CSc 217 Probability and Statistics for Computer Science

The City College of New York

Grove School of Engineering

Department of Computer Science

Key	Value
Instructor:	Alex Washburn
Email:	teaching@recursion.ninja
Section:	CSc 21700/55291
Semester:	Fall 2023
Credit Hours:	3 credits
Textbook:	*"Probability and Statistics for Computer Scientists"* 2nd Ed, Baron
Format:	In-person
Room:	NAC 7/227
Time:	Tuesday & Thursday 2:00pm - 3:15pm
Office Hours:	Tuesday 1:00pm - 2:00pm or by appointment
Zoom Info:	Zoom Meeting ID: `743 2040 5246` Passcode: `0xC217FA11`
Course Page:	github.com/recursion-ninja/Course-CSc-21700-2023-Fall

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Course Description

> Project course in which students work as leaders or members of project teams. Individual oral presentations and written reports. Overview of applicable discrete and stochastic foundations: combinatorics, probability, and Monte Carlo. Introduction to modeling formalism with examples from numerical and logical processes. Simulation languages such as R are demonstrated. Student projects entail simulations of physical or social science problems. Emphasis on student presentations with statistical analysis and visual summaries.

The course can be thought of having three phases. The first phase comprises an introduction to the mathematical foundations of probability theory. Here students are introduced to concepts relevant in the application of probability theory in computer science. These concepts will be reienforce through mathematical homework assignments and this phase will conclude with the first midterm. The second phase builds upon the concepts of the first by introducing many common probability distributions. Students gain an understanding as to when different distributions relate to real world phenomona. This understanding will be gained through working with distributions in homework programming assignments. The second phase concludes with the second midterm. The final phase consists of a group project applying the techniques developed in the prior two phases.

As the course progresses throughout the semester, the three phases of the course transition from pure mathematical theory to the technical practice of programming. The table below loosely conceptualizes this transition.

Phase	Theory	Practice
Foundations	1	0
Distributions	$\frac{1}{2}$	$\frac{1}{2}$
Actualizations	0	1

List of Topics:

1. Probability, Basic definitions:
    - Probabilistic models
    - Sample space
    - Probability Axioms
    - Discrete uniform law
    - Countable additivity axiom
2. Conditional Probability
    - Bayes'rule
    - Independence
    - Multiplication rule

- Total Probability Theorem
- Independence vs. Pairwise Independence

3. Principles of Counting
    - Discrete Uniform Law
    - Basic Counting Principle – Combinations
    - Binomial Probabilities
4. Discrete Random Variables
    - Random Variables
    - Probability Mass Function(PMF) – Geometric PMF
    - Binomial PMF
    - Expectation and variance
    - Properties of Expectations
5. Discrete Random Variables and Conditional Probabilities
    - Conditional PMF
    - Conditional Expectation
    - Conditional Variance
    - Total Expectation Theorem
    - Expectation of Geometric Distribution
    - Joint PMFs
    - Joint PMFs: Conditional Probability
    - Independence of Random Variables
    - Independent Random Variables and Expectation; Independent Random Variables and Variance
    - Binomial Mean and Variance, Hat Problem
6. Continuous Distributions:
    - Probability density
    - Mean and Variance
    - Cumulative distribution function, Mixed distributions
    - Gaussian (normal) PDF
    - Calculating normal probabilities – Joint PDF
    - Joint Expectation
    - Independence
    - Conditioning
7. Introduction to Statistics:
    - Data Representation
    - Population vs Sample – Sample statistics
    - Law of large numbers – Sampling Distribution – Normal Population
    - Central Limit Theorem – Z-scores
    - Confidence Intervals

Course Schedule

Tuesday	**Thursday**	Tuesday Activities	Thursday Activities
08/29	08/31	Topic 1, Syllabus	Topic 1
09/05	09/07	Topic 2, **Homework № 1**	Topic 2
09/12	09/14	Topic 2, **Homework № 2**	Topic 3
09/19	09/21	Topic 3, **Homework № 3**	Topic 3
09/26	09/28	**Homework № 4**	**Midterm I**
10/03	10/05	Topic 4	Topic 4
	10/12		Topic 5
10/17	10/19	Topic 5, **Program № 1**	Topic 5
10/24	10/26	Topic 6, **Program № 2**	Topic 6
10/31	11/02	Topic 7, **Program № 3**	Topic 7, **Skill Survey**
11/07	11/09	**Program № 4**, **Midterm II**	Project grouping
11/14	11/16		**Proposal Presentation**
11/21			
11/28	11/30		**Progress Report № 1**
12/05	12/07		**Progress Report № 2**
12/12	12/14		**Final Presentation**, **Peer Survey**

Due Dates

Assignments are submitted through BlackBoard and are due at `11:59PM` on the date specified below.

