Introduction to Discrete Structures
Fall 2023
Course Information

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Department of Computer and Information Science
Brooklyn College

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Instructor — Amotz Bar-Noy

- **E-mail:**
  - TR11: amotz.CUNY+2210S23TR11@gmail.com
  - TR2: amotz.CUNY+2210S23TR2@gmail.com

- **Internet:** [http://www.sci.brooklyn.cuny.edu/~amotz/discretemath.html](http://www.sci.brooklyn.cuny.edu/~amotz/discretemath.html)

- **Class Hours:** Tuesdays and Thursdays
  - TR11: 11:00am–12:15pm
  - TR2: 2:15pm–3:30pm

- **Classroom:** ???

- **Office Hours:** Room 2112 or Classroom
  - TR11: Thursdays 12:30am–1:30pm
  - TR2: Thursdays 3:45pm–4:45pm

- **Zoom Links:**
  - TR11: [https://us02web.zoom.us/j/88913444494?pwd=VTJZaWRZblZMeDc3Z010aDFXanRGZz09](https://us02web.zoom.us/j/88913444494?pwd=VTJZaWRZblZMeDc3Z010aDFXanRGZz09)
  - TR2: [https://us02web.zoom.us/j/88119834156?pwd=QTVMSTNRbFBmS0NBK2ttRnNjNDNDdz09](https://us02web.zoom.us/j/88119834156?pwd=QTVMSTNRbFBmS0NBK2ttRnNjNDNDdz09)
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Prerequisite Courses and Knowledge

**Computer and Information Science**
- 1.10, or 1.20, or 1110 [1.5], or 1115, or both of 1113 and 1114, or 1170, or 1180, or 1215

**Mathematics**
- 1011 [2.9] or 2.92
- or assignment to Mathematics 3.20, 1201 [3.3], or 4.10 by the Department of Mathematics.
Syllabus 1110/1115:


General link

http://www.brooklyn.cuny.edu/courses/ShowCourse.do?redirect=/acad/course_info.jsp&dsc=CISC.&crs_num=1115&div=U

Detailed link

http://www.brooklyn.cuny.edu/web/aca_naturalsciences_cis/CISC1110.pdf
Math Prerequisite

Syllabus

- Preparation for calculus. Trigonometry. The concept of function, including, linear and quadratic functions, composition of functions, polynomials and rational functions, exponential, logarithmic, trigonometric, and inverse trigonometric functions. Conic sections. Binomial theorem.

General link

http://www.brooklyn.cuny.edu/courses/ShowCourse.do?redirect=/acad/course_info.jsp&dsc=MATH.&crs_num=1011&div=U

Detailed link

http://www.brooklyn.cuny.edu/web/aca_naturalsciences_math/Math1011_Syllabus.pdf
Some Textbooks

  https://www.kth.se/social/files/557ec6b0f27654784e263d66/fullbook.pdf


  http://discrete.openmathbooks.org/pdfs/dmoi-tablet.pdf

- A list of books on “Discrete mathematics for Computer Science” from Google:  
  https://www.google.com/search?q=list+of+books+on+discrete+mathematics+for+computer+science&rlz=1C1CHBF_enUS762US762&source=univ&tbs=shop&tbo=u&sa=X&ved=0ahUKEwiEk5HHiKDfAhUIm–AKHWYIAGQsxgIzAE
Some Course Notes

Some Online Video Lectures

- Video lectures for Mathematics for Computer Science from MIT:
  https://ocw.mit.edu/courses/6-042j-mathematics-for-computer-science-fall-2010/video_galleries/video-lectures/

- Trevtutor: Discrete Math 1 and Discrete Math 2 (lectures and exercise sessions)
  https://www.youtube.com/playlist?list=PLDDGPdw7e6Ag1EIzn2-m-qXu4XX3A0cIz
  https://www.youtube.com/playlist?list=PLDDGPdw7e6Aj0amDsYInT_8p6xTSTGEi2

- Introduction to Higher Mathematics (first 12 lectures):
  https://www.youtube.com/playlist?list=PLZzHxk_TPOStgPtqRZ6KzmkUQBQ8TSWVX
Some Online Text Tutorials

- “Discrete Mathematics An Open Introduction” by Oscar Levin:
  http://discrete.openmathbooks.org/dmoi2/frontmatter.html

- “Discrete Mathematics Tutorial” by tutorialspoint
Some Books with Problems and Solutions

  https://alas.matf.bg.ac.rs/~mil164/Materijali/DS.pdf
  ∗ Many examples with full solutions.

