UNIVERSITY OF GUAM
UNIBETSEDÅT GUAHAN

COLLEGE OF NATURAL & APPLIED SCIENCES
Division of Mathematics & Computer Sciences

Course: CS 271-01 Discrete Structures (3 credit Hours)

Semester: FALL 2024

Class Meeting: M W 8:00 – 9:20 p.m. **RM:** WB 1

Instructor: Dr. Raymond Paulino
Office: WB Annex Rm 9
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Email: paulinor4388@triton.uog.edu
Office Hours: MW 10:00-12:00, TTh: 1:50-2:50
All other times by appointment upon request

Moodle Key: cs27101stu2024

Catalogue Course Description:
CS271 Discrete Structures (3)
Course provides students with the foundations of discrete mathematics as they apply to computer science, Topics include functions, relations, sets, simple proof techniques, Boolean algebra, propositional and predicate logic, fundamentals of counting, graphs, trees, hash table, maps, discrete probability.

Prerequisites : MA165, CS202 (Grade of C or higher)

Course Content:
Topics treated in this course include logic, sets, proofs, algebraic systems, elementary and advanced counting, relations, graph theory (including trees), Boolean algebra, formal languages and finite state machines.

Rationale for Offering the Course:
Discrete structures serve as a foundation for many areas in computing. Discrete structures include material from such areas as set theory, logic, graph theory, and probability theory. The material in discrete structures is pervasive in the areas of data structures and algorithms as well formal specification, verification, database, networks, cryptography, operating systems, etc. virtually almost every area of computer science.

Intended Student Learning Outcome:
After completing the course, successful students will be able to
1. *demonstrate knowledge* of mathematical concepts and techniques from set theory, logic and counting to describe and solve numerical and algorithmic problems;
2. *use* the theory of relations and functions to describe, understand and create suitable data structures;
3. *perform and evaluate* different search algorithms in tree structures;
4. *understand* the basic properties of graphs;
5. *identify and locate* Euler and Hamiltonian Circuits in graphs, *find solution* for a variety of other algorithmic problems in graphs.

Textbook: Discrete Mathematical Structures by Kolman, Busby and Ross, 6th edition.

Format/Activities in the Class:
Classes consist of lectures, demonstrations, paper-pencil problem solving and presentations.

You are expected to attend each class session. Learning mathematics requires that you study and practice mathematics *every day*. *Dialogue and cooperative learning* is encouraged. Please, make effort to come to the board and my office hours frequently to share your solutions. You will learn *clear communication* of your ideas.

Assignments, Quizzes, Exams: You will have to *read the textbook for each class in advance* and review the section. **You need to do *all homework assignments,* even if I don't collect them.**

There will be **quizzes** to prepare you for the exams. There will be two or three **midterm exams**. A preliminary time schedule is listed below. Timing may change depending on the progress we make with the course material. The **Final Exam** is cumulative.

Read all sections covered every day, work all homework and worksheet problems assigned on a daily/weekly basis, work on all review problems assigned for scheduled exam.

Quizzes and Exams: Each week there will be either a quiz or an exam. The exam problems will be from the quizzes, and the quiz problems will come from or similar to the homework.

Quizzes and Exams wills be either one of the following **types**:

Type 0. In Class, Closed notes & book. No calculator, computer internet, and outside communication.

Type 1. In Class with open notes, book, and calculator allowed, but no communicating with others. You may use your laptop or iPad but must show me that you're offline.

Type 2. In Class with option to take home. If you finish before class time ends, then you will get 10% extra credit.

Type 3. Take home.

I will let you know ahead of time, which type of Quiz/Exam it will be.

Please come to Office Hours after you get your quizzes and exams back so I can help you improve and fix your mistakes. Various extra credit opportunities are given throughout the course and announced in class.

