CSIS-213: DISCRETE STRUCTURES

Effective Term
Fall 2024

BOT Approval Date
11/09/2023

Discipline
CSIS - Computer Sci/Info Systems
Course Number
213

Course Title
Discrete Structures

Short Title
Discrete Structures

Credit Status (CB 04)
D - Credit - Degree applicable

Units

Lecture Units
3.00

Total Units
3.00

Hours

Lecture Contact Hours
48-54
Out of Class Hours Lecture
96-108

Total Contact Hours
48 - 54

Total Out of Class Hours
96 - 108

Total Student Learning Hours
144 - 162

Distance Education
Yes

Distance Education

Distance Education Type
Both Fully Online and Hybrid Online

Fully Online Delivery Requirements:
a. Students must be notified via the college schedule of classes and the syllabus for the class if proctored tests are required for this course
b. Any planned face-to-face meetings, such as an orientation or study session, must be optional

c. The MSJC curriculum committee requires the use of accessible, asynchronous discussion as a component of every fully online course

Are you using publisher content?

No

Regular Substantive Interaction

Instructor-to-student, student-to-student, and student-to-content contact shall be distributed in a manner that will ensure regular substantive interaction (RSI) is maintained not only weekly but also for the duration of the course. Instructor interactions should be equivalent in time, quality and consistency to the engagement students would receive in a face-to-face course—for example, through announcements, discussion participation, personalized feedback, video messages, or other instructional communications. Instructors are expected to be responsive to student inquiries within a 24-72 hour time frame excluding holidays. RSI will be maintained through a variety of methods: • Orientation - Students must be oriented to the online and face-to-face portions at the start of the course. • Announcements - Announcements using the course management system must be posted at least weekly to keep students current on course events, due dates, materials, etc. • Discussion Forums - Content-related discussion forums within the designated CMS will include appropriate instructor participation and will be initiated and maintained, with timely feedback provided. Instructors are required to monitor the discussions and related activities to provide guidance and direction. Open-ended discussion boards may be used to further learning and interaction. • MSJC Communication – Instructor will use MSJC-administered communication tools (such as email or the designated CMS communication tools) to regularly communicate with and provide ease of access to students. • Timely Feedback - Timely feedback on student work will be provided by the instructor, which may include comments and/or rubrics, within the Grades area of the designated CMS. • Scheduled Meetings – Hybrid and synchronous courses will meet at regularly scheduled times. ADA Compliance - All course interactions and content must be designed with accessibility in mind and meet ADA requirements.

C-ID (Admin Only)

C-ID COMP 152

Catalog Description

This course is an introduction to the discrete structures used in Computer Science with an emphasis on their applications. Topics covered include: Functions, Relations and Sets; Basic Logic; Proof Techniques; Basics of Counting; Graphs and Trees; and Discrete Probability.

Requisites

Prerequisite(s)

Prerequisite(s) (must be taken before)
CSIS-113A or CSIS-113B (with a grade of C or better).

Codes

TOP Code (CB 03)

0706.00 - Computer Science (transfer)

CIP Code

11.0701 - Computer Science.

Repeatability Code

No

Grading Option

Letter grade OR P/NP

Cal-GETC Areas

Approved Cal-GETC Area

AREA-2

Learning Objectives

Learning Objectives

Learning Objective
1. Evaluate how formal tools of symbolic logic are used to model real-life situations, including those arising in computing contexts such as program correctness, database queries, and algorithms.
2. Appraise the ideas of mathematical induction to recursion and recursively defined structures.
3. Analyze a problem to create relevant recurrence equations.
4. Compare different traversal methods for trees and graphs.
5. Evaluate the binomial theorem to independent events and Bayes' theorem to dependent events.
6. Evaluate initiatives that promote equitable access to mathematical education.
7. Compare examples and potential sources of algorithmic bias in computer systems and computer logic that can reinforce biases of race, gender, sexuality, and ethnicity in modern software systems.
8. Construct correct direct and indirect proofs.
9. Arrange division into cases in a proof.
10. Propose logical reasoning to solve a variety of problems.
11. Consider binary relations between two sets; determine if a binary relation is reflexive, symmetric, or transitive or is an equivalence relation; combine relations using set operations and composition.

Learning Outcome Information

Course Learning Outcomes

Learning Outcome
1. The student will demonstrate an understanding of Digital Logic Circuits, Combinational Circuit, Boolean Expressions, Gates, Binary Addition and Subtraction, Hexadecimal Notation.
2. The student will demonstrate the proper application of Implication, Converse, Inverse, Contrapositive, Negation, Contradiction, Direct, Counter example, and Contradiction proof techniques.
3. The student will create functions that illustrate the proper usage of Arrow Diagrams, Boolean Functions, Surjections, Injections, Inverse, and Composition.
4. The student will develop counting and probability algorithms that display the proper usage of the Pascal Formula, Binomial Theorem, Conditional Probability, Bayes Theorem, and Independent Events.

