EE 126 Probability and Random Processes: Course Syllabus

1 Administrative Info

- **Instructor**: Prof. Kannan Ramchandran, 269 Cory Hall, `kannanr@eecs.berkeley.edu`
- **Lectures**: Tue/Thu, 9:30 - 11:00 am, 241 Cory Hall
- **GSIs**:
  - Kangwook Lee, 264 Cory Hall, `kw1jjang@eecs.berkeley.edu`
  - Ramtin Pedarsani, 264 Cory Hall, `ramtin@eecs.berkeley.edu`
  - Rishi Sharma, `rsh@berkeley.edu`
  - Sahaana Suri, `sahaana.suri@eecs.berkeley.edu`
  - Note: All emails that do not start with **'[EE126]' followed by a space** will not be responded.
  - **Discussions**:
    - Kangwook and Ramtin will hold each week's discussions alternatively.
    - Section 101: Wed, 3:00 - 4:00 pm, 521 Cory Hall
    - Section 102: Wed, 10:00 - 11:00 am, 521 Cory Hall
  - **Office Hours**:
    - Kannan Ramchandran: Tue, 11:00 am - 12:00 pm, 212 Cory Hall
    - Kangwook Lee: Mon, 4:00 pm - 5:00 pm, 531 Cory Hall
    - Ramtin Pedarsani : Wed, 4:00 am - 5:00 pm, 531 Cory Hall
  - **Homework Parties**:
    - Rishi Sharma and Sahaana Suri will hold homework parties.
    - HW Party#1: Mon, 6:30 pm - 8:00 pm, Cory 540A/B
    - HW Party#2: Tue, 6:30 pm - 8:00 pm, Cory 540A/B
  - **Course Website**: bCourses / Piazza

2 Course Info

- **Description**: Probability is a mathematical discipline that allows one to reason about uncertainty: it helps us to predict uncertain events, to make better decisions under uncertainty, and to design and build systems. Throughout the course, we will teach you the fundamental ideas of probability and random processes along with the mini-labs. The hands-on assignments are carefully designed so that they prove how the mathematical concepts can be used to design and build modern systems in many engineering fields: communication systems and networks, signal processing systems, and control systems.
- **Textbooks** :
  - (BT) Dimitris P. Bertsekas and John N. Tsitsiklis, Introduction to Probability, 2nd Edition, Athena Scientific, 2008.
  - (W) Jean Walrand, Probability in Electrical Engineering and Computer Science: An Application-Driven Course, 2014. (e-book available)
- **Course Outline**: The course consists of 4 modules as follows.

1. M1. The fundamentals of Probability / 4 weeks / Main reference : BT
   - Labs: Intro. to Python, Insurance for Cloud Storage, Multimedia Compression and Transmission
   - Discrete Random Variables, Continuous & General Random Variables
   - Random Vectors
   - Function of Random Variables
   - Expectation, Variance, Cond. Expectation
   - Bounds: Jensen, Markov, Chebyshev, Chernoff
   - Law of large numbers, Central limit Theorem: Confidence Interval, Multiplexing
2. M2. Random Processes / 3.5 weeks / Main reference : BT & W
   - Labs: Search Engines (PageRank), Reliability of Cloud Storage, Latency in Data Centers
   - Discrete Markov Chains - PageRank
   - LLN for Markov Chains
   - Poisson Process
   - Continuous Markov Chains & Queues
   - Random Graphs
3. M3. Inference / 3 weeks / Main reference : BT & W
   - Labs: Comp-Bio (DNA and RNA sequencing)
   - Detection & Bayes Rule
   - Neyman-Pearson Theorem
   - Estimation
   - LLSE, MMSE
   - Hiden Markov Chain
   - Expectation Maximization & Clustering
4. M4. Advanced Materials and Other Applications / 2.5 weeks / Main reference : BT & W
   - Proof of LLN & CLT
   - Proof of Big Theorem
   - Other applications

3 Grade / Homework / Discussion Forum / Exams / Schedule

- **Course Grading** : Homework assignments (15%), midterm 1 (20%), midterm 2 (25%), and final exam (40%)
- **Homeworks**
  - Weekly homeworks will be assigned every Thursday, and must be submitted by **9am of the following Thursday.** as **a PDF file for the theory part and an ipynb file for the mini-lab part**.
  - Homeworks, solutions, and general announcements will be posted on bCourses.
  - Each homework should be self-graded and the self-graded score should be submitted online by **5pm of the following Monday.** For detailed description of self-grading policies, please refer Section 4.
  - We will automatically drop 2 homeworks with the lowest scores.
  - **No late submission or self-graded score accepted.**
  - Any homework that is hard to read gets 0 score.
- **Discussion Forum**
  - We will be using Piazza for class discussion only. Rather than emailing questions to the GSIs, we encourage you to post your questions on Piazza. GSIs will answer some of unresolved questions on the forum on every Monday and Wednesday. Find our class page at: https://piazza.com/berkeley/fall2014/ee126/home
- **Midterms**
  - Midterm 1: Tuesday, September 23, 6-8pm, Location: 390 Hearst Mining Hall & 101 Morgan Hall

- Midterm 2: Thursday, November 13, 6-8pm, Location: 245 Li Ka Shing
- Final exam: Tuesday, December 16, 3-6pm

- **Course Schedule (subject to change)**

w	Materials
1	Probability Space, Conditional Probability, Bayes' Rule, Independence, Counting / Discrete RVs(prob. mass functions), Expectation and Variance, Joint PMF
2	Conditioning and Independence, General RVs, CDFs and Normal random variables
3	Joint PDFs and conditioning, Covariance, Transforms
4	Transforms (cont.), Chebyshev, Weak Law of Large number, Central Limit Theorem, Midterm # 1 (Tuesday evening)
5	Review and Applications, Bernoulli Processes
6	Discrete Time Markov Chains
7	Poisson Processes, Continuous Time Markov Chains
8	Continuous Time Markov Chains, Review and Applications
9	Detection, Bayes' Rule
10	Neyman-Pearson Theorem
11	Estimation, LLSE, MMSE, Holiday (Tue)
12	Hidden Markov Chains, Midterm# 2 (Thursday evening), Viterbi Algorithm
13	Expectation Maximization, Clustering
14	Thanksgiving (Thur), Speech Recognition
15	Applications, Review (Thur), RRR (Tue)

4 Homework policy

- **Collaboration**: Discussions about homeworks are allowed and encouraged, but each student is expected to write his/her own solutions.

- **Self-Grading**: Students should make a photocopy of each assignment for self-grading and future reference. One copy will be turned online by the due date. The solutions will then be posted on bCourses on the same day, and the students will use the second copy to grade their own assignment.

  You can earn one of 4 possible scores for a problem: `0`, `1`, `2`, and `3`. If your solution is entirely correct, you get `3` point. If your solution is more than 66% correct on a single-part problem, or if you solve at least two thirds of the parts entirely correctly for a multi-part problem, you get `2` point. If your solution is more than 33% correct on a single-part problem, or if you solve at least one third of the parts entirely correctly for a multi-part problem, you get `1` point. Otherwise you get `0` for the problem.

  We sample and grade the submitted copies and check for inconsistencies with the self-graded scores. Please note the department policy on academic dishonesty: `http://www.eecs.berkeley.edu/Policies/acad.dis.shtml`

- **Submission of Homework and Self-graded score**: For each homework, one has to submit both a PDF file for the theory part and an ipynb file for the mini-lab part through bCourses. After grading each assignment based on a posted solution, students will submit their score through online. Self-graded score has to be submitted via Google Forms, of which link will be provided with each solution.