Syllabus for CSC302 - Discrete Structures for Computer Science

Summer Section

Instructor:	Dr. Xiang Huang	**Time:**	Async
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Office Hours: Through Calendly on my homepage or by email. I will check email frequently but some travels might happen during summer. Please understand that I will not check my email during weekends.

Course Description: This course is designed to introduce participants to the topics from discrete structures that are relevant to computer science. Topics covered are not limited to number systems, sets, logic, functions, and relations, combinations, permutations, probability, and statistics.

Prerequisite: 'C' or better in college algebra.

Special Notice for the 8-Week Summer Section:

- Please understand that due to the condensed nature of this 8-week summer course, we will need to move very quickly. Expect to cover twice the usual amount of material each week, averaging about two chapters. Some weeks a new chapter will begin on Monday with a cumulative exam scheduled for Sunday.
- I want to make it clear from the outset that the summer version of this course is more demanding, not easier. We cannot afford to gloss over or skip any material because this class serves as a prerequisite for many subsequent courses. **You must keep up with the rapid pace or consider taking this course during a regular semester.**

Textbook: This course will use an online text from zyBooks. It is an interactive text that has Participation and Challenge activities that will be part of the course grade. Please follow the instructions on Canvas for your online access.

Grading: The final grade will be based on Assignments (210 Points), zyBook Participations and Challenges (250 Points), and Tests (300 Points). Total Points are subject to change.

Accommodations:

- If you are a student with a documented temporary or ongoing disability in need of academic accommodations, please contact the Office of Disability Services at 217-206-6666. I would however suggest you take this course in the regular semester.
- Disabilities may include but are not limited to: Psychological Health, Learning, Sensory, Mobility, ADHD, TBI, and Asperger's syndrome. In some cases, accommodations are also available for shorter-term disabling conditions such as severe medical situations.
- Accommodations are based upon underlying medical and cognitive conditions and may include but are not limited to: extended time for tests and quizzes, distraction-free environment for tests and quizzes, a note taker, interpreter, and FM devices.
- Students who have made a request for an academic accommodation that has been reviewed and approved by the ODS will receive an accommodation letter which should be provided by the student to the instructor as soon as possible, preferably in the first week of class.

- For assistance in seeking academic accommodations please contact the UIS Office of Disability Services (ODS) in the Human Resources Building Room 80 phone number 217-206-6666.

Course Content:

1. **Logic:**
    - Propositions and logical operations
    - Evaluating compound propositions
    - Conditional statements
    - Logical equivalence
    - Laws of propositional logic
    - Logical reasoning
    - Rules of inference with propositions
    - Predicates and quantifiers
    - Quantified statements
    - De Morgan's law for quantified statements
    - Nested quantifiers
    - More nested quantified statements
    - Rules of inference with quantifiers
2. **Proofs:**
    - Mathematical definitions
    - Introduction to proofs
    - Best practices and common errors in proofs
    - Writing direct proofs
    - Proof by contrapositive
    - Proof by contradiction
    - Proof by cases
3. **Sets:**
    - Sets and subsets
    - Set of sets
    - Union and intersection
    - More set operations
    - Set identities
    - Cartesian products
    - Partitions
4. **Functions:**
    - Definition of functions twice
    - Floor and ceiling functions
    - Properties of functions
    - The inverse of a function

- Composition of functions
- Logarithms and exponents

5. **Algorithms & Computation:**
   - An introduction to algorithms
   - Asymptotic growth of functions
   - Analysis of algorithms
   - Finite state machines
   - Turing machines
   - Decision problems and languages
6. **Number Theory, Cryptography & Integer Properties:**
   - The Division Algorithm
   - Modular arithmetic
   - Prime factorizations
   - Factoring and primality testing
   - Greatest common divisor and Euclid's algorithm
   - Number representation
   - Fast exponentiation
   - Introduction to cryptography
   - The RSA cryptosystem
7. **Induction and Recursion:**
   - Sequences
   - Recurrence relations
   - Summations
   - Mathematical induction
   - More inductive proofs
   - Strong induction and well-ordering
   - Loop invariants
   - Recursive definitions
   - Structural induction
   - Recursive algorithms
   - Induction and recursive algorithms
   - Analyzing the time complexity of recursive algorithms
   - Divide-and-conquer algorithms: Introduction and merge sort
   - Divide-and-conquer algorithms: Binary search
   - Solving linear homogeneous recurrence relations
   - Solving linear non-homogeneous recurrence relations
   - Divide-and-conquer recurrence relations
8. **Introduction to Counting:**

