Course Syllabus

Jump to Today

CMPR.X401 – C Programming, Advanced – 3 Units

Instructor: Radhika Grover

Course Description

C remains one of the most popular programming languages. It is widely available on most, if not all, computing platforms. This language is highly valued for its speed, low-level capabilities and platform independent characteristics. It is also actively used in the development of other languages. This course will broaden your skills as a C language programmer by introducing sophisticated problem-solving and optimization techniques.

This course delves into the design, implementation, and use of advanced data structures. Students will solidify their understanding of strings, arrays, pointers, structures, unions and bit manipulation. Emphasis will be on programming that employs and improves upon a variety of data structures. Through this course, you will learn to write efficient programs by understanding the complexities of various algorithms.

Topics Include:

- Data types, variables, operators, and operator precedence
- Arrays in general, including two-dimensional and multi-dimensional configurations
- Dynamic memory allocation
- Pointers, strings, file input and output
- Data structures such as linked, circular and doubly linked lists, stacks, queues, and hash tables
- Binary trees in general, including implementation, traversal and drawbacks, AVL trees, B trees, and B+ trees
- Recursions and implementation of recursive algorithms
- Huffman algorithm
- Sorting routines, Big O notation and the complexity of algorithms
- Graphs: their traversal and applications

Prerequisite Skills

- C Programming for Beginners
- Students should have a good understanding of programming using data types such as pointers, control flow, structures and functions.

Notes

None

Learning Outcomes

At the conclusion of the course, you should be able to:

- Define a data type and understand the memory layout for different variables.
- Manipulate arrays of any data type, program with loops and control flow, play with pointers.
- Define user created structures, use files to read the input data and write output.
- Allocate structure memory dynamically, manipulate linked lists.
- Sort complex data though simple and advanced sort routines.
- Create tree structures, assign data elements in tree format and traverse trees.
- Create a BTree structure to store multiple elements of data in a tree node with multiple children.
- Create graph nodes to traverse through them, find shortest path from a graph between two nodes.
- Identify a minimum spanning tree from a graph created with the node information.

Course Outline

Here's an outline of what I plan to cover in class. But, it may be changed to meet your class's needs.

Week/Module	Topics (align with Learning Outcomes)	Assignments
1	**Programming environment, data types, variables, operators, operator precedence** - Setting up the programming environment - Overview of data types, pointers, variables, operators and operator precedence rules - Overview of loops - Scope	- **Review Module 1 slides**
2	**Pointers and File I/O** - Pointers to variables, arrays and function references - Pointers with character strings - File pointer - Functions to read from and write to files - Functions with pointer arguments	- **Review Module 2 slides**
3	**Arrays, Structures and Strings** - Enums, macros, array subscripts, array as function arguments - Pointers to arrays - Dynamic memory allocation - Creating a string	- **Review Module 3 slides** - **Read sections 3.2 and 3.6 of Sedgewick**

	- String functions - Arrays of pointers - Character operations - Structures (functions and arrays with structures)	
4	**Recursion** - Understanding recursion by tracing the stack - Examples of recursion	- **Review Module 4 slides** - **Read sections 5.1 to 5.3 of Sedgewick**
5	**Sorting and analysis of algorithms** - Various sorting algorithms (shellsort, heapsort, merge sort, quick sort) - Decision trees - Analysis of algorithms	○ **Review Module 5 slides** ○ **Read chapter7 of Weiss**
6	**Lists, Stacks, and Queues** - Linked List and their implementation - Stack Model, implementation of stacks and their applications - Queue Model, array and linked list implementation of queues and their applications	- **Review Module 6 slides** - **Read sections 3.3, 4.2 to 4.5 of Sedgewick**
7	**Binary trees, AVL Trees, B Trees** - Tree traversals - depth first search and breadth first search - Binary trees - Implementation of a Binary search tree, analysis - AVL Trees - single and double rotations - B-trees, B+ trees - Huffman tree	- **Review Module 7 slides** - **Read sections 5.4-5.6, 12.3-12.6 and 16.3 of Sedgewick** - **Homework 1 due** - **Discussion 1**
8	**Priority Queues** - Binary heap, basic heap, heap-order property - Implementation of binary heaps and their applications	- **Review Module 8 slides** - **Read sections 9.5 to 9.7 of Sedgewick** - **Homework 2 due** - **Discussion 2**