EVALUATION AND GRADES:

-	Midterm Exams:	40% (2-3 midterms)
-	Final Exam:	20%
-	Quizzes	25% (10-11 quizzes)
-	HW and Participation	15%
	Total:	100%

Letter grades will be assigned as follows:

98 – 100%	A+	4.0
93 – 97%	A	4.0
90 – 92%	A-	3.67
87 – 89%	B+	3.33
83 – 86%	B	3.00
80 – 82%	B-	2.67
77 – 79%	C+	2.33
70 – 76%	C	2.00
60 – 69%	D	1.00
0 – 59% F	F	0

Make-Up, Due Dates, and Attendance:

For Extenuating circumstances that you need to miss a quiz or exam, then I will allow you to do makeup if I decide that you have a valid excuse. If your excuse is valid then I will let you know how to do a makeup. **You must notify me at least one week before you do the makeup.** ←VERY IMPORTANT, do not wait till the last day of class. A student who has missed 15 class sessions (excused or unexcused), will be automatically given a course grade of an F.

Working together

You are encouraged to choose one or more *study partners* to learn together. While working together is encouraged, please note that all work, quiz or test you hand in must reflect *your own individual efforts*. Keep in mind that the scores, including your overall semester score that you earn, will be in direct correlation with the individual effort you invest in studying your subject.

ACADEMIC DISHONESTY: Plagiarism and cheating are serious offenses and may be punished by failure on the exam, paper or project, failure in the course and/or expulsion from the University and a letter placed in your permanent file. For more information refer to the academic dishonesty policy in the University handbook.

COURSE POLICIES:

Attend each class on time, participate and do the coursework. If you cut a class, it is *your responsibility* to make up any missed class material. Cell phones, or any distractive devices must be *turned off* in the classroom. Be courteous in class, respect and pay attention to your instructor/classmate who works at the board. *Focus on learning* so that your understanding benefits the most from your participation in the class activities. *Academic dishonesty* and *plagiarism* are serious violations of university policy, punished by failing grade and/or suspension. *Never cheat* and *never be dishonest*!

DROP DATE:

Please see the current UOG Course Schedule for the last days to withdraw.

FOR CLASSMATES:

You are encouraged to exchange *contact information* with your classmates. Choose at least one *study partner*. Contact your classmate(s) if you miss a class and make up the missed material. You are also encouraged to form *study groups.* List here some contact information from your classmates:

Your Math Resources: There are several campus resources available to you if you need extra help with any of the course material.

- Your instructor! Make an appointment to meet with me.
- The Math Tutor Lab! The CNAS Math Tutor Lab is located at the Agriculture and Life Sciences Building in Room 230 (ALS230). For more information, please call 735-2064, email mathtutorlab@triton.uog.edu or visit the tutor lab website www.uogmathlab.org

Special Accommodations:

For individuals covered under the ADA (Americans with Disabilities Act), if you are a student with a disability requiring academic accommodation(s), please contact the Disability Support Services Office to discuss your confidential request. A Faculty Notification letter from the Disability Support Services counselor will be provided to me. To register for academic accommodations, please contact or visit Sallie S. Sablan, DSS counselor in the School of Education, office 110, disabilitysupport@triton.uog.edu or telephone/TDD 671-735-2460.

Tobacco Policy:

The University of Guam is a tobacco-free campus and has a total ban on sales, smoking and distribution and use of tobacco and tobacco-based products on campus. UOG is committed to promoting the health, wellness and social well-being of the University Community, the people of Guam and the Western Pacific.

