CSA 2315: Data Structures

Department of Computer Science

Fall Semester 2026

Faculty Information

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Office Hours: Wednesday 2-4 pm, online or in-person, please email ahead of time

Course Description

This course is a further application of programming techniques and focuses on the design, analysis, and implementation of data structures. Students will study abstract data types (ADTs), linear structures (arrays, stacks, queues, and linked lists), and non-linear structures (trees, graphs, heaps, hash tables, dictionaries, and maps). The course also introduces algorithm analysis, recursion, sorting, searching, and graph traversal techniques. Throughout the semester, topics are connected to current applications in artificial intelligence (AI), machine learning (ML), and natural language processing (NLP) so that students can see how foundational data structures power modern computing.

Prerequisite: CSA 1320 (Computer Science II), or equivalent CS 1320/CS 1321 under prior course numbering.

Programming Language: Python (primary). Examples in other languages may be shown for comparison.

Course Materials

Textbook (Recommended):

- Aditya Bhargava, Grokking Algorithms: An Illustrated Guide for Programmers and Other Curious People.
- Marcello La Rocca, Grokking Data Structures.

Program Student Learning Outcomes

Upon completion, students will be able to:

- Explain the role of data structures in problem solving and software design.
- Analyze algorithm performance using Big-O notation.
- Implement and use linear data structures: arrays, stacks, queues, linked lists.
- Implement and use non-linear data structures: trees, graphs, heaps, hash tables.
- Apply recursion in problem solving and algorithm design.
- Use graph traversal techniques such as BFS and DFS.
- Apply shortest-path and optimization strategies (Dijkstra, greedy, dynamic programming).

Important Dates

- Aug 25 – First Day (Introductions only)

- Sep 1 – Classes start (Week 2)
- Nov 27–28 – Thanksgiving Break (No Class)
- Dec 3 – Last Day to Submit All Work & Capstone Project Due
- Dec 10 – Last Day of Class (Reserved for grading, no new work)

Course Student Learning Outcomes

Upon successful completion of this course, students will be able to:

- Demonstrate understanding of ADTs and their operations.
- Select and apply appropriate data structures to solve problems.
- Write correct and efficient programs using sorting, searching, and traversal algorithms.
- Evaluate the time and space complexity of algorithms.
- Recognize how core data structures underpin AI, ML, and NLP applications.
- Present solutions and reasoning clearly in both code and written form.

Marketable Skills

Students will develop:

- **Problem-Solving & Critical Thinking** – Breaking complex problems into manageable steps.
- **Technical Literacy** – Data structures, algorithms, and performance analysis.
- **Analytical Skills** – Using asymptotic analysis to compare approaches.
- **Communication Skills** – Explaining design choices in writing and orally.

Course Quizzes, Assignments, and Grading

Assignment Type	% of Final Grade	Description
Weekly Assignments	70%	Applied coding and reflection exercises that build each week (approximately 14 assignments, ~5% each).
Final Capstone Project	30%	A comprehensive project integrating multiple data structures and algorithms.
Total	**100%**	

Late Assignment Statement:

Assignments are due by 11:59 PM on the posted due date. Late submissions will be accepted up to 48 hours past the deadline with a 10% deduction per day. Work submitted more than 48 hours after the due date will not be accepted unless prior arrangements have been made with the instructor for extenuating circumstances. Participation in discussions must follow module timelines; late posts may not receive credit.

Grading Rubrics

Weekly Assignments (70% of grade) — Rubric (approx. 5% each):

- Understanding of Concept (clear, correct, thoughtful)
- Application & Examples (program works, meaningful examples)
- Clarity & Organization (code is readable, structured)
- Completion (all requirements met)

Capstone Project (30% of grade) — Rubric:

- Integration of Course Content (uses multiple data structures/algorithms)
- Depth & Creativity (originality and effort)
- Correctness & Efficiency (program runs correctly and efficiently)
- Clarity & Professionalism (report/presentation clear and well organized)

