



CS 104 Data Structures (Finalized for Release)

* Note: Some minor changes or changes that favor student grade outcomes may still be applied.

Units: 4

Spring 2026, M/W 2-3:20 pm in SGM 124 and T/Th 8-9:20 am in SGM 101

Website: <https://bytes.usc.edu/cs104>

Instructor: Mark Redekopp

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Office Hours: See website

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Teaching Assistant and UG Tutors

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Administrative TA: Feiyu Zhu (feiyuzhu@usc.edu)

IT Help: See Viterbi IT [website](#).

Course Description

Data structures including linked lists, balanced search trees, heaps, hash tables; probability and number theory applicable to the analysis of randomized data structures

The course covers the fundamentals of data structures. As a programmer becomes more proficient, they realize that how well and efficiently a problem can be solved often depends on how the data are stored. Some of the ideas are quite sophisticated and clever, and we will explore a spectrum of them in this class, ranging from fairly basic to moderately advanced structures.

The other side is that once one realizes the importance of data structures, it is natural to think of programs not as sequences of instructions that pass around some data, but as data packets that come with the code needed to process them. This is at the heart of the object-oriented design paradigm, and often leads to more modular and extensible (and readable) programs.

The class will put significant emphasis on a theoretical understanding of data structures, their implementation, and the object-oriented viewpoint. Assignments will contain significant programming projects along with programming-free questions to explore how data structures work.

Learning Objectives

Below are the specific, measurable skills a student will demonstrate by the end of the course. These objectives will be both taught and assessed in the course and are aligned with the assignments, assessments and learning materials.

1. Ability to choose appropriate and efficient data structures and algorithms to solve a problem.
2. Ability to compare data structures and algorithms for efficiency using algorithm analysis and experiments.
3. Ability to apply algorithm analysis and knowledge of discrete mathematics to evaluate algorithms and data structures.
4. Ability to implement and use linear data structures, including stacks, queues, lists.
5. Ability to implement and use search structures and algorithms including binary search, search trees, and hash tables.
6. Ability to use and implement search data structures, including search trees and hash tables.
7. Ability to use and implement priority queues.
8. Knowledge of and ability to implement sorting algorithms and compare their performance analytically and empirically.
9. Understanding of graphs and their representations; ability to implement graph search using BFS, DFS, and Dijkstra's Algorithm.
10. Ability to write recursive functions and understand when recursion is appropriate to a problem.
11. Ability to write readable and maintainable code.
12. Ability to explain computational solutions in person and in writing.
13. Use probability as a tool in analyzing the efficiency of various data structures
14. Use basic number theory to analyze basic hash functions.

Prerequisite(s): None.

Co-Requisite(s): None

- CSCI 103: Introduction to Programming
- CSCI 170: Discrete Methods in Computer Science.

Recommended Preparation:

Course Notes

All content will be linked through [Brightspace](#) and our website: <http://bytes.usc.edu/cs104>. PDF versions of lecture slides will be posted on our website before lecture and may be printed before coming to class or used electronically.

Technological Proficiency and Hardware/Software Required

A working laptop able to access the Internet is required to complete homeworks and some exams. Loaner laptops may be available via the [USC Computing Center Laptop Loaner Program](#). Other software and support is available from USC Technology Support and some useful links include: [Zoom information for students](#), [Brightspace help for students](#), [Software available to USC Campus](#).

Required Readings and Supplementary Materials

We will be using “**Data Structures and Algorithm Analysis in C++**” by Mark Weiss. In addition, you should have a Discrete Mathematics textbook (whichever book you used for CSCI 170 will suffice): We will specifically refer to reading from “**Essential Discrete Mathematics for Computer Science**” by Lewis & Zax. You may also find the course lecture notes useful. You may download (and possibly print) the [lecture notes](#). These are based on teaching of CSCI 104 in past semesters, and cover the material quite accurately as presented in class. However, the lecture notes may be out of order and cover different topics, as we have changed the schedule significantly. We will also be providing detailed lecture slides and recorded videos that you may also use.

Instructional Administrator TA

For administrative issues such as online tool/website access, requesting lecture recordings, academic/exam accommodations, etc., post privately on **Edstem** or contact our instructional administrator TA listed on the first page of this syllabus rather than the instructor.