Date	**Day**	**Assignment**
09/05	Monday	Problem Set № 1
09/12	Monday	Problem Set № 2
09/19	Monday	Problem Set № 3
09/26	Monday	Program Set № 4
10/17	Monday	Program Lab № 1
10/24	Monday	Program Lab № 2
10/31	Monday	Program Lab № 3
11/07	Monday	Program Lab № 4
11/07	Monday	Skill Survey
11/16	Wednesday	Project Proposal
11/23	Wednesday	Project Report № 1
11/30	Wednesday	Project Report № 2
12/14	Wednesday	Presentation
12/17	Sunday	Peer Survey

Assignments

Grade	Score Earned
A	>= 90%
B	>= 80%
C	>= 70%
D	>= 60%
F	< 60%

The letter grade earned by a student will be *at least* what is described in the table above. A plus or minus to a letter grade may be determined by the relative performance of the student to their peers in the course, their participation in helping peers in other teams with technical problems, and the peer comment surveys at the end of the semester.

The score earned by a student will be dertermined by five broad assessments of equal weight (20%).

Mathematical Problem Sets

Course Component	Weighted Score
Problem Set № 1	5%
Problem Set № 2	5%
Problem Set № 3	5%
Program Set № 4	5%

Students will submit 4 homework assignment designed to tests a students understanding of probability theory.

Programming Lab Practica

Course Component	Weighted Score
Program Lab № 1	5%
Program Lab № 2	5%
Program Lab № 3	5%
Program Lab № 4	5%

Students will work through 4 programming assignments; each of these will be structured as a lab practicum. To complete the a practicum, students will follow guided instructions to produce a program or simulation demonstrating applications of probability.

Miderm Examination 1

Course Component	Weighted Score
Midterm № 1	20%

Midterms will be proctored in-person during standard class time.

Miderm Examination 2

Course Component	Weighted Score
Midterm № 2	20%

The second midterm will have the same format as the first midterm.

Group Project

Course Component	Weighted Score
Skill Survey	2%
Project Proposal	2%
Progress Report № 1	2%
Progress Report № 2	2%
Final Presentation	10%
Peer Comment	2%

There will be a group project during the last third of the semester, comprising five weeks. The group project can be subdivided into three phases:

1. **Planning** *(1 week)*
    - Students will be organized into project teams
    - Teams will develop and present a project proposal
    - Students will pitch potential project ideas for the semester
2. **Development** *(3 week)*
    - Each week on *Tuesdays:*
        - The scheduled class period will be reserved for teams to collaborate independently
        - The instructor will be available during the scheduled class period for consultation on technical difficulties with projects
        - The instructor will *also* be available during office hours immediately *after* the scheduled class period
    - Each week on *Thursdays:*

  - Each team member will present their *completed* contibutions to the project since the *last* week
  - Each team member will present their *planned* contibutions to the project for the *next* week
  - Teams will have an opportunity to ask questions and solicit feedback from the instructor and their peers in other teams regarding issues with their project

3. **Conclusion** *(1 week)*

   - Teams will present their Project Presentation at the end of December
     - Teams must submit a script / slides of their presentation *before* class begins on 12/14
     - Each team member must present an aspect of the project
     - The presentation should demonstrate the final and complete functionality of the project
   - Team members will submit a confidential Peer Comment survey describing their experience working with their peers.

Project Reporting

Each week students will report on the progress of their product. *Each* student is expected to report on the contributions they made since the *last* product report, and state their planned contributions to complete for the *next* project report. After team members have reported on their recent and tenetive contributions, the floor will be opened up for any team member to solicit assistance or feedback on one or more technical issues they are experiencing. The instructor or their peers will attempt to provide them with assistance addressing their issue(s). Students who can provide guidance to members of another tem will be given additional consideration on their project reporting for that week.

Standard Information

Academic Violations

City College regards acts of academic dishonesty (e.g., plagiarism, cheating on examinations, obtaining unfair advantage, and falsification of records and official documents) as serious offenses against the values of intellectual honesty. The college is committed to enforcing the CUNY Policy on Academic Integrity and will pursue cases of academic dishonesty according to the City College Academic Integrity Procedures. Special attention is given to CONTRACT CHEATING (this is where students have work completed on their behalf which is then submitted for academic credit).