	• Binomial queues – structure and operations • Priority queues in the standard library	
9	**Hashing** • Hash functions • Hash tables without linked lists: linear problng, quadratic probing, double hashing • Rehashing • Universal hashing and extendible hashing	• **Review Module 9 slides** • **Read sections 14.1 to 14.5 of Sedgewick** • **Homework 3 due** • **Discussion 3**
10	**Graph algorithms** • Graph traversals • Shortest-Path algorithms: Dijkstra's algorithm	• **Review Module 10 slides** • **Read section 9.3 of Weiss** • **Homework 4 due** • **Discussion 4**
11	**Graph algorithms** • Minimum spanning tree: Prim's algorithm	• **Review Module 11 slides** • **Read section 9.5 of Weiss** • **Research paper due**
12	**NP-Completeness** • Class NP • NP-Complete Problems	• **Review Module 12 slides** • **Read section 9.7 of Weiss** • **Project due**

Required Tools and Materials

• None

Recommended Tools and Materials

• Algorithms in C, 3rd edition, Sedgewick, Addison-Wesley Professional ISBN-13: 978-0201314526, ISBN-10: 0201314525

• C Programming for Scientists and Engineers with Applications, Reddy and Ziegler, Jones and Bartlett Learning ISBN-13: 978-0763739522, ISBN-10: 0763739529

• Data Structures and Algorithm Analysis in C, Mark Allen Weiss, Benjamin/Cummings Publishing Company Inc.

Performance Evaluation

Activity	Percentage	Description
Homework	40%	The homework assignments have short to moderately long programming assignments
Test 1	20%	Held in week 6 (Feb 15) on topics covered covered in weeks 1 to 5
Test 2	20%	Held in week 10 (March 14) on topics covered in weeks 6 to 9
Research Paper	10%	Discussion of improvement implementations of data structures or algorithms in class
Dicsussion on Puzzles and Games	10%	Participation in the discussion forum to solve given puzzles and games by considering (a) algorithm efficiency (b) memory efficient (c) code brevity
Total:	**100%**	

Grading

Letter grades (A through F) are the default options. However, students have until the day before the course end date to change their grading preference to a Credit/No Credit Option.

Grading scale

Grade options	%
A	≥ 93
A-	90-92
B+	88-89
B	83-87
B-	80-82
C+	78-79
C	73-77

C-	70-72
D+	68-69
D	63-67
D-	60-62
F	59 and below
Credit	60 and above
No Credit	59 and below

*For alternative grading options, students MUST contact extensiongrades@ucsc.edu (mailto:extensiongrades@ucsc.edu) with the Alternative Grade Form.

 Click Here to Review the [Grading and Credits Website](https://www.ucsc-extension.edu/info/policies/grading-and-credits-policy/)   (https://www.ucsc-extension.edu/info/policies/grading-and-credits-policy/)

UCSC Extension Policies:

Click here to view and print the **[UCSC Extension Policies (PDF)](https://file.ucsc-extension.edu/unexfiles/UNEX_Policies_Syllabus.pdf)   (https://file.ucsc-extension.edu/unexfiles/UNEX_Policies_Syllabus.pdf)**

Course Summary:

Date	Details	
Wed Mar 4, 2020	📅 **Complete Course Evaluation (https://classroom.ucsc-extension.edu/calendar?event_id=12018&include_contexts=course_4619)**	12pm
Sun Feb 7, 2021	📝 **Galactic search (https://classroom.ucsc-extension.edu/courses/4619/assignments/39114)**	due by 11:59pm
Sun Feb 14, 2021	📝 **Halloween candy binge / VIP riders (https://classroom.ucsc-extension.edu/courses/4619/assignments/39113)**	due by 11:59pm
Mon Feb 15, 2021	📝 **Warmup assignment - part 1 (https://classroom.ucsc-extension.edu/courses/4619/assignments/39124)**	due by 10pm
Sun Feb 21, 2021	📝 **Warmup assignment - part 2 (https://classroom.ucsc-extension.edu/courses/4619/assignments/39125)**	due by 11:59pm

Date	Details	
Sun Feb 28, 2021	📝 **Warmup assignment -part 3 (https://classroom.ucsc-extension.edu/courses/4619/assignments/39126)**	due by 11:59pm
Sat Mar 20, 2021	📝 **Research paper (https://classroom.ucsc-extension.edu/courses/4619/assignments/39122)**	due by 11:59pm