COURSE LEARNING OUTCOMES Mapping
This course covers the following ACM/IEEE CC2013 Body of Knowledge student learning outcomes:

- **DS/Fundamentals**
- **DS/Logic**
- **DS/Proof Techniques**
- **DS/Basics of Counting**
- **DS/Graphs and Trees**
- **DS/Discrete Probability**
- **AL/Basic Automata, Computability & Complexity**

CS 271 Student Learning Outcomes (SLO)	Program Learning Outcomes (PLO)*	Institutional Learning Outcomes (ILO)*	Activities/Assessments
1, 2, 7, 10, 12, 15, 16,17, 19	1	1	Tests, Final exam
2, 3, 14,		2	Tests, final exam, Homework
13	2	1	Tests, Final exam
6, 9, 18	3	3	Homework, tests, final exam

CS Student Learning Outcomes (SLOs)

SLO-1. Analyze a problem to determine underlying recurrence relations. [Usage

SLO-2. Apply

a. Bayes theorem to determine conditional probabilities in a problem. [Usage]

b. 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. [Usage

c. formal methods of symbolic propositional and predicate logic, such as calculating validity of formulae and computing normal forms.

d. proper proof techniques (direct proof, proof by contradiction, and induction) in the construction of a sound argument.

e. properly addition principle, multiplication principle, and the pigeonhole principle to solve problem.

f. the tools of probability to solve problems such as the average case analysis of algorithms or analyzing hashing. [Usage]

SLO-3. Compute

a. probabilities of events and expectations of random variables for elementary problems such as games of chance.

b. permutations and combinations of a set and interpret the meaning in the context of a particular application.

c. the variance for a given probability distribution. [Usage]

SLO-4. Convert logical statements from informal language to propositional and predicate logic expressions.

SLO-5. Demonstrate different traversal methods for trees and graphs, including pre-, post-, and in-order traversal of trees. [Usage]

SLO-6.

a. Describe how symbolic logic can be used to model real-life situations or applications, including those arising in computing contexts such as software analysis (e.g., program correctness), database queries, and algorithms. [Usage]

b. the strengths and limitations of propositional and predicate logic.

SLO-7. Determine which type of proof is best for a given problem. [Assessment]

SLO-8. Differentiate between dependent and independent events. [Usage]

SLO-9. Explain

a. the parallels between ideas of mathematical and/or structural induction to recursion and recursively defined structures. [Assessment]

b. the relationship between weak and strong induction and give examples of the appropriate use of each. [Assessment]

c. with examples the basic terminology introduced in the course such as set, relation function, graph, tree

d. with examples the basic terminology of discrete probability.

SLO-10. Identify

a. a case of the binomial distribution and compute a probability using that distribution. [Usage]

b. the basic structure of proof technique used in a given proof: direct proof, proof by contradiction, and induction.

SLO-11. Illustrate by example the basic terminology of graph theory, as well as some of the properties and special cases of each type of graph/tree. [Familiarity]

SLO-12. Map real-world applications to appropriate counting formalisms, such as determining the number of ways to arrange people around a table, subject to constraints on the seating arrangement, or the number of ways to determine certain hands in cards (e.g., a full house).

SLO-13. Model 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. [Usage]

SLO-14. Perform

a. computations involving modular arithmetic.

b. the operations associated with sets, functions, and relations.

SLO-15. Relate practical examples to the appropriate set, function, or relation model, and interpret the associated operations and terminology in context.

SLO-16. Show how concepts from graphs and trees appear in data structures, algorithms, proof techniques (structural induction), and counting. [Usage]

SLO-17. Solve a variety of basic recurrence relations. [Usage]

SLO-18. State the well-ordering principle and its relationship to mathematical induction. [Familiarity]

SLO-19. Use the rules of inference to construct proofs in propositional and predicate logic.

CS Program Learning Outcomes (PLOs)

PLO-1. **Analyze a complex computing problem and to apply principles of computing and other relevant disciplines to identify solutions.**

PLO-2. **Design, implement, and evaluate a computing-based solution to meet a given set of computing requirements in the context of the program's discipline.**

PLO-3. **Communicate effectively in a variety of professional contexts.**

PLO-4. **Recognize professional responsibilities and make informed judgments in computing practice based on legal and ethical principles.**

PLO-5. **Function effectively as a member or leader of a team engaged in activities appropriate to the program's discipline.**

PLO-6. **Apply computer science theory and software development fundamentals to produce computing-based solutions.**

UOG Institutional Student Learning Outcomes (ILOs)

—For more information about the following ILOs, please refer to the most recent UOG Undergraduate Course Catalog.

