MATH 3012 QH: Applied Combinatorics, Fall 2020

Welcome to Applied Combinatorics! I hope that you will find this to be a useful and fundamental course for your future studies. This course is part of the Distance Mathematics program, which offers advanced mathematics courses to advanced high school students in Georgia through distance education. Lectures and exams are provided at the same level as what would be offered for a traditional face-to-face course, and all exams are to be written under the supervision of a live proctor.

1 Instructor and Office Hours

Instructor: Yaofeng Su
Email: yaofeng.su@math.gatech.edu
Instructor Office Hours: every Friday 8-9pm.

2 Grader and Technical Support

Grader: A grader will be hired to help grade weekly homework and worksheet sets. Any questions about the grading of your homework should be directed to your instructor via email.

Technical Support: Any technical questions can be directed to either Dr. Bekki George or Dr. Greg Mayer via email. Or they can be posted to the Piazza forum which they will help moderate.

- Dr. Bekki George, rgeorge60@gatech.edu
- Dr. Greg Mayer, greg.mayer@gatech.edu

3 Textbook

Our textbook will be the 2017 edition of Applied Combinatorics, available at www.rellek.net/appcomb. The text was authored by Keller and Trotter, and was written with Georgia Tech students and Math 3012 as a target audience. Although it is a mathematics text, it has computer science and engineering concepts, principles and applications close to its surface. This textbook has been under development for the past ten years and extensive revisions have been incorporated in recent years. The web-based version is a major upgrade, and we expect that this format will be especially useful for students. Students who need or want hard copy can probably find a way to purchase one through Amazon or Barnes and Noble, but we emphasize that such a purchase is entirely optional. This text is a joint project between Professor Trotter and Mitchel T. Keller, who completed his Ph.D. in spring 2010 at Georgia Tech, with Professor Trotter serving as his thesis advisor. Mitch won a presigious Marshall Sherfield postdoctoral fellowship in the Department of Mathematics of the London School of Economics.

4 Course Websites

- **Canvas**: grades, resources, announcements, and homework will be posted on Canvas.
- **Piazza**: students will be invited to a Math 3012 Piazza site dedicated to our class, but Canvas will have a link to our Piazza page as well.
- **Lectures**: students will be required to view video lectures in one of two places:
  - https://sites.gatech.edu/math3012openresources/
  - Canvas
- The following URL

  https://people.math.gatech.edu/~trotter/math-3012/toppage.html

  may contain resources that may appear useful. In particular one can see old exams given by Prof. Trotter.

5 Topics Outline

1. **Discrete structures:** Graphs, digraphs, networks, designs, posets, strings, patterns, distributions, coverings, partitions.
2. **Enumeration:** Permutations, combinations, inclusion/exclusion; generating functions; recurrence relations, Polya counting.
3. **Algorithms and Optimization:** Sorting, spanning trees, shortest paths, eulerian circuits, Hamitonian cycles, graph coloring, planarity testing, network flows, bipartite matchings, chain partitions.

6 Learning Outcomes

Students should be able to explain and write simple combinatorial and inductive proofs. Students will be able to analyze and use the discrete structures in the course, solve basic enumerative or optimization problems, and implement the algorithms discussed.

7 Grading Policies

Numerical grades are converted to letter grades based on the standard intervals: A: [90%, 100%], B: [80%, 90%), C: [70%, 80%), D: [60%, 70%), F: [0%, 60%). Any changes made to these intervals could only be made after the final exam is held. Percentage grades are not rounded to the nearest integer before conversion to letter grades. For example, 89.99999% is converted to a B, and 79.9999% is converted to a C, and so on.

Grades will be determined by the following distribution. Details about the project will be announced early in the semester.

assessment	weight
worksheets	8 %
homework	16 %
quizzes	6 %
midterms	30 %
final exam	20 %
project	20 %

8 Assessments

8.1 Homework and Worksheets

Homework and worksheets will be assigned weekly on Tuesdays, and will be due the following Tuesday by 11 p.m. Students must upload a single PDF of their work to homework assignments on Canvas.

- Solutions must be typed, submitted as a single PDF file that is no more than 2 MB in size.
- All students are encouraged to collaborate, but must write up their solutions independently. I take these policies seriously and violations will be dealt with in a strict manner compatible with the Georgia Tech honor code (available at http://www.honor.gatech.edu/).
- Unexcused late homework will not be accepted.
- Worksheets will graded for completion only.
- Most or all homework problems will be graded by the grader.
- Homework and worksheets will be graded and returned within a week after they are due.
- A small amount points may be allocated for organization and following instructions during the upload process. Please indicate where questions are located and rotate pages to the proper orientation.

8.2 Quizzes

There will be three quizzes throughout the semester.

- Quizzes will be administered through Canvas on the day the midterm is released.
- Each quiz will consist of roughly 10 to 15 true/false questions, similar to the true/false questions found in the WTT Test Archive (which is on Canvas).
- Students will only have one opportunity to complete each quiz.
- Quizzes are released at 8am on the day the midterm is released and remain open for 12 hours. Quizzes close at 8pm on the day the quiz is released.
- Once a student starts the quiz, they will have 30 minutes to complete it (unless of course they start the quiz less than 30 minutes before the quiz closes).
- Students can use any resources while taking these tests including online calculators and Mathematica, but cannot communicate with anyone during these tests including using Reddit or online message boards or using solutions provided from another student or third party. In other words, do your own work but you can use technology to solve problems. Communication with the Instructor in Canvas messaging is allowed (to clarify the question if needed).

8.3 Midterms and Final Exam

There will be three midterms and a final exam. Midterms are un-proctored open-book exams that will be released at 8:00 am on the dates specified below.