- Sum and product rules
- The bijection rule
- The generalized product rule
- Counting permutations
- Counting subsets
- Subset and permutation examples
- Counting by complement
- Permutations with repetitions
- Counting multisets
- Assignment problems: Balls in bins
- Inclusion-exclusion principle
- Counting problem examples

9. **Discrete Probability:**

   - Probability of an event
   - Unions and complements of events
   - Conditional probability and independence
   - Bayes' Theorem
   - Random variables
   - Expectation of a random variable
   - Linearity of expectations
   - Bernoulli trials and the binomial distribution

10. **Advanced Counting:**

    - Generating permutations and combinations
    - Binomial coefficients and combinatorial identities
    - The pigeonhole principle
    - Generating functions

11. **Relations / Digraphs:**

    - Introduction to binary relations
    - Properties of binary relations
    - Directed graphs paths and cycles
    - Composition of relations
    - Graph powers and the transitive closure
    - Matrix multiplication and graph powers
    - Partial orders
    - Strict orders and directed acyclic graphs
    - Equivalence relations
    - N-ary relations and relational databases

12. **Graphs:**

- Introduction to graphs
- Graph representations
- Graph isomorphism
- Walks, trails, circuits, paths, and cycles
- Graph connectivity
- Euler circuits and trails
- Hamiltonian cycles and paths
- Planar graphs
- Graph coloring

13. **Trees:**

- Introduction to trees
- Tree application examples
- Properties of trees
- Tree traversals
- Spanning trees and graph traversals
- Minimum spanning trees

Tentative Schedule: See it on Canvas for the actual schedule. This schedule is subjected to change.

Week	Topic	Tasks	Due Date
Week 1	Unit 1 Logic 1.1-1.7	Assignment 1A (1.1-1.7), zyBook PA Unit 1, zyBook CA Unit 1, DB Week 1 Introduction	Sunday 11:59PM
	Unit 1 Logic 1.8-1.13	Assignment 1B (1.8-1.13), zyBook PA Unit 1 (cont.), zyBook CA Unit 1 (cont.), DB Week 2 E/C	Sunday 11:59PM
Week 2	Unit 2 Proofs	Assignment 2, zyBook PA Unit 2, zyBook CA Unit 2, DB Week 3 E/C	Sunday 11:59PM
	Unit 3 Sets	Assignment 3, zyBook PA Unit 3, zyBook CA Unit 3, DB Week 4 E/C	Sunday 11:59PM
Week 3	Unit 4 Functions, Unit 5 Algorithms & Computations	Assignment 4/5, zyBook PA Unit 4, zyBook CA Unit 4, zyBook PA Unit 5, zyBook CA Unit 5, DB Week 5 E/C	Sunday 11:59PM
	Test 1	TEST 1 (Unit 1-5)	Sunday 11:59PM
Week 4	Unit 6 Number Theory	Assignment 6, zyBook PA Unit 6, zyBook CA Unit 6, DB Week 7 E/C	Sunday 11:59PM
	Unit 7 Induction and Recursion 7.1-7.8	Assignment 7A (7.1-7.7), zyBook PA Unit 7, zyBook CA Unit 7, DB Week 8 E/C	Sunday 11:59PM
Week 5	Unit 7 Induction and Recursion 7.9-7.18	Assignment 7B (7.8-7.17), zyBook PA Unit 7, zyBook CA Unit 7, DB Week 10 E/C	Sunday 11:59PM
	Unit 8 Counting, Unit 9 Advanced Counting	Assignment 8/9, zyBook PA Unit 8, zyBook CA Unit 8, zyBook PA Unit 9, zyBook CA Unit 9, DB Week 9 E/C	Sunday 11:59PM