Attendance

In-person attendance is the only supported option for lecture and lab. There is also part of your course grade will be earned via pop-notetaking activities, which can only be earned via in-person attendance. **There is a graded aspect related to attendance that will be described below.**

Illness or Emergency: For lectures, if you are ill or have an emergency, **make a PRIVATE (non-anonymous) post on EdStem** to request a lecture recording. But we will only provide the recording **TWICE** during the semester. Thus, you should plan on attending each lecture to save those TWO recording requests in case you become ill or have an emergency later in the semester. Exceptions to this rule will ONLY be made if [USC Campus Support and Intervention](#) is involved and suggests it.

Recordings: For review purposes, we will release links to the lecture recordings relevant to the exam on our Q&A website **1-2 weeks before exams**. We encourage you to review lecture notes, attend office hours, and form study groups in place of relying on recorded lectures for review.

Description and Assessment of Assignments

Homeworks

Philosophy: While modern CS practice in industry utilizes generative AI, it is critical that you gain the skills that will eventually be needed to a.) solve problems that AI currently does not, b.) be able to understand generated code well enough to know when it is wrong, and c.) to fix that code. Evidence and feedback from industry partners and other teaching institutions indicates that learning programming is still best done through repeated practice (to build “muscle” memory) and should involve some amount of coding **and debugging** from “scratch”. To **best prepare for exams**, you should solve each homework by coding from scratch and **AVOID use of AI to either generate code or find errors**. Only through the **(sometimes arduous) process of debugging manually and getting help from instructors and TAs** will you likely gain the skill set you need to excel on the exams and in future CS practice.

Availability and Submission: Homework problem statements will be provided on our course [website](#). Analysis (paper/pen) problems will be submitted on Gradescope while coding problems will be submitted on Github via Github Classroom. Gradescope can be accessed through Brightspace. Instructions will be provided for how you can register and access the Github classroom website.

Grading: Most HWs are **100 points**. **Coding problems** will be awarded points for correctness of the code as determined solely through **automated tests** that match the output of your program to the expected, correct output. These tests will generally be provided to you. If you want to be certain of your grade, you must follow the submission [instructions](#) on your own. Often students forget to commit a file that is needed for their code. **This is NOT an excuse for a regrade**. By following the instructions linked above, you can be sure of your grade. (**The excuse that you ran the tests locally, but the tests did not work on your pushed (submitted) code, is INSUFFICIENT and will not be awarded points**. Regrades will NOT be accepted for reasons such as, “The tests ran on my machine” or “I forgot to push my code”.) However, to aide your certainty, we will also TRY to run the automated tests on your latest submission at two time points: around 2 days before the submission deadline, and then sometime shortly after the deadline itself. If you do not obtain the score you expect, you can consider fixing the code, but the late penalty will be assessed. **Written** problems will be graded ONLY AFTER the due date and will be graded visually. You must support any work and simply stating an answer without supporting work or showing your steps will result in **NO CREDIT** even if your answer is correct.

Deadlines and Late Policy: Deadlines will be listed (and updated as needed) on the **homework** page of our website. You may submit late up to **96 hours (4 days)** after the deadline. **You do NOT need to alert anyone**, but just push your code. You will be assessed a flat **20-point late penalty** for a submission 1 second to 96 hours after the deadline. No submissions will be allowed after the late deadline.

Use of (Generative) Artificial Intelligence and Academic Integrity. Only by spending significant time working and **struggling** with the assignments yourself or with course staff will you gain the skills needed

to excel on exams. While use of (generative) AI is not strictly prohibited on coding and written assignments, it is STRONGLY DISCOURAGED! Even if you write significant code on your own, as soon as you ask AI to generate an outline of how to approach the code or help debug some code you've written, etc. you have ALREADY lost valuable learning experience, much less if you start by asking AI to write significant portions of code for you. Only through failure and the ensuing struggle will you develop the mental skills and recall needed to perform well on the exams.

Direct copying of significant sections of code or written work from other students or previous solutions IS prohibited and may be referred to the Office of Academic Integrity and a sanction applied. See the section on Academic Integrity below. With this said, we encourage that if you get stuck you seek help from other students or even form weekly study sessions where you work on the homework. You should NOT simply look at others' code and use their approach nor have them fix your code for you. But discussions that do NOT specify approach in detailed coding terms of pseudocode but verbal approaches to the design and strategies for debugging are welcome.

