Department of Math, Computer Sci, & Data Sci

Instructor:	Almabrok Essa
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Lectures: T/Th   8:30 am – 9:45 pm

Location: D-E 120

Office Hours: T/Th   10:00 – 11:30 am & 3:30 – 5:00 pm.
If none of this work, email me for appointment or stop by whenever you see my office is open.

Credit Hours: 3

Prerequisites: None!
The course will be completely self-contained, but will expect a great deal from the students in the way of intellectual curiosity and willingness to explore.

Course Description:

This course will introduce the mathematical foundations of computer science. Students will develop an understanding of number representation and computation, fundamental topics in set theory, functions, relations, graph theory, propositional logic, and Boolean algebra with an emphasis on applications to computer science such as algorithms, cryptography, digital logic, etc. Further develop the mathematical concepts and technique which should serve as a preparation for more advanced quantitative courses.

Textbook:

- Recommended not Required - Discrete Mathematics and its Applications, 8th edition, by Kenneth Rosen, McGraw Hill 2019.
- Any old or new discrete math textbook will do the job.
- Additional materials may be provided by the instructor for selected topics.

Expected Outcomes:

Upon the completion of this course, students should be able to:

- Understand and use the discrete structures that are backbones of computer science.
- Use various representations of numbers (e.g., binary, hexadecimal, etc.).
- Use language and notation of set theory correctly.
- Perform operations on discrete structures such as sets, functions, and relations.
- Differentiate between functions and relations.
- Interpret and represent logical statements using formal language and notation.
- Model problems using graphs, trees, and matrices.

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Program Objectives and Outcomes:

Computational Thinking and Problem Solving:
- Students will decompose a problem, system or task into parts that are easier to conceive, understand, implement, and maintain.
- Students will recognize patterns among similarities or common differences between a variety of problems.
- Students will use and compare fundamental abstract data types.

Theoretical Foundations:
- Students will apply mathematical foundations to the discipline of computer science.
- Students will understand the theoretical and practical significance of computational theory and its application to important real-world problem domains.
- Students will learn that discrete structures are the backbones of computer science.

Why This Course Matters?
Discrete Math is the language of computer science. It gives you the tools to:
- Prove algorithms correct.
- Analyze efficiency of programs.
- Model data with graphs and relations.
- Understand the math behind security, AI, and networks.

This course will use written homework assignments, quizzes, and exams as the primary means of assessing progress towards these learning outcomes.

Grading Policy:

Quizzes:	25%	*There will be several quizzes given randomly in class*
Homework:	20%	*There will be 8 – 12 assignments*
Midterm exam:	30%	*There will be 2 midterm exams*
		***09/23** & **10/28** (8:30 am – 9:45 am)*
Final exam:	25%	*Thursday **12/11** (8:00 am – 9:50 am)*

A	>=	93
A⁻	>=	90
B⁺	>=	87
B	>=	83
B⁻	>=	80
C⁺	>=	77
C	>=	73
C⁻	>=	70
D	>=	60
F	<	60

In general, grades will be assigned according to this scale in the right:

I may change this slightly based on students' performance in tests that will benefit the students.

Course Policies:

- Attendance to all classes is required. Each student is responsible for his/her missed classes, as well as for any schedule changes decided in class.
- Homework is due the end of day on specified date. **No material will be accepted** after the deadline **unless** a permission is granted by the instructor prior to the deadline.

- A student who misses two assignments must see the instructor immediately with an explanation.
- Talk to instructor for special cases, such as illness. Proper documents may be required as a proof such as a doctor's note.
- Discussions on homework are allowed. **But all homework must be independent work.**
- Any forms of cheating may cause penalties, from getting an **F** in the course to academic actions according to the university regulations.

Course Topics (at a glance):

Logic & Proofs:

Propositional Logic: Use the propositional and predicate logic to express statements; truth tables, propositional equivalences, etc.

Boolean Algebra & Logic Circuits: Simplify logic using Boolean laws; design and analyze basic digital circuits; etc.

Mathematical Induction: Principle of mathematical induction

CS applications: propositional logic, CPU design, digital logic, etc.

Basic Structures:

Sets: Operations on sets; cardinality of sets; equivalence of sets

Functions: Understand functions (One-to-One; Onto; bijection) and their importance in mappings.

Matrices and their classical operations.

Relations: Relations and their properties; representing relations using matrices; operations on relations; equivalence relations.

Graph Theory. Graphs terminology and special types of graphs; applications of graphs.

Counting: Basic counting principles; pigeonhole principle; tree diagrams

CS applications: applications of relations, graph theory (DFA), etc.

Number Theory & Cryptography:

Divisibility and modular arithmetic.

Integer representations and base change.

Primes and GCDs/LCMs; Euclidean algorithm; Bezout's identity

CS applications: applications of congruences (hashing functions, check digits), data representation, cryptography/cybersecurity, etc.

Artificial Intelligence (AI) Assistance Policy: <mark>RED – Use Prohibited</mark>

Students are not allowed to use AI in this course, including for assignments and other learning activities. Unauthorized use of AI will be treated as a violation of the University 's *Policy on Academic Honesty.* By NOT using the AI for your graded work, you will build independent mathematical thinking, logic skills, reasoning & proof fundamentals, etc. *In short: AI can provide answers, but discrete math is about learning to think mathematically.*

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Academic Honesty:

"**Cheating**" means intentionally misrepresenting the source, nature, or other conditions of academic work to receive undeserved credit, including the use of artificial intelligence (AI) when prohibited. John Carroll University (JCU) affirms that acts of cheating debase the academic degree awarded, have no place in the University, and are severe offenses to academic goals, objectives, and the rights of fellow students. JCU does not tolerate any type of cheating and will take disciplinary action up to and including expulsion. The policy of academic honesty can be found at: Academic Honesty Policy - JCU.

Mental Wellness Statement:

As a college student, there may be times when personal or life stressors interfere with your academic performance and/or negatively impact your daily life.

If you or someone you know is experiencing mental health challenges at JCU, consider contacting the Counseling Center by calling 216-397-4283, or visiting their website at University Counseling Center and requesting an appointment in the online portal. The center also offers drop-in consultations with a therapist in their Let's Talk program – no appointment necessary. All services are free and confidential.

Disability Statement:

If you have a disability for which you will need to request accommodations, please contact as soon as possible the Office of Student Accessibility Services (SAS), their webpage → SAS Page and email → sas@jcu.edu. After they certify your needs, I will work with you on accommodations.

Accessibility, Inclusion, Harassment and Bias:

John Carroll University is committed to fostering an equitable and accessible learning and working environment, based upon open communication, mutual respect, and ethical values consistent with the Jesuit and Catholic tradition. See → Policies & Procedures for how we express this commitment.

This syllabus is subject to change!