  ∗ Although most of the problems are about Algorithms, there are many that are relevant to Discrete Math.
What is Discrete Math?

A long answer part 1

- Discrete mathematics is the study of mathematical structures that are **fundamentally** discrete rather than continuous.

- In contrast to real numbers that have the property of varying smoothly, the objects studied in discrete mathematics such as integers, graphs, and statements in logic do not vary smoothly in this way, but have distinct, separated values.

- Discrete mathematics therefore excludes topics in continuous mathematics such as calculus or Euclidean geometry.

- Discrete objects can often be enumerated by integers.
More formally, discrete mathematics has been characterized as the branch of mathematics dealing with countable sets (finite sets or sets with the same cardinality as the natural numbers).

However, there is no exact definition of the term discrete mathematics.

Indeed, discrete mathematics is described less by what is included than by what is excluded: continuously varying quantities and related notions.

The set of objects studied in discrete mathematics can be finite or infinite. The term finite mathematics is sometimes applied to parts of the field of discrete mathematics that deals with finite sets, particularly those areas relevant to business.
What is Discrete Math for Computer Science?

A shorter answer

- Discrete mathematics is the part of mathematics devoted to the study of discrete (i.e. distinct) objects.

- In general, it is used whenever objects are counted, when relationships between finite (or countable) sets are studied, and when processes involving a finite number of steps are analyzed.

- It is important for computer science because in computing machines, information is stored and manipulated in a discrete fashion.
Why study Discrete Math?

Proofs, proofs, and more proofs:
- What distinguishes Math from other “exact” sciences.

More subjective answers:
- Problem solving: Talent, Intuition, Luck, Experience, **Hard Work**.
- Mathematical thinking, critical thinking, mathematical reasoning,...
- **Fun** with math (e.g., via puzzles) and Math as an **art**.

Do we or I really need Math?
- What if I want to be a programmer?
- What if I want to be a system person?
This Course

Flexible curriculum:
- Quantity vs. quality.
- Many orders among the topics are good.

Are we starting from the beginning?
- No!!! It is assumed that you already know a lot!

Resources for study:
- Textbooks, lecture notes, video lectures, online tutorials, practice exercises, blogs, wikipedia, ...
- There are too many choices, how to select the “right” one?

What if I care only about the final grade?
- Master the material studied in this course?!
Syllabus

Part 1: The fundamentals
- Proofs; Sets; Logic;

Part 2: The heart
- Induction; Recursion; Counting; Combinatorics; Probability

Part 3: Some pillars
- Algorithms; Graphs; Number Theory;
# Tentative Schedule

| Classes 1,2 | Aug 29,31, 2023 | Introduction |
| Classes 3,4 | Sep 5,7, 2023 | Proofs |
| Classes 5,6 | Sep 12,14, 2023 | Sets |
| Classes 7,8 | Sep 19,21, 2023 | Logic |
| Class 9 | Sep 26, 2023 | **First Midterm Exam** |
| Classes 10,11 | Sep 28, Oct 3 2023 | Induction |
| Classes 12,13 | Oct 5,12 2023 | Recursion |
| Classes 14,15 | Oct 17,19, 2023 | Counting |
| Classes 16,17 | Oct 24,26, 2023 | Combinatorics |
| Classes 18,19 | Oct 31, Nov 2, 2023 | Probability |
| Class 20 | Nov 7, 2023 | **Second Midterm Exam** |
| Classes 21,22 | Nov 9,14, 2023 | Algorithms |
| Classes 23,24 | Nov 16,21, 2023 | Graphs |
| Classes 25,26 | Nov 28,30, 2023 | Number Theory |
| Classes 27,28 | Dec 5,7 2023 | Conclusions |
| Class 29 | Dec 14, 2023 | **Final Exam** |

**Remarks**

- There are no classes on Tuesday Oct 10 and Thursday Nov 23.
- Final exam: Thursday Dec 14, 2023 from 10:30am to 1:30pm in the Tanger auditorium in the library.
In-Person Classes and Zoom Sessions

Classes

* In each 75-minute class, a slide-based lecture coupled with Internet videos will be presented.
* The slides will be posted on the course website [http://www.sci.brooklyn.cuny.edu/~amotz/discretemath.html](http://www.sci.brooklyn.cuny.edu/~amotz/discretemath.html)

Zoom

* The zoom link for the class is
  
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* There will be Zoom sessions in parallel to the in-person classes.
* The Zoom sessions will not be recorded and the focus will be on the students who attend the in-person classes.
* If the in-person classes are canceled, we meet via Zoom on the same days and times.
Attendance

- Except for the first two classes, the last class, and the exams (not quizzes), attendance is not mandatory.
- Absent students are responsible for the material covered in class.