Code Formatting: In past semesters, we have awarded some points for each submission based on the formatting and style of your code. While we will not assign points for style, any company you work for will have a style guide for how they want your code to be formatted and structured. Here is a [sample](#). Other resources are listed on our website.

Extensions: If a major illness, injury or other emergency occurs, please make a private note on [Edstem](#) to inform the course staff and how long of an extension you are requesting and how much of the work you have ALREADY completed. Extensions are not automatically granted and must be reserved for a significant medical situation or other emergency. If you have NOT started (or done minimal) work as shown in your Github (push) history, we may decline the extension. This means extensions are really for those that have already been working diligently on the assignment, and a true emergency or severe illness arose within the last day or two before the deadline.

Note: A minor illness, minor injury or other incident a few days before the deadline, club / interview activities, or a trip home to see family does not qualify for an extension. Start early anticipating that things may come up closer to the deadline. If you have not started early and ask for an extension, your request may be rejected. Commit and push your intermediate work often as a record of your effort on an assignment.

The most consistent advice from students who have done well in CS 104 is (you guessed it): **start early!**

Lecture “Pop” Quizzes/Notes

Overview: Experience has shown that those who attend lectures generally do better and pass the class at a higher rate than those who do not. But we do not simply want attendance, but engagement and critical thinking during the lecture. In today's world of AI, devices, and connectivity, it is so easy to be distracted. But to generate work of value for an employer, a startup, or in graduate school, you need to be able to focus, think, and engage. To try to incentivize that, we will provide a “notes” worksheet sometime AFTER the start of lecture that will have areas to fill in with important parts of the lecture or examples we work together or you work individually. At the end of lecture, you must submit a pic of your work on Brightspace or Gradescope (we will indicate which) within the last 5 minutes of class (and ONLY within that time window).

- Out of the 28 lectures during the semester, we anticipate using this for **one half to two-thirds** of the lectures
- The lectures that we provide these “quiz/notes” will not be announced in advance (and just because we have a quiz in the Monday section does NOT mean the Tuesday section will).
- You may only fill these out for your registered lab section.
- You may miss 4 “lecture” notes without any loss in your grade. After that, you will lose a corresponding fraction of the course credit.

We are piloting this approach this semester. It is NOT an attempt to cramp your style or be heavy handed. We want to give you credit for being present, thinking, and engaged. REALLY, we want to help you have a better chance of doing well on exams. Being present in lecture is helpful to achieve that.

Labs

Overview: Labs are small group sessions led by course staff. Several labs will focus on teaching you common (and VERY useful) tools for writing, building, testing, and debugging your code. Other labs will focus on reviewing the concepts presented that week along with a few exercises to perform. Labs are intended to be a place for questions and collaboration where you are encouraged to work together, learn from each other and help one another.

Attendance/Participation: Graded based on attendance and giving an honest effort. Your lab leader will provide instructions for how to log your attendance. You may miss at most 2 labs during the semester and still receive credit for the lab portion of your grade. **If you have a dispute about attendance, please contact your discussion leader directly within 1 week.**

- You must **attend the lab in person.**
- You may **ONLY attend your registered lab section** since seating is not available for anyone to go to any lab.
- You have **2 excused lab sessions** where no penalty will be applied. These are strictly for illness or emergencies. While you can use them for other purposes, you will not be granted additional absences if you get sick later in the semester unless USC Campus Support indicates a valid emergency has occurred.
- **To use an excused absence simply email your lab instructor and let them know you will be missing lab.**
- Labs are **graded CR/NC**. The criteria to receive CR will be specified at the start of lab but, unless otherwise noted, requires that you must attend for the vast majority of the session, participate in any (individual or group exercises), and achieve 50% or more on any assessments (though usually, you will have opportunity to revise your work during the lab so that achieving 50% or more is not burdensome).
- Some collaboration (in pairs) is allowed and encouraged for labs, but it must be blatantly clear to the lab staff that both members are equally contributing. One member should not be telling (or showing) the other student what to write, but instead, you can help your fellow student if they encounter an error or question. If a staff member, directs you to work separately or more independently you need to alter your approach.

