

## Basic Course Information

**MATH 120. Discrete Mathematics for Computer Science.**

**Prerequisite:** Precalculus (MATH 122 or the equivalent)

**Section:** MATH 120, Section XX

**Meeting Times:** XX.

**Instructor:** XX

**Email:** X.X@qc.cuny.edu

**Textbook:** Our main textbook will be *Discrete Mathematics: An Open Introduction, 3<sup>rd</sup> Edition* by Oscar Levin and is accessible at <http://discrete.openmathbooks.org/dmoi3/dmoi.html>. This is a free online textbook that covers the vast majority of the topics in this class. Your instructor will provide additional readings for the topics that are not in the textbook.

**Video Lecture Repository:** <https://math.qc.cuny.edu/math-120>

**Online Homework: Webwork,** accessible at <https://webwork.qc.cuny.edu/>

## What is the structure of this course?

This is not your standard math class. Many people find the ideas you learn in this class engaging and eye opening. The goal of this course is to build your fluency with the mathematical ideas you will be seeing throughout your computer science training. This class is structured to give you plenty of practice actively grappling with the concepts and discussing them with your peers.

This course will be taught using “flipped learning”. This means that the content delivery (or “lecture”) portion of the course happens **outside** the classroom through pre-recorded videos. You are responsible for watching the videos and completing a “daily preparation” exercise before class. In-class time is devoted to diving deeper into the course material through discussion, structured activities, and group work. Afterward, the day’s learning is reinforced through homework exercises.

Approximately once per week there will be a quiz to ensure that you have become proficient in each of the concepts. These quizzes will be supplemented by two midterms and a final exam: One midterm will cover Topics 1 and 2; one midterm will cover Topics 3 and 4, and a cumulative final exam will cover Topics 1-5.

## What will I be learning?

By the end of the course, you will be able to do the following.

### Topic 1: Sets

Objective 1.1. **Definitions and Notation.** I understand the concepts of definitions and notation. Given a term, I can write down the precise definition, my personal understanding, an example, and a non-example. Given a symbol, I can understand its context in a mathematical expression, and translate its meaning and use into English.

- Objective 1.2. **Set Notation.** I can represent a set in roster notation and set-builder notation. I can determine if an object is an element of a set. I can determine whether two sets are equal or subsets of one another. I understand the difference between a finite and infinite set.
- Objective 1.3. **Set Operations and Venn Diagrams.** I can perform operations on sets (intersection, union, complement, difference) and represent the operations as Venn Diagrams. I can compute the power set of a set and the Cartesian product of multiple sets.
- Objective 1.4. **The Language of Logic.** I can convert between real-world situations involving collections of objects and abstract expressions involving sets. I can determine the English equivalent of the complement of a set. I can apply De Morgan's Laws when finding the complements of expressions involving AND or OR.

## Topic 2: Combinatorics

- Objective 2.1. **Addition, Multiplication, and Permutations.** I can use the additive principle when counting disjoint sets. I can use the multiplicative principle when counting sequences of independent events. I can count the number of permutations and  $k$ -permutations of a set of  $n$  objects.
- Objective 2.2. **Applications of Venn Diagrams.** Given a counting word problem, I can develop an appropriate model involving set notation and Venn diagrams. I can apply the Principle of Counting the Complement and the Principle of Inclusion and Exclusion to solve counting problems.
- Objective 2.3. **Combinations and Binomial Coefficients.** I can count the number of ways to choose  $k$  objects from a group of  $n$  objects *when repetition IS NOT allowed*. I can count the number of bit strings of length  $n$  and weight  $k$ . I understand how these two concepts are related. I can calculate the binomial coefficient ( $n$  choose  $k$ ).
- Objective 2.4. **Multicombinations.** I can count the number of ways to choose  $k$  objects from a group of  $n$  objects *when repetition IS allowed*. I can use the "stars and bars" method to count the number of ways to distribute objects among a group. I can calculate ( $n$  multichoose  $k$ ).
- Objective 2.5. **Applying the correct method.** I can determine whether a real-world scenario concerns ordered or unordered objects and replacement or non-replacement and apply the correct method of counting.

## Topic 3: Functions

- Objective 3.1. **Defining Functions.** I can determine whether a rule described in words is a function, including whether it is well defined.
- Objective 3.2. **Domain, Range, and Codomain.** I can determine the domain, range, and codomain of a function.
- Objective 3.3. **Images and Preimages.** I can determine the image of an element in the domain and a preimage of an element in the codomain.
- Objective 3.4. **Injective, Surjective, and Bijective Functions.** I can determine whether a function is injective, surjective, or bijective.
- Objective 3.5. **Special Functions.** I can evaluate special computer science functions: floor, ceiling, factorial, DIV ( $//$ ), and MOD ( $\%$ ). Given an integer  $a$  and a positive integer  $b$ , I can find integers  $q$  and  $r$  such that  $a=qb+r$  and  $0\leq r<b$ .