Week asdfas	Topic	Tasks	Due Date
Week 6	Unit 10 Discrete Probability	Assignment 10, zyBook PA Unit 10, zyBook CA Unit 10, DB Week 10 E/C	Sunday 11:59PM
	Test 2	TEST 2 (Units 6-10)	Sunday 11:59PM
Week 7	Unit 11 Relations	Assignment 11, zyBook PA Unit 11, zyBook CA Unit 11, DB Week 14	Sunday 11:59PM
	Unit 12 Graphs	Assignment 12, zyBook PA Unit 12, zyBook CA Unit 12, DB Unit Week 15 E/C	Sunday 11:59PM
Week 8	Unit 13 Graphs, Unit 14 Boolean Algebra	Assignment 13/14, zyBook PA Unit 12, zyBook CA Unit 12, zyBook PA Unit 13, zyBook CA Unit 13, DB Week 16 E/C	Sunday 11:59PM
	Test 3	TEST 3 (Unit 11-14)	Saturday 11:59PM
Week 9	Grades Due	Grades to UIS	Wednesday

Course Requirements:

- Use UIS email and Canvas for communicating with the instructor.
- Complete all assigned readings covered in the materials.
- Access the course materials and complete assignments within the guidelines as established in the course calendar.
- Visit the course website (Canvas) frequently.
- Adhere to assignment deadlines which are firm unless a student is given special permission by the instructor. Late submissions are subject to partial or no credit.
- Contact the instructor immediately if special circumstances cause interruption of course activities.
- Keep backup copies of all work.
- Submit only original work. Any form of plagiarism is strictly prohibited as required by University policy. Violation of this rule will result in ”no credit” for an assignment or ”no credit” for the course and may result in dismissal from the program.

Assignment Details:

- Working Together on Assignments and Programming Challenges: Students may work together provided that the methods used promote a learning environment for all involved.
- Tests: There are three tests during the semester. All the questions for these assessments come from pools of questions used to create the weekly assignments. No new material will be introduced on the tests. The three tests are due by the due date and may not be made up unless prior arrangements have been made with the instructor. The Blended (on-campus) section will not have tests; instead, we will have oral presentations.

- zyBook Participation and Challenge Activities: The online text for this course is interactive and requires your input to complete the activities. To earn the Participation and Challenge points each week, you must complete the assigned unit by Sunday at 11:59PM. On Monday, the zyBook report for the unit will be downloaded and the grades entered in Canvas. There is nothing you need to submit to Canvas.
- Discussions Boards: You may post questions and responses to the discussion board for other students and the instructor. You may also post links to instructional material you have found on the web. When you post a link, please CITE the website. There will be a discussion board for each week. Responses must not contain solutions. They should be instructive and useful for the entire class. Substantive questions/responses will be awarded extra credit (one or two points). The extra credit might be collected at the end of the semester. I will not monitor the activities frequently. There is no other extra credit offered. I encourage you to take advantage of the opportunity.
- Assignments are in the form of true/false, fill-in-the-blank, short answer, and multiple-choice questions. They are completed in Canvas and due each Sunday at 11:59PM.

Academic Integrity:

- Acts of plagiarism will result in a 0 for the assignment for all students willingly involved (first offense); subsequent offenses will result in a failing grade for the course.
- I support the UIS policy on Academic Integrity which states in part:

  > "Academic integrity is at the heart of the university's commitment to academic excellence. The UIS community strives to communicate and support clear standards of integrity so that undergraduate and graduate students can internalize those standards and carry them forward in their personal and professional lives. Living a life with integrity prepares students to assume leadership roles in their communities as well as in their chosen profession. Alumni can be proud of their education and the larger society will benefit from the University's contribution to the development of ethical leaders. Violations of academic integrity demean the violator, degrade the learning process, deflate the meaning of grades, discredit the accomplishments of past and present students, and tarnish the reputation of the university for all its members."

- If you need more information about the Academic Integrity Policy, it is available online at http://www.uis.edu/academicintegrity/ or you can locate it from the A-Z index on the UIS homepage listed as "Academic Integrity". The detailed policy is located under the "Policy" link.