8.3.1 Dates and Topics

- Midterm 1. Week 6, Thu, Sep 24, 2020, released at 8:00 am, covers lectures 1 to 9 (inclusive)
- Midterm 2. Week 10, Thu, Oct 22, 2020, released at 8:00 am, covers lectures 9 to 17 (inclusive)
- Midterm 3. Week 13, Thu, Nov 12, 2020, released at 8:00 am, covers lectures 17 to 24 (inclusive)
- Final exam Part 1 and 2, Friday Dec 4, 2020, 8:00 am to 8 pm

Students should contact their instructor as soon as possible if any of the above dates or times cannot be accommodated. If the instructor is notified well in advance, students can take their exams on campus.

8.3.2 Exam Procedures

- Exams are released through Canvas announcements that are posted when the exams are to be released.
- All exams are due 12 hours after they are released.
- Exams must be typed.
- Midterms and the final exam will be administered as take-home exams. Meaning that these exams will be open book: students can use any resources available to them to answer the questions that are given.
- Students will still need to justify their reasoning by showing their work. Solutions to sample exams will give an idea of how much to writing is needed.
- Students can take exams at home.
- Students can ask the instructor questions during the exam via email or through Canvas messaging.
- Unless students are asked to use a particular method or theorem, they are allowed to use any approach to solve any problem they are given.
- Piazza will be temporarily inactive during these exams.
- Students can use any resources while taking these tests including online calculators and Mathematica, but cannot communicate with anyone during these tests including using Reddit or online message boards or using solutions provided from another student or third party. In other words, do your own work but you can use technology to solve problems.
- Communication with the Instructor in Canvas messaging is allowed (to clarify the question if needed).
- A small amount points may be allocated for organization and following instructions during the upload process. Please indicate where questions are located and rotate pages to the proper orientation.

8.3.3 Make-up Procedures

- Students who are unable to take any midterms or the final exam at the scheduled times, for any reason, are responsible for notifying their instructor prior to the exam and as soon as possible.
- Any student who misses a midterm exam, with reasonable explanation, may have an opportunity to write a make-up exam.
- Students cannot take a make-up midterm exam before the exam is scheduled.
- Make-up midterm exams must be taken less than five business days after the midterm is scheduled. For example, if the regularly scheduled midterm were held on a Thursday, the make-up midterm cannot be written on the following Wednesday. It must be written on or before the following Tuesday. Situations where it is not possible to do so are very rare and handled on a case-by-case basis. In some situations, the student might be given an EX (excused) grade in the Canvas Gradebook and the average of the remaining midterm exams will be used for the midterm exam portion of their final grade.
- **There will be no make-up final exams**. Students who miss the final exam might qualify for an incomplete, but incompletes can only be assigned under specific circumstances that are defined on the Office of the Registrar's website: registrar.gatech.edu/info/incomplete-grades. Students who miss the final exam and do not qualify for an incomplete will simply receive a grade of zero on their exam.

9 Tips on How to Type Documents

Worksheets, homework, and exams must be typed and uploaded to Gradescope. If you prefer, you can type your work using LaTeX. Overleaf is a popular platform for developing LaTeX documents.

10 Tips on How to Upload Documents into Gradescope

The Submitting PDF Homework guide has advice on how to upload documents into Gradescope.

11 Announcements

Students are responsible for obtaining announcements made through Canvas.

12 Computing Element

This course is a math course and no programming will be required for the completion of homework sets. But combinatorics is closely related to computer science, and students are strongly encouraged to use and understand computer programs developed for this course. On the other hand, no prior programming knowledge is assumed.

13 Student Support

As mentioned above there are office hours, and students are strongly encouraged to drop by for help. Come sooner rather than later. Experience shows that some Georgia Tech students are reluctant to ask for help as it something they never had to do in high school. Don't fall into this trap. The School of Mathematics wants every student to succeed and we will help you if you make the effort.

14 Accessibility

- Disability and Campus Accessibility

  http://policylibrary.gatech.edu/disability-and-campus-accessibility

- Assistance for individuals with disabilities

  https://disabilityservices.gatech.edu/

- Academic accommodations for students with disabilities

  http://policylibrary.gatech.edu/b.-academic-accomodationsstudents-disabilities

15 Netiquette

Netiquette is the etiquette of online behavior. Since written communication is the main means of communication in an online course, you will need to follow the same rules of behavior as you would in a face-to-face course when communicating with the other students in the class. This means that you will have to respect other students taking this course. Negative personal comments are strictly prohibited.

16 Institute Dates

- Aug. 17: Start of classes
- Sept. 7: Labor Day holiday
- Nov. 23-24: Final instructional days (no new material or scheduling of any other assessments)
- Nov. 25-29: Thanksgiving break
- Nov. 30-Dec. 8: Reading days and final assessments
- Dec 14: Final Grades due to Registrar
- Dec 15: Final Grades available

17 Tentative Course Schedule

Changes to the following schedule would be announced via Canvas announcements.

week	dates	lectures	assignments due	exams
1	08/17 - 08/23	1,2	none	
2	08/24 - 08/30	3,4	WS1	
3	08/31 - 09/06	5,6	HW1	
4	09/07 - 09/13	7,8	WS2	
5	09/14 - 09/20	9,10	HW2	
6	09/21 - 09/27	11,12	none	Midterm 1
7	09/28 - 10/04	13,14	WS3	
8	10/05 - 10/11	15,16	HW3	
9	10/12 - 10/18	17,18	HW4	
10	10/19 - 10/25	19,20	none	Midterm 2
11	10/26 - 11/01	21,22	WS4	
12	11/02 - 11/08	23,24	HW5	
13	11/09 - 11/15	25,26	none	Midterm 3
14	11/16 - 11/22	27	HW6	
15	11/23 - 11/29	none	none	
16	11/30 - 12/06	none	none	Final Exam