Exams

Time and Location: There will be **three** midterm exams and **one** final. The exams are tentatively scheduled for week 7, 11, and 14 (but may be moved to a different date in exceptional cases). Tentatively, we will use the **EVENING QUIZ SECTION**, but may give the exam in your REGISTERED LECTURE session of that same week and use the Quiz section for a Zoom-based lecture. The final arrangement will be announced at least 1 week before the exam. The exam location will be announced in class and on the web site. You are responsible for finding out when and where the exams will be held. If you are unable to make an exam, you may receive a 0 if there is not accompanied by a documented emergency excuse **OR** we may use the average of other exams in place of the missed exam.

Alternate times/Makeups: Given the number of students and staff availability we CANNOT support taking the exam at an alternate time (unless you have USC accommodations and have scheduled the exam at OSAS for the same day). **Check and place the exam dates on your calendar NOW.**

Academic Accommodations: If you have USC approved academic accommodations, you should upload your documentation at the beginning of the semester (but at least 2 weeks before an exam) via the **form linked on the homepage of our website**. Then please schedule your exam at OSAS for the same day as the exam at a start time BEFORE we begin the regularly scheduled exam.

Exam Style: Exams are designed to not only test your retention of the material but your ability to apply it to design and analyze new or novel problems. In this way, your mastery and depth of understanding of the course content will be assessed.

- Exams will likely contain some paper/pencil coding that will be based on what you've done and learned by carefully working through your homework. Other problems may be multiple choice, analysis, or fill in the blank.

Because the majority of points will be related to coding or tracing through provided code to analyze its behavior, your struggle with the homework coding problems and lab exercises will greatly pay off.

Students who simply "get the assignments done" without reviewing and understanding each facet will often struggle on the exams.

Exams are to be completed individually. You are NEVER allowed to show others your answers NOR receive ANY assistance from another human, device, or AI-based tools during an exam. Failure to observe these policies will lead to a violation report to the [Office of Academic Integrity](#) (OAI) and the sanctions described in the section on Academic Integrity Violations below. To avoid violations, you must produce all answers by yourself without help, guidance or input from any other source.

General Policy for AI-Generated Work

Since analytical, and critical thinking skills are part of the learning outcomes of this course, all assignments are best done individually, only seeking guidance (and not full solutions) from course staff like TAs and the instructor. Developing strong competencies in these areas will prepare you for future coursework and a competitive workplace.

Academic Integrity Violations

Students believed to have violated academic integrity will be reported to the [Office of Academic Integrity](#) (OAI). Students that admit to the violation will be eligible to avoid a full academic review and hearing by using the Faculty Student Resolution process. Full details are described at this [webpage](#).

Important: Students with a pending violation or who are found to have violated academic integrity may **NOT drop the course** and must receive a letter grade.

- The penalty for an unintentional violation is a 0 on the assignment and a FULL LETTER drop (A- to B-).
- The penalty for a violation **on an exam is an F in the course.**

Grading Timeline and Contesting Grades

Most assignments will be graded within 1-2 weeks of the due date. For contesting your grade. You have **AT MOST 1 WEEK** after scores are posted to contest your grade. For labs, email or talk with your lab leader. For assessments on Gradescope, you **MUST** use the Regrade Request feature to make your request (no emails or EdStem posts will be accepted). For other assignments, post a private note on EdStem detailing why you believe the assignment was factually graded wrong (or the wrong rubric item was applied). But we will not entertain requests for changing the rubric.

Grading Scale and Breakdown

The course grade will be a weighted average of the following components:

Component	Weight
Lecture “Pop” Quizzes Notes	7%
Lab	7%
Written Homework	6%
Coding Homework	10%
Lowest Exam	0%
2 nd Lowest Exam	15%
2 nd Highest Exam	25%
Highest Exam	30%

Table 1 Grading Breakdown

The table below shows the lower cutoff for each letter grade based on your final weighted course percentage.

F	D	C	C+	B-	B	B+	A-	A
<50	50	60	65	70	75	80	85	90%

Assignment Rubrics and Submission Policy

See relevant sections earlier in the syllabus.

Grading Timeline

Homeworks will be auto graded on the Codio, and you will already know if you have passed the automated tests before the deadline.