Course Schedule

Week	Topic	Notes
1	**Course Introduction**	Overview of syllabus, expectations, and tools. What are data structures? What is an algorithm? Why data structures matter: large-scale systems and code clarity. Demo: How code benefits from intentional choice of data structure Assignment 1: Hello World
2	**Algorithms & Problem Solving**	How to select the right data structure for your application? Real-world examples and pseudocode basics. Linear vs. constant-time lookup, and why large-scale systems such as search engines and language-model vocabularies depend on efficient data structures. Discussion: algorithms as the foundation of machine learning pipelines. Assignment 2: Getting creative with data structures (pseudocode and written assignment)
3	**Algorithm Analysis (Big-O Basics)**	Intuition for fast vs. slow algorithms. Review of math concepts. Compare linear search vs. binary search; focus on why efficiency matters rather than formal proofs. AI connection: inference cost and why efficient search matters at the scale of modern AI systems. Assignment 3: Big-O Worksheet
4	**Arrays & Lists**	Arrays, array operations, and real-world use cases. List implementations and traversal. Mini exercises: student roster, shopping-list manager. AI connection: tensors and embeddings in machine learning are, at bottom, arrays.
5	**Linked Lists**	Singly and doubly linked lists; insertion, deletion, and traversal. Trade-offs vs. arrays. AI connection: buffers and streams for continuously arriving data.
6	**Stacks**	Last-in, first-out (LIFO) structure; push/pop operations. Applications: expression evaluation, undo functionality, the call stack. NLP connection: stacks in parsing and syntax-tree construction.

Week	Topic	Notes
7	**Queues & Introduction to Recursion**	First-in, first-out (FIFO) structures and applications. Introduction to recursive thinking. AI connection: task and job queues in model-training pipelines.
8	**Recursion & Divide and Conquer**	Recursive problem solving, base cases, and the divide-and-conquer strategy; preview of merge sort. (Textbook: recursion and divide-and-conquer chapters)
9	**Sorting Algorithms**	Insertion sort, selection sort, and merge sort (concept + coding). AI connection: ranking and top-k retrieval in search and recommender systems.
10	**Searching, Hash Tables, Dictionaries & Maps**	Hash functions, collisions, and dictionary/map ADTs. NLP connection: tokenizer vocabularies, word-frequency models, and feature hashing.
11	**Trees & Binary Search Trees**	Tree terminology. Traversals: pre-order, in-order, post-order. Binary search trees (insert/search). AI connection: decision trees in machine learning; tries for autocomplete; parse trees in NLP.
12	**Heaps & Priority Queues**	Heap property, insertion and removal, and priority queues. AI connection: beam search in language generation; foundation for shortest-path algorithms.
13	—	Thanksgiving Break (No Class).
14	**Graphs & Optimization Strategies**	Graph representation (adjacency list/matrix); BFS and DFS traversal; introduction to Dijkstra's shortest path; survey of greedy vs. dynamic programming (example: edit distance, a classic NLP algorithm). Capstone work time. AI connection: knowledge graphs, social-network analysis, and how information (and misinformation) spreads through networks.
15	**Capstone Project & Wrap-Up**	Capstone submission and presentations. Options: student management system (arrays + linked lists + sorting); mini text dictionary (hash tables); simple expression evaluator (stacks); keyword-spread tracker (hash tables + graphs).
16	**Grading Week**	Reserved for project grading and feedback; no new work.

ADA Statement

SRSU Accessibility Services. Sul Ross State University (SRSU) is committed to equal access in compliance with the Americans with Disabilities Act of 1973. It is SRSU policy to provide reasonable accommodations to students with documented disabilities. It is the student's responsibility to initiate a request each semester for each class. Students seeking accessibility/accommodations services must contact Mrs. Mary Schwartze Grisham, LPC, SRSU's Accessibility Services Director, or Ronnie Harris, LPC, Counselor, at 432-837-8203 or email mschwartze@sulross.edu or ronnie.harris@sulross.edu. RGC students can also contact Alejandra Valdez at 830-758-5006 or email alejandra.valdez@sulross.edu. Our office is located on the first floor of Ferguson Hall, room 112, and our mailing address is P.O. Box C122, Sul Ross State University, Alpine, Texas, 79832.

Student Responsibilities Statement

All full-time and part-time students are responsible for familiarizing themselves with the Student Handbook and the Undergraduate & Graduate Catalog and for abiding by the University rules and regulations. Additionally, students are responsible for checking their Sul Ross email as an official form of communication from the university. Every student is expected to obey all federal, state, and local laws and is expected to become familiar with the requirements of such laws.

SRSU Distance Education Statement

Students enrolled in distance education courses have equal access to the university's academic support services, such as library resources, online databases, and instructional technology support. For more information about accessing these resources, visit the SRSU website.

Students should correspond using Sul Ross email accounts and submit online assignments through Blackboard, which requires a secure login. Students enrolled in distance education courses at Sul Ross are expected to adhere to all policies pertaining to academic honesty and appropriate student conduct, as described in the student handbook. Students in web-based courses must maintain appropriate equipment and software, according to the needs and requirements of the course, as outlined on the SRSU website. Directions for filing a student complaint are located in the student handbook.