Program Learning Outcomes

Learning Outcome
Research and apply industry reference models and best practices in order to improve process designs.
Apply systems concepts in the investigation, evaluation, and resolution of information technology problems.

Institutional Learning Outcomes

Critical Thinking: The student will analyze problems, gather and synthesize relevant information, evaluate ideas, information, and evaluate alternative points of view to create, innovate and implement effective solutions.

Content

Course Lecture Content

1. Functions, Relations, Sets, and Functions
   a. Relations (surjections, injections, inverses, composition)
   b. Reflexivity, symmetry, transitivity, equivalence relations
   c. Sets (Venn diagrams, complements, Cartesian products, power sets)
   d. Pigeonhole principles Cardinality and countability
2. Basic Propositional logic
   a. Logical connectives Truth tables
   b. Normal forms (conjunctive and disjunctive)
   c. Validity Predicate logic

   d. Universal and existential quantification
   e. Modus ponens and modus tollens Limitations of predicate logic
3. Proof Techniques
   a. Notions of implication, converse, inverse, contrapositive, negation, and contradiction
   b. The structure of mathematical proofs
   c. Direct proofs Proof by counterexample
   d. Proof by contradiction
   e. Mathematical induction
   f. Strong induction
   g. Recursive mathematical definitions Well orderings
4. Basics of Counting
   a. Counting arguments
   b. Sum and product rule Inclusion-exclusion principle
   c. Arithmetic and geometric progressions
   d. Fibonacci numbers
   e. The pigeonhole principle
   f. Permutations and combinations
   g. Basic definitions Pascal's identity
   h. The binomial theorem
   i. Solving recurrence relations
   j. Common examples
   k. The Master theorem
5. Graphs and Trees
   a. Trees
   b. Undirected graphs
   c. Directed graphs
   d. Spanning trees/forests
   e. Traversal strategies
6. Discrete Probability
   a. Finite probability space, probability measure, events
   b. Conditional probability, independence, Bayes' theorem
   c. Integer random variables, expectation
   d. Law of large numbers
7. Assess the relevance of discrete mathematics concepts to address the promotion of equity and inclusion to solve real world problems.
   a. Apply Discrete Structures to Real-World Issues:
   b. Critically Evaluate Algorithmic Bias and Fairness
   c. Collaborate on Diverse Problem-Solving Teams
   d. Explore Applications in Social Justice
   e. Promote Equity in Access to Mathematical Education

Methods of Instruction

Method

Lecture

Integration

Lecture, with supporting visual materials (presentation or multimedia) will introduce conceptual and practical skills such as the analysis of a problem to create relevant recurrence equations, evaluate initiatives that promote equitable access to mathematical education, the different traversal methods for trees and graphs, the construction of correct direct and indirect proofs.

DE Adaptations for MOI

Lecture, with supporting visual materials (presentation or multimedia) will introduce conceptual and practical skills such as the analysis of a problem to create relevant recurrence equations, evaluate initiatives that promote equitable access to mathematical education, the different traversal methods for trees and graphs, the construction of correct direct and indirect proofs.

Lectures will be delivered using video capture software to embed voice into lecture slides. Internet technologies HTML, and CSS will be used to deliver additional lecture notes and sample materials. All lecture material will be located within the course management system. All videos will be captioned, or a transcript of the video will be provided.

Method

Observation and Demonstration

Integration

Guided practice and demonstration will illustrate lecture principles and reading assignments, with a focus on such Discrete Structures problems as mathematical induction to recursion and recursively defined structures, different traversal methods for trees and graphs, Use division into cases in a proof, Identify examples and potential sources of algorithmic bias in computer systems.

DE Adaptations for MOI

Guided practice and demonstrations to apply discrete structure methods such as the binomial and Bayes theorems, different traversal methods for trees and graphs, mathematical induction to recursion, and the use of formal tools of symbolic logic to model real life situation will be accomplished by using video/ audio capture software that will permit instructor demonstration to be captured and deployed. Hands-on activities can be similarly accommodated and supplemented with the use of software simulations.

Guided practice and demonstrations will be accomplished by using video / audio capture software (e.g., Camtasia) that will permit instructor demonstration to be captured and deployed. Hands-on activities can be similarly accommodated and supplemented with the use of software simulations. All provided videos will be fully captioned or a transcript of the audio provided. In addition, all images will have alternate text provided. Guided practice will be delivered and collected in the assignments tool of the course management system.

