CS 530 - Mathematical Foundations in Computer Science

Spring 2020

Course Description

This course covers the mathematical foundations of Computer Science focusing on basic mathematical structures, mathematical logic and probability theory. It is designed to provide students with proficiency in applying these concepts to problem solving and formal reasoning. To achieve this, the course provides students with significant hands-on practice with the use of computational tools.

Instructor

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Class

Innovation Hall, Room 134
Wednesday, 7:20 PM - 10:00 PM (see exceptions below)

Prerequisites

- MATH 125 or INFS 501
- STAT 344

Text Books

1. *Mathematics for Computer Science* by E. Lehman, F.T. Leighton and A.R. Meyer; see https://courses.csail.mit.edu/6.042/spring18/mcs.pdf, or the full text on the Blackboard
2. Problems with Solutions (MIT Course 6.042)
    a. 2010 Fall - https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-042j-mathematics-for-computer-science-fall-2010/exams/
        i. Midterm practice problems
        ii. Midterm
        iii. 2004 final exam
        iv. 2006 final exam
        v. 2008 final exam
    b. 2005 Fall - https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-042j-mathematics-for-computer-science-fall-2005/exams/
        i. Practice Quiz 1
        ii. Quiz 1
        iii. Quiz 2
        iv. Final Exam
3. Supplemental materials:
    a. Lecture Notes on Mathematical Logic by Vladimir Lifschitz (https://www.cs.utexas.edu/users/vl/teaching/388Lnotes.pdf)
    b. Probability course notes by Richard Weber (http://www.statslab.cam.ac.uk/~rrw1/prob/prob-weber.pdf)

Grading

- 5 Homeworks (5 points each) - 25%
- Midterm exam (35 points) - 35%
- Final exam (40 points) - 40%
- Bonus points:
    - Class participation - 3
    - Midterm exam - 3
    - Final exam - 4

A+: 100+; *A*: [93, 100); *A*-: [88, 93); *B*+: [83, 88); *B*: [78, 83); *B*-: [73, 78); *C*: [65, 73); *F*: [0,65)

Bonus Points

- Class Participation
  - Students are strongly encouraged to participate in lectures by asking and answering questions, and taking part in discussions.
  - One bonus point is awarded for providing a correct answer to a question posed by the instructor.
  - One check mark is awarded when a student is active in one class by trying to answer questions. Three check marks result in one bonus point.
  - In one class, you may earn a maximum of 1 point and 1 check
- Exams
  - Additional points are awarded for answering one problem of extra complexity. Students are advised to attempt such problem after trying all other questions.

Exercises

- Suggested exercises are posted in the schedule below
- In cases when solutions are not available, students are encouraged to cooperate with other students using Piazza (see below)
- Additionally, answers to homework assignments and the midterm exam will be discussed in class

Tentative Schedule

Date	**Topic**	**Test**
Jan 22	Foundations 1. Proofs, Sets, Relations. Sections: 1.3, 1.6, 1.8, 2.1, 2.2, 4.1, 8.3, 4.3, 4.4. Problems: 1.12, 1.13, 1.14, 1.16, 4.1, 4.3, 4.14, 4.16, 4.20 (text 1); 3 (text 2.b.i)	
Jan 29	Foundations 2. Induction. Sections: 5.1, 5.2, 7.1. Problems: 5.1, 5.3, 5.4, 5.5, 5.7, 5.8, 5.18, 5.19, 5.31, 7.2, 7.3, 7.4a, 7.8, 7.9, 7.12 (text 1); 2 (text 2.a.i); 6.b (text 2.b.iv)	HW1 assigned
Feb 5	Foundations 3. Recursion. Sections: 7.2, 7.3. Problems: 7.16, 7.18, 7.21, 7.26 (text 1)	HW1 due
Feb 12	Foundations 4. Number theory: the greatest common divisor. Sections: 9.1, 9.2. Problems: 9.1, 9.2, 9.3, 9.7, 9.9ab, 9.10a-e (text 1); 4a (text 2.a.ii); 5 (text 2.b.ii)	HW2 assigned
Feb 19	Foundations 5. Number theory: cryptography. Sections: 9.3, 9.4,	HW2 due

	9.5, 9.6, 9.7, 9.9, 9.10, 9.11. Problems: 9.23, 9.26, 9.28ab, 9.30i-vi, 9.31, 9.40, 9.46, 9.48a, 9.50, 9.56, 9.60ab, 9.80, 9.83 (text 1); 2, 4 (text 2.a.i); 1e, 2 (text 2.b.iii)	
Feb 26	Mathematical Logic 1. Propositional logic: propositional formulas, equivalence, validity. Sections 3.1, 3.3. Problems: 3.1, 3.2, 3.4, 3.10, 3.11, 3.12 (text 1); 1 (text 2.a.ii); 1 (text 2.b.i)	
Mar 4	Midterm Exam	Midterm
Mar 11	Spring Break - NO CLASS	
Mar 18	Mathematical Logic 2. Propositional algebra. Sections: 3.4, 3.5. Problems: 3.18, 3.19, 3.21, 3.22, 3.23 (text 1); 1 (text 2.a.i)	HW3 assigned
Mar 25	Mathematical Logic 3. Predicate algebra. Section: 3.6. Problems: 3.26, 3.27, 3.28, 3.29, 3.30, 3.32 (text 1); 2 (text 2.b.i); 1 (text 2.b.ii)	HW3 due
Apr 1	Mathematical Logic 4. Practice with computing applications; see class notes	HW4 assigned
Apr 8	Probability Theory 1. Classical probability. Sections: 15.1, 15.3, 15.4, 15.5, 15.7. Problems: 15.1, 15.2, 15.3, 15.4, 15.9ab, 15.10, 15.14, 15.21a, 15.26 (text 1); 5 (text 2.a.iii); 5 (text 2.a.iv); 3a, 5 (text 2.a.v); 4 (text 2.b.iii)	HW4 due
Apr 15	Probability Theory 2. Probability spaces. Sections: 17.1, 17.2, 17.5.1, 17.5.2, 17.5.3, 17.5.4. Problems: 17.2, 17.12 (text 1); 4 (text 2.a.iii); 2b (text 2.a.iv)	HW5 assigned
Apr 22	Probability Theory 3. Conditional probability. Sections: 18.2, 18.3, 18.4, 18.5, 18.7. Problems: 18.1, 18.3, 18.5, 18.11, 18.12, 18.13, 18.16; 3 (text 2.a.iii); 4 (text 2.a.iv); 2 (text 2.a.v); 9 (text 2.b.iv)	HW5 due
Apr 29	Probability Theory 4. Random variables. Sections: 19.1, 19.2, 19.3, 19.4. Problems: 19.1, 19.4, 19.6a, 19.10, 19.11 (text 1); 6, 7, 8a (text 2.a.iii); 6a-d, 7ab (text 2.a.iv); 1a, 2b (text 2.a.v); 10 (text 2.b.iv)	
May 6	Final Exam - 7:30 PM	Final

Communication

This term we will be using Piazza for class discussion. The system is highly catered to getting you help fast and efficiently from classmates, the TA, and myself. Rather than emailing questions to the teaching staff, I encourage you to post your questions on Piazza. If you have any problems or feedback for the developers, email team@piazza.com.

Access page: https://piazza.com/gmu/spring2020/cs530/home, signup link: https://piazza.com/gmu/spring2020/cs530

Policies

Please note that all coursework should be done independently. Plagiarizing the homework and cheating on the exam will be penalized; see Honor Code at http://cs.gmu.edu/resources/honor-code.