Reward

- Students who attend the **in-person classes** will be awarded a grade of 100 that will be worth up to 5% of their final grade depending on the number of attended in-person classes.
Communication With The Instructor

From the Instructor

- Some announcements will be emailed to students using WebCentral (or CUNYFirst).
- Make sure that both systems have your preferred email address.
- Course material (lectures, assignments, exams & quizzes, announcements) will be posted on the course website.

To the instructor

- Email questions to the class email.
- Emails sent to my other email addresses will be ignored.

Office hours

- One hour on Thursdays 15 minutes after the end of the class either in room 2112 or in the classroom.
Online Procedure

Joining a zoom session
- Students must join the class prior to the start time, otherwise, they risk not being admitted.

Audio
- Audio should be muted unless the instructor requests a verbal response.

Camera
- Students are encouraged to turn their camera on.

Chat
- Students may ask questions using the chat option.
Assignments

Type of Assignments

- **Reading assignments:** to help students be better prepared for future topics.
- **Writing assignments:** for students to practice topics covered in previous classes.

Submission procedure

- The due dates for the writing assignments will be class dates.
- Students may submit a written (preferably typed) assignment before or after the class.
- Alternatively, students may submit a PDF version as an attachment to the class email.
Assignments

**Grading assignments**
- Assignments will be graded with a **Pass-Fail grade**.
- After the due date, detailed solutions will be posted on the course website.

**Preparing assignments**
- Try your best to do the assignments **alone**.
- Get help **only** if necessary.
- You **must** understand and be ready to explain to the instructor everything you write.
Exams and Quizzes

Final exam tentative time and room
- Date and time: Thursday Dec 14 from 10:30am to 1:30pm
- Room: The Tanger auditorium in the library

Midterm exams tentative dates
- Both midterm exams will be taken during class sessions.
  - ⭐ Midterm Exam 1: Tuesday September 26, 2023
  - ⭐ Midterm Exam 2: Tuesday November 7, 2023

Quizzes
- Quizzes will be announced ahead of time.
- The plan is for 2 quizzes but there could be more or less quizzes.
- Quizzes are not mandatory.
- A quiz grade counts only if it is higher than the final exam grade.
Grading Exams and Quizzes

Grading

- Exams and quizzes will be fully and accurately graded.
- Detailed solutions will be posted.

Answering questions

- Answer a question only within the given space for the answer.
- Use legible handwriting for exams and quizzes and typed text for assignments.
- You will get 20% of the credit if you leave the answer blank and no credit for a wrong answer.
Project

Scope

- The project is “open ended” and as such there will be no specific instructions of what to do. However, few examples will be offered to illustrate the types of projects that would qualify.

Approval

- Submitted proposals will be graded only if they were approved.

Submission

- Submitting a project is not mandatory. However it is a great opportunity to boost the final grade.

Deadlines

- The proposal deadline is Nov 16, 2023 and the submission deadline is Nov 30, 2023. These are firm deadlines; there will be no exceptions.
Final Grade

Components of the final grade

- 15% – 20% for the first midterm exam.
- 15% – 20% for the second midterm exam.
- 0% – 20% for the quizzes.
- 0% – 10% for the assignments.
- 0% – 15% for the project.
- 0% – 5% for attendance.
- 10% – 70% for the final exam.

The final exam percentage

- The percentage allocated to the final exam depends on the number of quizzes taken, the number of assignments submitted, the scope of the project, and attendance.
Honor Code

This course policy

- Students are expected to do the exams, the quizzes, and the project by themselves without any external help from other people, the Internet, or books and notes unless stated otherwise.
- Cheaters will be punished severely. At minimum, they will fail the specific exam or quiz, but they may fail the whole class.
- In addition, students who cheat risk disciplinary measures by Brooklyn College and CUNY.

CUNY policy on Academic Integrity

Academic Dishonesty is prohibited in the City University of New York and is punishable by penalties, including failing grades, suspension, and expulsion, as provided herein.