Method

Discussion

Integration

Weekly discussion will be conducted as a means to compare and contrast the use and implementation of the binomial and Bayes' theorems, traversal methods for trees and graphs, mathematical induction to recursion, the use of formal tools of symbolic logic to model real life situations and initiatives that promote equitable access to mathematical education.

DE Adaptations for MOI

Weekly discussion will be conducted as a means to compare and contrast the use and implementation of the binomial and Bayes' theorems, traversal methods for trees and graphs, mathematical induction to recursion, the use of formal tools of symbolic logic to model real life situations and initiatives that promote equitable access to mathematical education will be administered and collected using the discussion tool that is part of the course management system.

All text provided within the discussion will have appropriate contrast to meet ADA guidelines. All provided videos will be fully captioned or a transcript of the audio provided. In addition, all images will have alternate text provided.

Methods of Evaluation

Method

Exams/Tests

Integration

Written exams composed of short answer questions and small discrete logic example problems will be given that are designed to show the students understanding of the ideas of mathematical induction and recursion, traversal methods for trees and graphs, the application of binomial and Bayes' theorem, and the analysis of problems to create relevant recurrence equations.

Written exams will be evaluated based on completion without error; how well directions are followed; solution correctness; All exams will be delivered and collected through the assignments tool of the course management system.

DE Adaptations for MOE

Written exams composed of short answer questions and small discrete logic example problems will be given that are designed to show the students understanding of the ideas of mathematical induction and recursion, traversal methods for trees and graphs, the application of binomial and Bayes' theorem, and the analysis of problems to create relevant recurrence equations.

Questions on the exam will be delivered and collected using the exam or quizzes tool of the course management system. Feedback for the exams will be left in the comments area of the course management system gradebook tool. Written feedback will be provided within 72 of the assignment due date. All feedback will be provided within the exam or quiz tool of the course management system.

Written exams will be evaluated based on completion without error; how well directions are followed; solution correctness.

Method

Homework

Integration

Weekly assignments created from the current unit's lecture topic presented will be given. The assignments are intended to demonstrate the students understanding recurrence equations, traversal methods for trees and graphs, recursion and recursively defined structures, the application of logical reasoning to solve a variety of problems, and evaluating initiatives that promote equitable access to mathematical education.
Weekly assignments will be evaluated based on completion without error; how well directions are followed; solution correctness; proper input and output. All homework assignments will be delivered and collected through the assignments tool of the course management system.

DE Adaptations for MOE

Weekly assignments created from the current unit's lecture topic presented will be given. The assignments are intended to demonstrate the students understanding recurrence equations, traversal methods for trees and graphs, recursion and recursively defined structures, the application of logical reasoning to solve a variety of problems, and identifying and evaluating initiatives that promote equitable access to mathematical education.

Weekly assignments will be evaluated based on completion without error; how well directions are followed; solution correctness; proper input and output. All homework assignments will be delivered and collected through the assignments tool of the course management system.

Written feedback will be provided within 72 of the assignment due date. All feedback will be provided within the assignment tool of the course management system.

Method

Quizzes

Integration

Several quizzes derived from the reading and lecture material will be given that are aimed at demonstrating the student's understanding of mathematical induction, recursion and recursively defined structures, traversal methods for trees and graphs, and binomial and Bayes' theorems.

Quizzes will be evaluated based on completeness and solution solution correctness. All quizzes will be delivered and collected through the assignments tool of the course management system.

DE Adaptations for MOE

Several quizzes derived from the reading and lecture material will be given to evaluate the students understanding of traversal methods for trees and graphs, recurrence equations, mathematical induction, and recursion. Quizzes will be delivered and collected using the quizzes tool in the course management system. Feed back for the quizzes will be located in the comments area of the gradebook tool within the course management system.

Quizzes will be evaluated based on completeness and solution solution correctness. Written feedback will be provided within 72 of the quiz due date. All feedback will be provided within the exam or quiz tool of the course management system.

Assignments

Assignment Type
Writing

In-class and/or outside of class
Outside of class

Formative or Summative
Summative

Assignment
Assignment Title: Graph Coloring and Diversity

Objective: To explore the concept of graph coloring and its applications in promoting diversity and inclusivity.

Instructions:

Research the concept of graph coloring and its applications in computer science and mathematics.

Choose a real-world problem related to diversity and inclusivity, such as promoting diversity in the workplace, reducing discrimination, or addressing inequality in education.

Create a graph model that represents the problem, using nodes and edges to represent different groups of people or factors that influence the problem.

Use graph coloring algorithms to find a solution that promotes diversity and inclusivity. For example, you could use a coloring algorithm to assign different resources or opportunities to different groups in a way that ensures everyone has equal access.

Write a report summarizing your findings and reflecting on the importance of diversity and inclusivity in solving real-world problems.

