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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Office hours: by appointment

Teaching Assistant

Joshua Koyeerath
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Office hours: TBD

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](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/](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 -
      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
   b. Probability course notes by Richard Weber
      ([http://www.statslab.cam.ac.uk/~rrw1/prob/prob-weber.pdf](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

<table>
<thead>
<tr>
<th>Date</th>
<th>Topic</th>
<th>Test</th>
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<tbody>
<tr>
<td>Jan 22</td>
<td>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)</td>
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<tr>
<td>Jan 29</td>
<td>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)</td>
<td>HW1 assigned</td>
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<tr>
<td>Feb 5</td>
<td>Foundations 3. Recursion. Sections: 7.2, 7.3. Problems: 7.16, 7.18, 7.21, 7.26 (text 1)</td>
<td>HW1 due</td>
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<tr>
<td>Date</td>
<td>Event</td>
<td>Notes</td>
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<td>Feb 26</td>
<td>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)</td>
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<td>Mar 4</td>
<td>Midterm Exam</td>
<td>Midterm</td>
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<td>Mar 11</td>
<td>Spring Break - NO CLASS</td>
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<td>Mar 18</td>
<td>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)</td>
<td>HW3 assigned</td>
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<tr>
<td>Mar 25</td>
<td>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)</td>
<td>HW3 due</td>
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<tr>
<td>Apr 1</td>
<td>Mathematical Logic 4. Practice with computing applications; see class notes</td>
<td>HW4 assigned</td>
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<td>Apr 8</td>
<td>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)</td>
<td>HW4 due</td>
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<tr>
<td>Apr 15</td>
<td>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)</td>
<td>HW5 assigned</td>
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<tr>
<td>Apr 22</td>
<td>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)</td>
<td>HW5 due</td>
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<td>Apr 29</td>
<td>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)</td>
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<td>May 6</td>
<td>Final Exam - 7:30 PM</td>
<td>Final</td>
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**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.

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.