## Topic 4: Algebra, Sequences, Series, and Products

- Objective 4.1. **Exponents and Logarithms.** I can convert between expressions involving exponents and expressions involving logarithms. I can apply exponential and logarithmic rules to expand or simplify expressions. I can convert between  $\log_2$ ,  $\ln$ , and  $\log_{10}$ .
- Objective 4.2. **Sequences.** If I am given a function (as a formula or in words) that defines a sequence, I can determine the value of a specified term of the sequence. If I am given a constant sequence, arithmetic sequence, geometric sequence, or alternating sequence written using ellipses, I can find a formula for the sequence. I can determine the number of terms in a finite sequence.
- Objective 4.3. **Series and Products.** I can write a finite or infinite sum in sigma notation. I can write a finite or infinite product in pi notation. I can interpret an expression written in sigma or pi notation correctly. I can find the sum of a finite arithmetic series. I can find the sum of a finite or infinite geometric series.
- Objective 4.4.  **$\Sigma$  and  $\Pi$  Manipulations.** I can do sigma and pi manipulations involving sums, products, exponentiation, and logarithms.

## Topic 5: Divisibility and Modular Arithmetic

- Objective 5.1. **Modular Arithmetic.** I can add, subtract, and multiply numbers in  $Z_n$ . I can find powers of numbers in  $Z_n$  by applying rules of exponents, the technique of repeated squaring, and Fermat's Little Theorem.
- Objective 5.2. **Euclidean Algorithm.** I can determine if one number divides another. I understand the concept of the GCD of two numbers. I can use the Euclidean algorithm to find the GCD of two given numbers.
- Objective 5.3. **Prime Factorization.** I can determine the prime factorization of a positive integer and use this information to determine all divisors of an integer.
- Objective 5.4. **GCD and LCM via Prime Factorization.** I can use the prime factorizations of two positive integers to determine the GCD and LCM of those numbers.

MATH 120 fulfills the **MQR** Pathways requirement. As such, this course also includes the following learning objectives.

- MQR1.** Interpret and draw appropriate inferences from quantitative representations, such as formulas, graphs, or tables.
- MQR2.** Use algebraic, numerical, graphical, or statistical methods to draw accurate conclusions and solve mathematical problems.
- MQR3.** Represent quantitative problems expressed in natural language in a suitable mathematical format.
- MQR4.** Effectively communicate quantitative analysis or solutions to mathematical problems in written or oral form.
- MQR5.** Evaluate solutions to problems for reasonableness using a variety of means, including informed estimation.
- MQR6.** Apply mathematical methods to problems in other fields of study.

## How do I get help?

**Learning takes time.** You need to make time in your schedule to watch the content videos before class, complete the daily preparation activities before class, go back over the day's content after class, complete the homework assignments, and prepare for the assessments. Even though the content may seem easy at the beginning of the semester, things will build throughout the semester and get harder as time progresses. There is a large community of people thinking about the ideas in this course who can support you in your learning.

### Help from classmates

The strongest part of your support network is your set of peers. You are *encouraged* to work together with your fellow classmates to understand the material. There are many ways in which you can do this: Form study groups with regularly scheduled meetings. Have a video watching party in person or over zoom. Work together on the homework. Ask each other questions about the material in person or on the course discussion board. Make up practice quiz or exam questions for each other.

### Help from peer mentors and tutors

Queens College has free tutoring available for students in this class. These tutors can be found in two locations:

- The Mathematics Laboratory in Kiely 331 (<https://sites.google.com/view/qc-math-tutoring/home>)
- The Learning Commons (learn more here: <https://www.qc.cuny.edu/academics/qclc/>).

Use this help as often as you need it!

### Help from your instructor

We all want you to succeed. *At the first sign* that you feel like you are falling behind in class, reach out to your professor and discuss ways to get back on track. Your professor offers Office Hours which is time for you to ask questions, get additional feedback, and learn about additional support structure available to you. Office hours will be determined by popular demand during the first week of the semester and posted on the discussion board.

## How does homework work in this class?

Homework in this class has two flavors. It will be made very clear what is expected each day by the posts on our Course Discord – sign up with the link at the top of this syllabus.

- To give you practice with some of the more computational aspects of the curriculum, some assignments will be posted online on Webwork, a free open-source homework system. The link to our Webwork site is posted at the top of this syllabus. To log in to Webwork, you must use your short QC username IN ALL LOWER CASE (like alastname123 for "Alicia Lastname") and use your CAMS password. (If you've forgotten your username and/or password go to <https://cams.qc.cuny.edu/>.) If you are running into issues logging in, let me know.
- When the content is more conceptual, homework questions will be posted on the course Discord. You will be expected to contribute to the class discussion, either by asking questions when something is unclear, answering someone else's question, or generally contributing your ideas to the discussion by asking about extensions to the problems or sharing different ways to think about the problems.

