to miss two assignments.
- **Surprize Quiz** 15%
  These will be given throughout the duration of the course. They will be short 10-15 min open book, in-class quizes.
- **Mid-term** 15%
  Take home exam, due the next day. This can include both paper-and-pencil and programming problems. Students are not allowed to discuss among themselves in solving these problems.
- **Final** 45%
  Take home exam, due the two days after it is given. This can include both paper-and-pencil and programming problems. Students are not allowed to discuss among themselves in solving these problems.

Grading policy:No relative grading

A+ : $90 \leq$ Score; **A** : $80 \leq$ Score < 90; **B** : $70 \leq$ Score < 80; **C** : $60 \leq$ Score < 70; **D** : $50 \leq$ Score < 60; **E** : $40 \leq$ Score < 50; **F** : Score < 40;

Policy for academic dishonesty

There will be zero tolerance towards academic dishonesty, and anyone found carrying out such activities will receive an '**F**' grade in the course. Activities such as copying assignments, submitting some else's code, cheating on quizzes and exams etc. are considered academically dishonest behavior.

References

1. G Strang, *Introduction to linear algebra*. Wellesley, MA: Wellesley-Cambridge Press, 1993.
2. CD Meyer, *Matrix analysis and applied linear algebra*. Siam; 2000 Jun 1.
3. S Boyd and L Vandenberghe, *Introduction to Applied Linear Algebra – Vectors, Matrices, and Least Squares* . Online book
4. Papoulis, Athanasios, and S. Unnikrishna Pillai. Probability, random variables, and stochastic processes. Tata McGraw-Hill Education, 2002.
5. Kay, Steven. Intuitive probability and random processes using MATLAB®. Springer Science & Business Media, 2006.

Other Resources

1. Online course on *Linear Algebra* by G Straing at MIT OCW. Course Link
2. Online course on *Linear Dynamical Systems* by S Boyd. Course Link

Course Content

1. Vectors
2. Matrices
3. Orthogonality
4. Matrix Inverses
5. Eigenvectors and Eigenvalues
6. Positive Definiteness and Matrix Norms
7. Singular Value Decomposition
8. Least Squares Methods
9. Experiments, Sample Spaces, and Probability
10. Random Variables and Probability Distribution
11. Transformations and Expectation of Random Variables
12. Multiple Random Variables
13. Random Processes
14. *Statistical Estimation