Computer Science Facilities & Labs

All computer science students can use any of the general-purpose labs throughout City College. In addition, computer science majors and students enrolled in CSci courses can an obtain an account on the Computer Science Department Network. More information can be found on the Computer Science Department's website.

Counseling & Wellness Services

Counseling & Wellness Services (CWS) provides mental health, health and wellness services aimed at enhancing students' quality of life and maximizing personal and academic growth and development. More information can be found on the Counseling & Wellness Services website.

Special Needs

Students with special needs should see me for accommodation.

Sexual Misconduct

In compliance with the CUNY Policy on Sexual Misconduct, City College reaffirms the prohibition of any sexual misconduct, which includes sexual violence, sexual harassment, and gender-based harassment retaliation against students, employees, or visitors, as well as certain intimate relationships. Students who have experienced any form of sexual violence on or off campus (including CUNY-sponsored trips and events) are entitled to the rights outlined in the Bill of Rights for City College.

a. Sexual Violence: Students are strongly encouraged to immediately report the incident by calling 911, contacting NYPD Special Victims Division Hotline (646-610-7272) or their local police precinct, or contacting the College's Public Safety Office (212-650-7777).

b. All Other Forms of Sexual Misconduct: Students are also encouraged to contact the College's Title IX Campus Coordinator, Diana Cuozzo (jtrose@hunter.cuny.edu or [212-650-7330][phone-cuozzo]) and seek complimentary services through the Counseling and Wellness Services Office. CUNY Policy on Sexual Misconduct Link:

http://www.cuny.edu/about/administration/offices/la/Policy-on-Sexual-Misconduct-12-1-14-with-links.pdf

Legal Considerations

ADA Compliance

In compliance with the American Disability Act of 1990 (ADA) and with Section 504 of the Rehabilitation Act of 1973, City College is committed to ensuring

educational parity and accommodations for all students with documented disabilities and / or medical conditions. It is recommended that all students with documented disabilities (Emotional, Medical, Physical and / or Learning) consult the Office of Accessibility located in North Academic Center, Room 1/218 to secure necessary academic accommodations. For further information and assistance please call (212-650-8441)/TTY (212-650-5913).

Family Educational Rights and Privacy Act (FERPA)

The Family Educational Rights and Privacy Act (FERPA) (20 U.S.C. § 1232g; 34 CFR Part 99) is a Federal law that protects the privacy of student education records. The law applies to all schools that receive funds under an applicable program of the U.S. Department of Education.

FERPA gives parents certain rights with respect to their children's education records. These rights transfer to the student when he or she reaches the age of 18 or attends a school beyond the high school level. Students to whom the rights have transferred are "eligible students."

- Parents or eligible students have the right to inspect and review the student's education records maintained by the school. Schools are not required to provide copies of records unless, for reasons such as great distance, it is impossible for parents or eligible students to review the records. Schools may charge a fee for copies.
- Parents or eligible students have the right to request that a school correct records which they believe to be inaccurate or misleading. If the school decides not to amend the record, the parent or eligible student then has the right to a formal hearing. After the hearing, if the school still decides not to amend the record, the parent or eligible student has the right to place a statement with the record setting forth his or her view about the contested information.
- Generally, schools must have written permission from the parent or eligible student in order to release any information from a student's education record. However, FERPA allows schools to disclose those records, without consent, to the following parties or under the following conditions (34 CFR § 99.31):
  - School officials with legitimate educational interest;
  - Other schools to which a student is transferring;
  - Specified officials for audit or evaluation purposes;
  - Appropriate parties in connection with financial aid to a student;
  - Organizations conducting certain studies for or on behalf of the school;
  - Accrediting organizations;
  - To comply with a judicial order or lawfully issued subpoena;
  - Appropriate officials in cases of health and safety emergencies; and
  - State and local authorities, within a juvenile justice system, pursuant to specific State law.

Schools may disclose, without consent, "directory" information such as a student's name, address, telephone number, date and place of birth, honors and awards, and dates of attendance. However, schools must tell parents and eligible students about directory information and allow parents and eligible students a reasonable amount of time to request that the school not disclose directory information about them. Schools must notify parents and eligible students annually of their rights under FERPA. The actual means of notification (special letter, inclusion in a PTA bulletin, student handbook, or newspaper article) is left to the discretion of each school.

For additional information, you may call 1-800-USA-LEARN (1-800-872-5327) (voice). Individuals who use TDD may use the Federal Relay Service.

Or you may contact us at the following address:

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Family Policy Compliance Office
U.S. Department of Education
400 Maryland Avenue, SW
Washington, D.C. 20202-8520
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