CSC 208 (D01A)

Introduction to Discrete Structures

Course Syllabus

Instructor	Jeffrey Elkner
Session	Spring 2025
Meeting Times	Section1: B Day 8:00 to 9:24 am / Section 2: B Day 11:32 am to 12:55 pm
Location	Arlington Career Center Room 512
Contact	jde232@email.vccs.edu

Course Description

Introduces discrete mathematics concepts in relation to computer science. Applies the use of Boolean algebra, analysis of algorithms such as logic, sets and functions, recursive algorithms, and recurrence relations, combinatorics, graphs, and trees. Assignments in this course require a basic understanding of programming concepts, problem solving, basic college algebra and trigonometry skills. 3 Credits.

General Course Purpose

CSC 208 is designed to provide students with components of discrete mathematics in relation to computer science used in the analysis of algorithms, including logic, sets and functions, recursive algorithms and recurrence relations, combinatorics, graphs, and trees.

Course Prerequisites/Co-Requisites

None.

Course Objectives

Critical Thinking

- Evaluate the success of computational solutions for a given scenario.

Written Communication

- Develop concrete and implementable solutions to a computational problem, and exchange ideas with robust logic and mathematically soundness in the computer literate community.

Quantitative Literacy

- Perform accurate calculations, interpret quantitative information, apply and analyze relevant numerical data, and use results to support conclusions.

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Professional Readiness

- Work well with others and display situationally and culturally appropriate demeanor and behavior.

Scientific Literacy

- Assess how current and emerging technologies contribute to technological development and dissemination.

Sets, Relations, and Functions

- Explain with examples the basic terminology of functions, relations, and sets.
- Perform the operations associated with sets, functions, and relations.
- Compare practical examples to the appropriate set, function, or relation model, and interpret the associated operations and terminology in context.
- Use the terms cardinality, finite, countably infinite, and uncountably infinite to identify characteristics associated with a given set.
- Demonstrate the algebra of sets, functions, sequences, and summations.

Proof Techniques

- Outline the basic structure of each proof technique, including direct proof, proof by contradiction, and induction.
- Apply each of the proof techniques (direct proof, proof by contradiction, and proof by induction) correctly in the construction of a sound argument.
- Deduce the best type of proof for a given problem.
- Explain the parallels between ideas of mathematical and/or structural induction to recursion and recursively defined structures.
- Explain the relationship between weak and strong induction and give examples of the appropriate use of each.
- Construct induction proofs involving summations, inequalities, and divisibility arguments.

Basics of Counting

- Apply counting arguments, including sum and product rules, inclusion-exclusion principle and arithmetic/geometric progressions.
- Apply the pigeonhole principle in the context of a formal proof.
- Calculate permutations and combinations of a set, and interpret the meaning in the context of the particular application.
- Compare real-world applications appropriate to counting formalisms.
- Solve a variety of basic recurrence relations.
- Analyze a problem to determine underlying recurrence relations.
- Perform computations involving algebraic and modular arithmetic.
- Determine if a recursive solution is more efficient than an iterative solution.

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Basic Logic

- Use a truth table to prove the logical equivalence of statements.
- Convert logical statements from informal language to propositional and predicate logic expressions.
- Apply formal logic proofs and/or informal, but rigorous, logical reasoning to real problems such as predicting the behavior of software or solving problems such as puzzles.
- Use the rules of inference to construct proofs in propositional and predicate logic.
- Describe how symbolic logic can be used to model computer applications.
- Apply formal methods of symbolic propositional and predicate logic, such as calculating validity of formulae and computing normal forms.
- Describe the strengths and limitations of propositional and predicate logic.

Graph & Trees

- Illustrate the basic terminology of graph theory including properties and special cases for each type of graph/tree
- Demonstrate different traversal methods for trees and graphs, including pre-, post-, and in-order traversal of trees.
- Solve a variety of real-world problems in computer science using appropriate forms of graphs and trees, such as representing a network topology or the organization of a hierarchical file system.
- Implement graph algorithms.
- Implement and use balanced trees and B-trees.
- Demonstrate how concepts from graphs and trees appear in data structures, algorithms, proof techniques (structural induction), and counting.
- Describe binary search trees and AVL trees.
- Explain complexity in the ideal and in the worst-case scenario for both implementations.

Discrete Probability

- Calculate probabilities of events and expectations of random variables for elementary problems.
- Differentiate between dependent and independent events.
- Explain the significance of binomial distribution in probabilities.
- Apply Bayes Theorem to determine conditional probabilities in a problem.
- Apply the tools of probability to solve problems.
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Recurrence Relations

- Explain recurrence relations in respect to sequence or multidimensional array of values in computing.
- Explain what types of problems are solved using recurrence methods.
- Explain how recurrence ties to complexity analysis.
- Apply recurrence relations in a given scenario.

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Boolean Algebra & Expressions

- Convert a verbal specification into a Boolean expression.
- Explain basic properties of Boolean algebra: duality, complements, standard forms.
- Apply Boolean algebra to prove identities and simplify expressions.
- Translate verbal specifications into Boolean expressions and state machines.
- Use Karnaugh maps to find minimal sum-of-products and products-of-sums expressions.

Combinatorial Circuits

- Explain the operation of discrete logic gates.
- Describe the relationship between Boolean algebra and electronic circuits.
- Analyze a combinational network using Boolean expressions.
- Design simple combinational networks that use NAND, NOR, and XOR gates.
- Design with MSI components such as encoders, decoders, multiplexers, adders, arithmetic-logic units, ROMs, and simple programmable logic arrays.
- Calculate delays in ripple carry adders and simple combinational arrays.

