Introduction to Probability and Linear Algebra (CS-723)

Instructor: Saketh

1 Goals, Scope and Syllabus

This course introduces the student to various fundamental concepts in probability theory and linear algebra. The knowledge of such mathematical tools is essential in various fields of computer science like Machine Learning, Communication Networks, Performance Modeling, Computer Graphics and Vision etc. Though the treatment of the subject is mathematical, focus is more on the problem solving techniques rather than on the formalism. The syllabus is also tuned based on the needs of computer science:

1. Introduction to probability

   - Classical and axiomatic probability, probability spaces, conditional probability and independence

2. Random variables

   - definition, common examples, multivariate random variables, moments and moment generating functions, functions of random variables, conditional expectation

3. Sequences of random variables

   - Convergence and central limit theorem

4. Introduction to random processes

   - Markov chains and characterization

5. Topics in statistics

   - Hypothesis testing, concentration inequalities

6. Introduction to linear algebra

   - Vectors, vector spaces, bases, dimensionality and orthogonality, matrices, fundamental subspaces of matrix, rank-nullity theorem

7. Spectral decompositions

   - Eigen value and singular value decompositions, applications

8. Properties of matrices

   - Special matrices, norms and determinants

Reference text books for this course are: [2, 5, 3, 4, 7, 8]. Also, the following video lecture series (available online) provide good insights into the subject [6, 1].

2   Evaluation Scheme

The grades (relative grading) will be decided based on the overall marks obtained in:

S.No.	Exam	Weightage	Date
1.	End-Semester	40%	16th-28th Nov'10
2.	Mid-Semester	20%	11th-18th Sep'10
3.	Two Quizes	10+10%	$\sim 20^{th}$ Aug'10,$\sim 15^{th}$ Oct'10
4.	Assignments	20%	Bi-Weekly

3   Contact

The course page is at http://www.cse.iitb.ac.in/saketh/teaching/cs723.html. Office hours for the course are Wed 3:00-5:00pm. During these hours the instructor will be available in his office (No. 306, Kanwal Rekhi Building) for clarifying specific queries that the students may have. The instructor can be contacted via phone: x7903 or email: saketh at cse anytime.

References

[1] Mrityunjoy Chakraborty. Probability and Random Processes Lecture Videos. Available at http://nptel.iitm.ac.in/video.php?courseId=1056&p=1.

[2] A. Papoulis and S. U. Pillai. *Probability, Random Variables, and Stochastic Processes*. Tata Mc-Graw Hill, 4 edition, 2002.

[3] S. M. Ross. *A First Course in Probability*. Pearson Education, 6 edition, 2002.

[4] S. M. Ross. *Introduction to Probability and Statistics for Engg. and Scientists*. Academic Press, 3 edition, 2004.

[5] S. M. Ross. *Introduction to Probability Models*. Academic Press, 9 edition, 2006.

[6] Gilbert Strang. Linear Algebra Lecture Videos. Available at `http://web.mit.edu/18.06/www/Video/video-fall-99.html`, 2000.

[7] Gilbert Strang. *Linear Algebra and its Applications*. Cengage Learning, 4 edition, 2006.

[8] Gilbert Strang. *Introduction to Linear Algebra*. Wellesley Cambridge Press, 4 edition, 2009.