CS 231 - Discrete Mathematics
Spring 2021

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MTH 11:10am - 12:30pm, remotely

Textbook

Required: Discrete Mathematics with Applications, 4th Edition by Susanna Epp, Thomson Learing 2010.

Please check here if you think you found an error in the text or have undue confusion: Errata

Class Time and Office Hours

- Class meets MTH 11:10am - 12:30pm on Zoom
- Office hours TH 12:30pm - 2pm on Slack
- TAs:
    - Yichun Cao, Fridays 9pm-10pm on Slack
    - Chen Fan, Saturdays 9am-10am on Slack
    - Zaynab Ghazi, Thursdays 8pm-9pm on Slack
    - Yutong Wu, Sundays 10am-11am on Slack
- Check the class website often for updates. Deadlines will also be listed there.

Remote Learning Resources

- Class website: www.cs.brynmawr.edu/cs231
- Moodle: assignment submissions, lecture notes and other handouts
- Zoom: live lectures and one-on-one meetings
- Slack: you will receive an invitation to join a class channel. This is the place to look for me or a TA if you have a question. Appointments for one-on-one Zoom meetings should be made here too.

Learning Goals

Students who complete the course will have demonstrated the ability to do the following:
- Reason mathematically about basic data types and structures (such as numbers, sets, graphs, and trees)
- Distinguish rigorous definitions and conclusions from merely plausible ones
- Synthesize elementary proofs, especially proofs by induction
- Model and analyze computational processes using analytic and combinatorial methods
- Apply principles of discrete probability to calculate probabilities and expectations of simple random processes

Outcomes

- Use logical notation to define and reason about fundamental mathematical concepts such as sets, relations, functions, and integers.
- Evaluate elementary mathematical arguments and identify fallacious reasoning (not just fallacious conclusions).
- Synthesize induction hypotheses and simple induction proofs.
- Apply the method of invariants and well-founded ordering to prove correctness and termination of processes and correctness of loops.
- Derive closed-form and asymptotic expressions from series and recurrences for growth rates of processes.
- Calculate numbers of possible outcomes of elementary combinatorial processes such as permutations and combinations.
- Calculate probabilities and discrete distributions for simple combinatorial processes; calculate expectations.
- Understand basic graph theory and its connection to data structures
- Understand applications in Computer Science, for example, logic gates and circuit design, induction and proof of correctness of loops, etc

Prerequisites

Any one of the following courses (or their equivalents at Haverford or Swarthmore) is required with a grade of 2.0 or better (or permission of the instructor).

1. CS 110

2. CS 113

3. CS 115

Schedule of Topics and Assignments

This schedule is *tentative*. Homework is **due every Monday before class**, except for Monday 2/15 and Monday 3/29. If you miss class, you must still make sure that your assignment is submitted to Moodle by 11:10am EST on the same Monday. **Electronic copies (PDFs) are required** - you may use any means of generating PDF documents, directly via an editor (Word or LaTeX), handwrite and take-photos/scan afterwards, or a combination - primarily with an editor but insert photos of hand-drawn figures. Whichever method you choose, you MUST end up with a PDF document in the end. Any assignments missing by the 11:10am deadline will not be accepted.

wk	Date	Lec	Topics	Reading	Hws	collected
1	2/15	1	Introduction, logical form and statements	1.1-1.3, 2.1-2.2	2.1: 5, 8, 13, 17, 35, 37, 46, 52	
	2/18	2	Conditional statements; arguments	2.2-2.3	2.2: 10, 15, 21, 35, 43, 50 2.3: 10, 13, 23, 28, 29, 32, 40	
2	2/22	3	Digital Circuits, Number Systems and Circuits for Addition	2.4-2.5	2.4: 2, 6, 10, 21, 31 2.5: 5, 11, 21, 26, 34, 37, 45, 47	2.1, 2.2
	2/25	4	Quantified statements	3.1-3.2	3.1: 4, 5, 15, 16b, 20, 29 3.2: 2, 4b, 4d, 8, 14, 25c, 44	
3	3/1	5	Arguments with quantified statements	3.3-3.4	3.3: 4c, 11e, 38, 40b, 43, 61 3.4: 14, 15, 19, 22, 27, 32, 34	2.3, 2.4, 2.5, 3.1, 3.2
	3/4	6	Direct proofs	4.1-4.5	4.1: 28, 37, 41, 56 4.2: 17, 25, 32 4.3: 16, 20, 43 4.4: 25, 52	
4	3/8	7	Indirect proofs	4.6-4.7	4.6: 4, 7, 12, 28, 35 4.7: 4, 8, 15, 17, 24	3.3, 3.4, 4.1, 4.2, 4.3, 4.4
	3/11	8	Algorithms; Sequences	4.8-5.1	4.8: 8b, 16, 20, 28 5.1: 7, 15, 17, 28, 50, 79	
5	3/15	9	Mathematical induction	5.2-5.3	5.2: 7, 11, 14, 36 5.3: 10, 17, 29, 35, 37	4.6, 4.7, 4.8, 5.1
	3/18	-	Midterm 1 (Chapters 2-3)			
6	3/22	10	Strong induction; The well-ordering principle	5.4	5.4: 2, 15, 18, 19, 21	5.2, 5.3
	3/25	11	Correctness of Algorithms	5.5	5.5: 2, 7, 9	
7	3/29	-	Spring pause			
	4/1	12				
8	4/5	13	Recursively defined sequences; Solving recurrences	5.6-5.7	5.6: 8, 14, 20, 32, 40 5.7: 11, 36, 44, 52	5.4, 5.5
	4/8	14	Recursion and structral induction; Set theory	5.9, 6.1	5.9: 8, 11, 14, 16, 18, 20 6.1: 12, 33c, 35c-d	