Homework assignments are NOT being provided as busywork. They are there for you to practice the material and prepare for the assessments so that you can show mastery of the learning objectives. You are more than welcome to work on the homework assignments with your classmates. Just make sure that you are responsible for understanding the responses. Remember: the goal is not for you to “give the right answer”. Instead, the goal is for you to become proficient in these concepts because you will be seeing them over and over in your future Computer Science classes.

## Weekly Quizzes, Midterm Exams, and the Final Exam

My goal is to make sure that everyone is making progress toward understanding the key concepts from this class. That is why there is a transparent list of learning objectives – you can know exactly what you need to learn to be able to succeed in this class. I expect that everyone should be able to become proficient in the material if you put in the time.

Approximately every week you will be given a chance to show that you have made progress toward two or three learning objectives through a quiz. These quizzes are a more low-stakes assessment will help you determine which content you need to prioritize studying before the midterm or final. Each quiz will take 10-15 minutes of class, given at the BEGINNING of the class session. (Make sure you are on time!) A missed quiz counts as a 0. Make-up quizzes will not be given. However, your lowest two quiz grades will be dropped.

There will be one midterm exam on Topics 1 and 2, one midterm exam on Topics 3 and 4, and a cumulative common final exam on Topics 1-5. There will be no make-up exam except in the case of a **documented** emergency. In the event of an unavoidable conflict with the midterm (an athletic meet, wedding, funeral, etc...), you must notify me BEFORE the exam (ideally a week before) so that we can arrange alternate arrangements for you to take the exam.

## How will I be graded?

You will be graded based on your work throughout the semester. Each of the following criteria will be graded separately and then a weighted average will be computed with the following weights given:

Daily Preparation Assignments: 5%

Engagement: 5%

Homework Assignments: 5%

Weekly Quizzes: 20%

Midterm 1: 20%

Midterm 2: 20%

Final Exam: 25%

**Daily Preparation Assignments** are graded on completeness. (0 or 1) You may miss up to three Daily Prep assignments and still receive full credit.

You should make every effort to come to class regularly. **Engagement** is graded on your active involvement in the discussions and activities. (0 or 1) You may miss up to three classes without impacting your engagement grade.

Online **Homework Assignments** are graded on correctness. Your homework percentage will be boosted by 10% to a maximum of 100%. Homework Discussions will be graded on engagement. Engagement takes many forms – asking questions, sharing ideas and methods, building on the knowledge and ideas of others.

**We are still living through a pandemic and life happens. I have tried to build flexibility into this grading scheme to address this. If you need additional flexibility or consideration, do not hesitate to contact me.**

## Grading Scale

<b>A+</b>	<b>A</b>	<b>A-</b>	<b>B+</b>	<b>B</b>	<b>B-</b>	<b>C+</b>	<b>C</b>	<b>C-</b>	<b>D+</b>	<b>D</b>	<b>F</b>
97-100	93-96	90-92	87-89	83-86	80-82	77-79	73-76	70-72	67-69	60-66	0-59

## Cheating/Plagiarism:

DON'T DO IT! It makes me very mad and very frustrated when students cheat. Cheating is the quickest way to lose the respect that I have for each student at the beginning of the semester. Both receiving and supplying the answers on a quiz or an exam is cheating.

I take cheating very seriously. If you cheat, you will receive a zero for the quiz/exam and I will report you to the academic integrity committee in the Office of Student Affairs to be placed on your permanent file. If you cheat twice, you will receive a zero for the class.

See the CUNY Policy on Academic Integrity: <http://www.cuny.edu/about/administration/offices/legal-affairs/policies-resources/academic-integrity-policy/>

## Accommodations for Students with Disabilities:

Students with disabilities needing academic accommodation should register with and provide documentation to the Office of Special Services, Frese Hall, room 111. The Office of Special Services will provide a letter for you to bring to your instructor indicating the need for accommodation and the nature of it. This should be done during the first week of class. For more information about services available to Queens College students, contact the Office of Special Services (718-997-5870) or visit their website (<http://sl.qc.cuny.edu/oss/>). If you need special accommodation for an assessment, contact me at least one week beforehand.

## Course Evaluations

During the final four weeks of the semester, you will be asked to complete an evaluation for this course by filling out an online questionnaire. Please remember to participate in these course evaluations. Your comments are highly valued, and these evaluations are an important service to fellow students and to the institution, since your responses will be pooled with those of other students and made available

online at <http://ctl.qc.cuny.edu/evaluations/data>). Please also note that all responses are completely anonymous; no identifying information is retained once the evaluation has been submitted.

## Technical Support

The Queens College Helpdesk (<http://www.qc.cuny.edu/computing/>, (718) 997-4444, [helpdesk@qc.cuny.edu](mailto:helpdesk@qc.cuny.edu)) is located in the I-Building, Room 151 and provides technical support for students who need help with Queens College email, CUNY portal, Blackboard, and CUNYfirst.