ILO-1. Critical thinking and problem solving

ILO-2. Mastery of quantitative analysis

ILO-3. Effective oral and written communication

ILO-4. Understanding and appreciation of culturally diverse people, ideas and values a democratic context.

ILO-5. Responsible use of knowledge, natural resources, and technology

ILO-6. An appreciation of the arts and sciences

ILO-7. An interest in personal development and lifelong learning

Tentative course calendar (Please see our moodle page for schedule updates.)

Weeks of 8/12 (Mondays) and 8/19	***Chapter 1: Fundamentals*** 1.1: Sets and Subsets 1.2: Operations on Sets 1.3: Sequences 1.4: Properties of the Integers	Weeks of 10/14 and 10/21	4.4 Properties of Relations 4.5 Equivalence Relations 4.6 Data Structures for Relations and Digraphs 4.7 Operations on Relations
Weeks of 8/26 and 9/2	1.5: Matrices 1.6 Mathematical Structures ***Holiday: Labor Day No Class on Mon. 9/2*** ***Chapter 2: Logic*** 2.1 Propositions and Logical Operations 2.2 Conditional Statements 2.3 Methods of Proof 2.4 Mathematical Induction 2.5 Mathematical Statements	Weeks of 10/28 and 11/4	**Review** **Exam 2** ***Holiday: All Soul's Day 11/2*** ***Chapter 7: Trees*** 7.1 Trees 7.2 Labeled Trees 7.3 Tree Searching
Weeks of 9/9 and 9/16	2.6 Logic and Problem Solving **Review** **Exam 1** ***Chapter 3: Counting*** 3.1 Permutations 3.2 Combinations 3.3 Pigeonhole Principle 3.4 Elements of Probability 3.5 Recurrence Relations	Weeks of 11/11 and 11/18	7.4 Undirected Trees 7.5 Minimal Spanning Trees ***Holiday: Veteran's Day 11/11*** ***Chapter 8: Topics in Graph Theory*** 8.1 Graphs 8.2 Euler Paths and Circuits 8.3 Hamiltonian Paths and Circuits 8.4 Transport Networks We may also go over some **Cryptography** using my notes. *Faculty Evaluations: 11/25 – 12/13*
Weeks of 9/23, 9/30, and 10/7	***Chapter 4: Relations and Digraphs*** 4.1 Product Sets and Partitions 4.2 Relations and Digraphs 4.3 Paths in Relations and Digraphs ***Fanuchanan Break: No Classes from 10/7-10/12***	Weeks of 11/25, and 12/2 Week of 12/9	**Review** **Exam 3** ***Holiday: Thanksgiving Holiday and Break 11/28-11/30*** Review for the Final ***Last Day of Class is Wed. 12/4*** ***Holiday: 12/9 Our Lady of Camarin Day*** Final Exam Week (12/10-12/12)

REDO and REVISION Policy for CS271:

- You can redo a total of **Seven problems** from any of the Quizzes. I decide on what count as "One problem". This depends on certain quizzes. It can be number labeling, or if a quiz consists of many parts (letter labeling a,b,c,), then I will let you know which counts as "One" problem".

- Redo is different from Make-Up work. For Excused Absence, you can make up the work first and then redo a problem later if it is not passed the deadline to redo. For Unexcused Absence, you cannot make up and cannot redo a problem.

- You can redo "One problem" in each of the Midterm Exams. But no redoes on the Final Exam. I decide on what counts as "One problem".

- To submit your redo, you must first discuss it with me during class or during my office hours, and then you can submit the correction.

- The deadline for redoes for a quiz or exam will be announced in class.

Learning is all about revision.