Academic Integrity

The University of Southern California is foremost a learning community committed to fostering successful scholars and researchers dedicated to the pursuit of knowledge and the transmission of ideas. Academic misconduct is contrary to this fundamental mission and includes any act of dishonesty in the submission of academic work (either in draft or final form), as well as cheating, plagiarism, fabrication (e.g., falsifying data), knowingly assisting others in acts of academic dishonesty, and any act that gains or is intended to gain an unfair academic advantage. Students are expected to uphold the highest standards of academic integrity in all coursework.

This course follows the expectations for academic integrity as stated in the [USC Student Handbook](#). All students are expected to submit assignments that are original work and prepared specifically for the course/section in this academic term. Students may not submit work written by others or “recycle” work prepared for other courses without obtaining written permission from the instructor(s). Students suspected of academic misconduct will be reported to the Office of Academic Integrity.

Academic dishonesty has a far-reaching impact and is considered a serious offense against the university. Violations will result in a grade penalty, such as a failing grade on the assignment or in the course, and disciplinary action from the university, such as suspension or expulsion.

For more information about academic integrity see the [Student Handbook](#), the [Office of Academic Integrity’s website](#), and university policies on [Research and Scholarship Misconduct](#).

Course Content Distribution and Synchronous Session Recordings Policies

USC has policies that prohibit recording and distribution of any synchronous and asynchronous course content outside of the learning environment.

Recording a university class without the express permission of the instructor and announcement to the class, or unless conducted pursuant to an Office of Student Accessibility Services (OSAS) accommodation. Recording can inhibit free discussion in the future, and thus infringe on the academic freedom of other students as well as the instructor. ([Living our Unifying Values: The USC Student Handbook](#), page 13).

Distribution or use of notes, recordings, exams, or other intellectual property, based on university classes or lectures without the express permission of the instructor for purposes other than individual or group study. This includes but is not limited to providing materials for distribution by services publishing course materials. This restriction on unauthorized use also applies to all information, which had been distributed to students or in any way had been displayed for use in relation to the class, whether obtained in class, via email, on the internet, or via any other media. Distributing course material without the instructor's permission will be presumed to be an intentional act to facilitate or enable academic dishonesty and is strictly prohibited. ([Living our Unifying Values: The USC Student Handbook](#), page 13).

Course Evaluations

Official USC Course Evaluation will be conducted at the end of the semester. However, intermediate feedback regarding course staff can be provided by emailing the instructor.

Course Schedule

	Topics/Daily Activities	Readings and Homework	Deliverable/ Due Dates
Week 1	Course Overview; Classes, Pointers, and Memory Allocation Linked Lists Review Lecture on Zoom during Thurs. Quiz Section	Ch. 1.1-1.5 Chapter 2 Ch. 3.3-3.5	
Week 2	Holiday – MLK Day Runtime	Ch. 1.3	HW1 (W)
Week 3	Recursion and Copy Semantics Recursion, ADTs, and STL	Ch 1.3, 1.5 Ch 3.3,4.8	HW1 (C)
Week 4	C++ STL, Inheritance and Polymorphism Array Lists	Class Notes Ch 3.6-3.7	HW2 (W)
Week 5	Stacks, Queues Templates	Ch. 3.6-3.7 Ch. 1.6	
Week 6	Holiday – President's Day Heaps	Ch. 6.1-6.5, 9.1 Ch. 9.3	HW2 (C)
Week 7	Heapsort, build-heap, Graph Algorithms Tree and Graph Traversals Exam 1 – Lists and STL	Ch. 6.1-6.5 Ch. 9.2-9.3,9.6	
Week 8	Iterators, Binary Search Trees AVL Trees	Ch. 4.1-4.2,4.6	HW3 (C)
Week 9	AVL Trees; Splay Trees Hash Tables Intro	Ch. 4.3-4.5, 4.7 Ch. 5.1, 5.3	HW4 (W)
Week 10	Counting Recursion and All Combinations Backtracking Algorithms,	; L&Z Ch 22 Ch. 2.	HW4 (C)
Week 11	Counting and Probability Exam 2 – Trees and Recursion	L&Z Ch 23,26	
Week 12	Probability Number Theory	L&Z Ch 27-29	HW5 (C)
Week 13	Number Theory Hash Functions and Bloom Filters	L&Z Ch 30-31 Ch. 5	HW6 (W)
Week 14	Tries, Skip Lists Amortized Analysis and Merge Trees Exam 3 – Hashing, Backtracking, Probability, and Number Theory	Ch 12.4, 11.1, 11.5. Class notes	
Week 15	Review	Class Notes	HW6 (C)
Final Assessment	See Exceptions Final List Wed. May 6th 8 a.m. - 10 a.m.		.