How assignment will be adapted in online format
The assignment will be created using the assignment editor found in the course management system. The assignment will be distributed and collected using the assignments area of the course management system. Feedback will be provided to students via the course management system within five days of submissions and a rubric will be utilized to provide students with evaluation criteria.

Assignment Type
Reading

In-class and/or outside of class
In-class
Outside of class

Formative or Summative
Formative

Assignment
In this assignment you will explore the development of cryptography and its connection to discrete structures. Please read the article “The Mathematics of Cryptography” by Keith Develin and summarize the key points regarding the historical development of cryptography. In addition, explain the fundamental role number theory has in cryptography. Please provide examples of how number theory concepts are used in cryptography.

How assignment will be adapted in online format

The assignment will be created using the assignment editor found in the course management system. The assignment will be distributed and collected using the assignments area of the course management system. Feedback will be provided to students via the course management system within five days of submissions and a rubric will be utilized to provide students with evaluation criteria.

Course Materials

Textbooks

Discrete Mathematics Essentials and Applications
Ali Grami
Academic Press, 2022
ISBN 978-0-12-820656-0

Class Size Information

Class Size

30

Class Size Category

C - Remedial or advanced math 30

Diversity and Inclusion

Explain how diversity and inclusion(e.g., gender, culture/race, sexuality, etc.) is infused into the course.

Lectures will include inclusive language to ensure that names and scenarios are culturally diverse and void of the reinforcement of stereotypes. Guided practice and demonstration will provide ideas on how discrete structures ideas can be applied to create equitable and inclusive environments. Assignments will be given that do not rely on any gender specific assumptions or stereotypes. Lectures and guided practice will encourage students to think critically about the social impact of mathematical concepts.

Describe how assignments, instruction, evaluation, course content, and interactions are contextualized for diverse learners promoting an equitable course.

A safe space will be created in the classroom to empower students to openly discuss equitable, inclusive, and diverse ideas. The safe space will be created by the development of appropriate language use, encouraging open and honest dialog, empowering students to share without ridicule, and by processing information shared by reconnecting it to the course content.

Assignments are constructed with flexibility and variety in mind to allow students to show what they have learned regardless of the academic strengths or familiarity with specific assignment types. An aspect of the assignments that will promote equity and inclusion is to allow the student to select from several different formats which will still meet the goal of the assignment.

Interactions

Explain how the course will incorporate student-to-student interaction.

Each lecture of the course will have several small programs to solve. Students are encouraged to work in groups to solve the problem as a team. In addition, two group projects will be assigned where students will be required to work with each other to derive a solution. Each unit of the course has its own discussion board where students can go to interact and help each other understand topics such as the ideas of mathematical induction and recursion, traversal methods for trees and graphs, the application of binomial and Bayes' theorem, and the analysis of problems to create relevant recurrence equations
To further promote student to student interactions a discussion board will be created in the course management system titled “Student Lounge” where students can go to converse and share ideas with each other.

Explain how the course will incorporate instructor-to-student interaction.

A welcome letter will be sent to the students the first day of class which not only welcomes students to the class but also gives details of how to navigate the course. The announcements area of the course management system will be used to send weekly announcement about important concepts and due dates. A welcome to class announcement will be provided which contains a video that explains the details of the class.
A separate discussion board will be created in the course management system for each unit of the class. These discussion boards are a place where students can get feedback from the instructor on such topics the use and implementation of the binomial and

Bayes' theorems, traversal methods for trees and graphs, mathematical induction to recursion, the use of formal tools of symbolic logic to model real life situations and the gender gap in the technology industry.

In addition, a general questions discussion board will be provided where students are encouraged to speak with the instructor on any Discrete Structures related topic.
Students are encouraged to email the instructor with any questions they may have that they do not want publicly published.

Explain how the course will incorporate student-to-content interaction.

All courses have an online lecture component. The content of the course has several “test your knowledge” pieces where students get instant feedback about their understanding of the material presented. In addition, a series of "video shorts" are given that reinforce topics given. Practice exams will be created as a way for students to get an understanding of the type of questions being asked on the exams and a way to hone skills before taking the exam. At the end of each lecture component several practice problems will be presented to give students a better understanding of the material offered in that unit. All practice problems will have the solution provided so students can reflect on their logic used to solve the problem.

Explain how the course will incorporate student-to-self interaction (metacognitive).

The course emphasizes the idea of thinking logically and to consider other logical interpretations of problem solving using a mathematical logic. Through discussion and assignment, we ask students to pose questions about problem solving and how they approach problem solving through the application of Discrete Structures. Through self-assessment we ask students to reflect on where they are successful and where they are having difficulty and how they can improve upon both their syntactical and logical skills.
We encourage students to think outside the box and investigate other problem-solving techniques from outside sources as a means to not only improve but to understand problem solving from other points of view.

Key: 1076