Major Topics to be Included

- Sets, Relations, and Functions
- Proof Techniques
- Basics of Counting
- Basic Logic
- Graph & Trees
- Discrete Probability
- Recurrence Relations
- Boolean Algebra & Expressions
- Combinatorial Circuits

Required Instructional Materials:

- *Discrete Mathematics: An Open Introduction* by Oscar Levin
- Other freely available resources as provided by instructor

Course Credit: 3 Credits

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Policies

I. Expectations

A. Introduction to Computer Science is a rigorous, college level course that will require sustained and consistent engagement from students.

B. An average of 90 minutes of homework will be assigned for each 90 minutes in class. We will be utilizing a flipped classroom learning environment, where the lecture portion of the course material will be viewed individually at home *before* class meets, and class time will be used for collaborative engagement and discussion.

C. Frequent "mini quizzes" at the beginning of class will be used to be sure homework readings and practice have been completed. To be successful in this class, students will be expected to be prepared for these quizzes when they arrive in class.

II. Grading Policies

A. Grading Scale: A= 100 - 90 B= 89 - 80 C= 79 - 70 D=69 - 60 F= 59 and below

B. Students will receive a weekly cumulative letter grade that will incorporate daily quizzes, tests, projects, and presentations. These weekly evaluations can be challenged by the student, *but only during the week immediately following when the evaluation is given*.

C. The average of the weekly evaluations will make up 70% of the final grade, with the course final exam making up 30%.

D. In cases where district grading policies conflict with college grading policies, the high school and college grades may differ; this may include assignment/test retakes, extended assignment due dates, capped minimum grade allowed, among other such district policies.

E. It is important that students check their final NOVA grades in SIS as soon as their course is completed.

F. Course Grade Appeals

i. Students who think that a semester grade is in error should contact the instructor immediately to present their concerns. Students who wish to appeal their grade or otherwise report a grievance will need to submit Form 125-021 within 20 days of the end of the semester. The original grade will stand if the student delays in submitting their appeal.

ii. NOVA's Student Grievance policy can be found here: https://www.nvcc.edu/policies/_files/608-Student-Grievances.pdf

iii. Form 125-021 can be found here: https://www.nvcc.edu/forms/

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III. Course Policies

A. Student Rights and Responsibilities
   i. Students should be familiar with the college's specific expectations concerning the conduct of its students. These expectations apply to all students, including Dual Enrollment students.
   ii. Student Rights and Responsibilities are outlined in the Student Code of Conduct, found here: https://www.nvcc.edu/students/handbook/conduct.html

B. Academic Integrity
   i.
   ii. To grant parents or guardians direct access to NOVA records, students will be required to submit a notarized copy of NOVA Form 125-356, found here: https://www.nvcc.edu/forms/pdf/125-356.pdf.
   iii. For more information about student privacy, parent limitations of access to students' educational records, and other restrictions on sharing students' personally identifiable information, please review NOVA Policy 613 (FERPA): https://www.nvcc.edu/policies/_files/613-FERPA.pdf.

D. Campus Services
   i. Dual enrolled students have access to full NOVA campus services to include tutoring, library, and counseling services; student resources are found here: http://www.nvcc.edu/students/index.html.

E. Office of Wellness and Mental Health
   i. During your time at NOVA, you may experience challenges including struggles with academics, finances, or your personal well-being. NOVA has support resources available. If you are seeking resources and support or if you are worried about a friend or classmate: https://www.nvcc.edu/wellness/index.html.

F. Course Drop and Withdrawal Policy
   i. Please note two important dates related to your enrollment in a course:
      a. The "Drop" date (also known as census date) for a course is the last day to drop a course. Dropping a course before the drop date will not appear on your NOVA transcript.
      b. The "Withdrawal" date is the last day to withdraw without a grade penalty. Dropping a course after the drop date and before the withdrawal date will result in a 'W' grade appearing on your transcript.
      c. To identify these dates for your dual enrollment course, please see below on the 'Course Schedule' chart or log into your myNOVA account and SIS.
   ii. Withdrawal Process
      a. Dual enrolled students are responsible for requesting to drop or withdraw from their DE classes, using Form 125-03, found at the following link: https://dashboard.nvcc.edu/Forms/125-03
      b. Dual enrolled students will use their myNOVA credentials to access the withdrawal form and will select one or more enrolled DE classes to withdraw.
      c. The withdrawal form is then routed to the assigned DE instructor and the Office of Dual Enrollment for review and approval.
      d. Check your VCCS email for the status of your request.

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G. Communication
   i. Students are required to use their VCCS email accounts (_____@email.vccs.edu) to communicate with college personnel and should check their email accounts regularly. Students may access their VCCS email accounts through myNOVA.

H. Title IX
   i. Title IX is a civil rights law that prohibits discrimination on the basis of sex in educational programs, activities, admission and employment. Complaints of sex-based discrimination, sexual violence, domestic violence, and sexual or gender-based harassment are governed by the Title IX Policy. For more information about Title IX or to make a report: https://www.nvcc.edu/titleix/index.html.

IV. Additional Course Information

A. DE students are expected to engage in college level course contents and discussions appropriate for adult learners. Mature topics may be discussed.

V. Course Schedule

A. Critical Course Dates

Course Start Date	Monday, February 3, 2025
Course Drop Date	Monday, February 24, 2025
Course Withdrawal Date	Friday, April 25, 2025
Final Exam Date	Thursday, June 12, 2025
Course End Date	Thursday, June 12, 2025

B. Final Exam Date: *The final exam will be given during the last day of class, Thursday, June 12th.*