Statement on University Academic and Support Systems

Students and Disability Accommodations:

USC welcomes students with disabilities into all of the University's educational programs. [The Office of Student Accessibility Services](#) (OSAS) is responsible for the determination of appropriate accommodations for students who encounter disability-related barriers. Once a student has completed the OSAS process (registration, initial appointment, and submitted documentation) and accommodations are determined to be reasonable and appropriate, a Letter of Accommodation (LOA) will be available to generate for each course. The LOA must be given to each course instructor by the student and followed up with a discussion. This should be done as early in the semester as possible as accommodations are not retroactive. More information can be found at osas.usc.edu. You may contact OSAS at (213) 740-0776 or via email at osasfrontdesk@usc.edu.

Student Financial Aid and Satisfactory Academic Progress:

To be eligible for certain kinds of financial aid, students are required to maintain Satisfactory Academic Progress (SAP) toward their degree objectives. Visit the [Financial Aid Office webpage](#) for [undergraduate](#)- and [graduate-level](#) SAP eligibility requirements and the appeals process.

Support Systems:

[Counseling and Mental Health](#) - (213) 740-9355 – 24/7 on call

Free and confidential mental health treatment for students, including short-term psychotherapy, group counseling, stress fitness workshops, and crisis intervention.

[988 Suicide and Crisis Lifeline](#) - 988 for both calls and text messages – 24/7 on call

The 988 Suicide and Crisis Lifeline (formerly known as the National Suicide Prevention Lifeline) provides free and confidential emotional support to people in suicidal crisis or emotional distress 24 hours a day, 7 days a week, across the United States. The Lifeline consists of a national network of over 200 local crisis centers, combining custom local care and resources with national standards and best practices. The new, shorter phone number makes it easier for people to remember and access mental health crisis services (though the previous 1 (800) 273-8255 number will continue to function indefinitely) and represents a continued commitment to those in crisis.

[CARE-SC: Confidential Advocacy, Resources, and Education Support Center](#) - (213) 740-9355(WELL) – 24/7/365 on call.

Confidential advocates, prevention educators, and professional counseling teams work to promote a universal culture of consent, and prevent and respond to gender- and power-based harm. Services available to all USC students at no cost.

[Office of Civil Rights Compliance](#) - (213) 740-5086

Information about how to get help or help someone affected by harassment, discrimination, retaliation on the basis of a protected characteristic, rights of protected classes, reporting options, and additional resources for students, faculty, staff, visitors, and applicants.

[Reporting Incidents of Bias or Harassment](#) - (213) 740-2500

Avenue to report incidents of bias, hate crimes, and microaggressions to the Office for Equity, Equal Opportunity, and Title for appropriate investigation, supportive measures, and response.

[The Office of Student Accessibility Services \(OSAS\)](#) - (213) 740-0776

OSAS ensures equal access for students with disabilities through providing academic accommodations and auxiliary aids in accordance with federal laws and university policy.

[USC Campus Support and Intervention](#) - (213) 740-0411

Assists students and families in resolving complex personal, financial, and academic issues adversely affecting their success as a student.

[USC Emergency Information](#)

Latest updates regarding safety, including ways in which instruction will be continued if an officially declared emergency makes travel to campus infeasible.

[USC Department of Public Safety](#)

For 24 hour emergency assistance or to report a crime: UPC: (213) 740-4321, HSC: (323)-442-1000.

For 24 hour non-emergency assistance or information: UPC: (213) 740-6000, HSC: 323-442-1200.

[Office of the Ombuds](#) - (213) 821-9556 (UPC) / (323-442-0382 (HSC)

A safe and confidential place to share your USC-related issues with a University Ombuds who will work with you to explore options or paths to manage your concern.

[Occupational Therapy Faculty Practice](#) - (323) 442-2850 or otfp@med.usc.edu

Confidential Lifestyle Redesign services for USC students to support health promoting habits and routines that enhance quality of life and academic performance.