Counseling

Sul Ross has partnered with TimelyCare, where all SR students have access to nine free counseling sessions. You can learn more about this 24/7/365 support by visiting TimelyCare/SRSU. The SR Counseling and Accessibility Services office will continue to offer in-person counseling in Ferguson Hall room 112 (Alpine campus), and telehealth Zoom sessions for remote students and RGC students.

Libraries

The Bryan Wildenthal Memorial Library and Archives of the Big Bend in Alpine offer FREE resources and services to the entire SRSU community. Access and borrow books, articles, and more by visiting the library's website, library.sulross.edu. Off-campus access requires logging in with your LoboID and password. Librarians are a tremendous resource for your coursework and can be reached in person, by email (srsulibrary@sulross.edu), or by phone (432-837-8123).

No matter where you are based, public libraries and many academic and special libraries welcome the general public into their spaces for study. SRSU TexShare Cardholders can access additional services and resources at various libraries across Texas. Learn more about the TexShare program by visiting library.sulross.edu/find-and-borrow/texshare/ or ask a librarian by emailing srsulibrary@sulross.edu.

Mike Fernandez, SRSU Librarian, is based in Eagle Pass (Building D-129) to offer specialized library services to students, faculty, and staff. Utilize free services such as InterLibrary Loan (ILL), ScanIt, and Direct Mail to get materials delivered to you at home or via email.

Academic Integrity

Students in this class are expected to demonstrate scholarly behavior and academic honesty in the use of intellectual property. Students should submit work that is their own and avoid the temptation to engage in behaviors that violate academic integrity, such as turning in work as original that was used in whole or part for another course and/or professor; turning in another person's work as one's own; copying from professional works or internet sites without citation; or collaborating on a course assignment, examination, or quiz when collaboration is forbidden. Students should also avoid using open

AI sources unless permission is expressly given for an assignment or course. Violations of academic integrity can result in failing assignments, failing a class, and/or more serious university consequences. These behaviors also erode the value of college degrees and higher education overall.

Classroom Climate of Respect

Importantly, this class will foster free expression, critical investigation, and the open discussion of ideas. This means that all of us must help create and sustain an atmosphere of tolerance, civility, and respect for the viewpoints of others. Similarly, we must all learn how to probe, oppose, and disagree without resorting to tactics of intimidation, harassment, or personal attack. No one is entitled to harass, belittle, or discriminate against another on the basis of race, religion, ethnicity, age, gender, national origin, or sexual preference. Still, we will not be silenced by the difficulty of fruitfully discussing politically sensitive issues.

Supportive Statement

I aim to create a learning environment for my students that supports various perspectives and experiences. I understand that economic disparity, health concerns, or unexpected life events may impact the conditions necessary for you to succeed. My commitment is to be there for you and help you meet the learning objectives of this course. I do this to demonstrate my commitment to you and to the mission of Sul Ross State University to create a supportive environment and care for the whole student as part of the Sul Ross Familia. If you feel like your performance in the class is being impacted by your experiences outside of class, please don't hesitate to come and talk with me. I want to be a resource for you.

Use of Generative Artificial Intelligence (AI)

University Statement (required):

The University does not recommend or endorse any specific AI tools or resources. Students should be aware that many generative AI tools (e.g., ChatGPT, Google Gemini, Microsoft Copilot) store user input and may use this data to train future models. For this reason, students should never upload or share personal, confidential, or identifiable information—such as names, ID numbers, health data, or assignment submissions containing such details—into any generative AI platform. When using AI tools, students should verify whether the tool complies with student privacy standards as indicated by the University. Faculty may recommend specific tools that better align with institutional data privacy policies, but ultimate responsibility for data protection rests with users. Students are encouraged to use faculty-recommended platforms when engaging in coursework involving generative AI. The University is not liable for any adverse experience or impact when students interact with these tools.

Course Policy — Use of Generative AI to write code is not permitted, other use may be allowed with acknowledgment:

Generative AI tools may be useful for brainstorming ideas, exploring possible approaches to problems, and receiving feedback on your own work. In this course, students shall only use generative AI to brainstorm ideas and never to generate text or code for assignments. Students shall give credit to AI tools whenever they are used. When using AI tools on assignments, add a brief appendix identifying (a) which AI tools were used, (b) how they were used (e.g., to generate ideas, debug code, clarify a concept), and (c) why they were used. All submitted code and written work must be your own; submitting AI-generated work as your own, or failing to acknowledge the use of generative AI tools, is a violation of university policy and will be treated as academic dishonesty. Students shall not use AI tools

during examinations or on specific assignments where their use is expressly prohibited. If you are unsure whether a particular use of AI is acceptable, please ask before submitting.