wk	Date	Lec	Topics	Reading	Hws	collected
9	4/12	15	Set theory; Counting basics; Multiplication rule	6.2-6.3, 9.1-9.2	6.1: 25, 30 6.2: 14, 22, 31, 41 6.3: 7, 20, 26, 37 9.1: 6, 13b, 19, 22, 33 9.2: 2, 14c, 15, 29, 30, 33	5.6, 5.7 5.9, 6.1
	4/15	16	Addition rule; The pigeonhole principle	9.3-9.4	9.3: 2, 10, 17, 20, 21, 22, 30, 49 9.4: 11, 16, 19, 30, 32, 36	
10	4/19	17	Combinations, r-combinations	9.5-9.6	9.5: 7, 11, 16, 20, 28 9.6: 4, 6, 12, 18	6.1, 6.2, 6.3 9.1, 9.2 9.3, 9.4
	4/22	18	The Binomial Theorem; Combinatorial Proofs	9.7	9.7: 7, 16, 39, 42	
11	4/26	19	Expected Value; Conditional Probability	9.8-9.9	9.8: 5, 15, 18, 20, 21, 23	9.5, 9.6, 9.7
	4/29	-	Midterm 2 (Chapters 4-6)			
12	5/3	20	Conditional Probability	9.9	9.9: 15, 24, 28, 29, 30, 33	9.8
	5/6	21	Graphs: intro, paths and circuits	10.1-10.2	10.1: 20, 28, 30, 33, 44, 48 10.2: 2, 8, 11, 35, 48, 49	
13	5/10	22	Matrix representation of graphs; Trees; Rooted trees	10.3-10.6	10.3: 4, 5, 6, 7, 21, 23 10.5: 3, 6, 23, 26 10.6: 3, 14, 17, 20	9.9, 10.1 10.2
	5/13	23	Review			

Total grade breakdown

Grades will be awarded according to the percentage breakdowns shown:

Homework 20%
Midterm 1 20%
Midterm 2 20%
Final exam 40%

Late work policy

Because of the weekly problem sets, late submissions inevitably "eat" into the next set. Late begets later and thus the class has a general "no late work" policy, except for circumtsances beyond your control. All extensions must be requested **at least 24 hours in advance** of the deadline. Extensions will be granted based on individual circumstances. **Time-management related problems are not valid reasons for extensions**.

Work handed in late without a previously granted extension may not be accepted.

Attendance and Participation

Attendance at, and active participation in, all class sessions is expected of all students. Participation will be taken into account in awarding of final grades for students who are "on the edge" between two grades. For example, a student with a B+/A- average and a strong attendance and participation record would receive an A-, while a student with a weak record would receive a B+.

Collaboration

It is your responsibility to understand and follow the collaboration policy in this class. The goal of the policy is to encourage collaboration while ensuring that you and your classmates really engage in learning how to solve the challenging problems you'll see in this course. If you are ever uncertain if collaboration or certain sources are allowed, you should ask the professor.

You are encouraged to discuss the lecture material and the labs and problems with other students, subject to the following restriction: the only "product" of your discussion should be your memory/understanding of it - you may not write up solutions together, or exchange written work or computer files. Collaboration is not allowed on examinations or quizzes.

You should avoid using outside sources (the internet, students not in this class, etc.). If your solution is inspired by any outside resources (I understand that sometimes it is hard to not see things), you MUST cite.

Learning Accommodations

Students requesting accommodations in this course because of the impact of disability are encouraged to meet with me privately early in the semester with a verification letter. Students not yet approved to receive accomodations should also contact Deb Alder, Coordinator of Accessibility Services, at 610-526-7351 in Guild Hall, as soon as possible, to verify their eligibility for reasonable accommodations. Early contact will help avoid unneccessary inconvenience and delays.