Math 355

Data Structures (3 Credit Hours)

When: MWF 1:00pm – 1:50pm   Section: 01

Where: 105 Science Building   CRN: 10132

Prereqs: MATH 240 – Programming in C++

What is this class about?

The study of Data Structures and Algorithms forms the core of Computer Science. Niklaus Wirth famously titled one of his books "Algorithms + Data Structures = Programs". In your previous classes, you have experienced this as you have learned to develop your own algorithms and utilized data structures to solve problems in both procedural and object-oriented languages.

As Computer Scientists, we are concerned with developing correct and efficient solutions to problems. However, real world problems have many solutions. Out of a large number of solutions, how do you know that your solution is the best one? As a programmer, how do you know when to save time by re-using existing solutions and when you need to develop your own? To discover how, we will explore some of the mathematical and theoretical underpinnings of Computer Science, such as Analysis of Algorithms, Algorithm Design Techniques and the Limits of Computation.

On a practical level, you will learn how to design, evaluate and code appropriate solutions to a wide variety of problems. We will delve into several of the data structures you have seen in other classes to learn their advantages and disadvantages as well as introduce new structures and algorithms for your consideration.

While Data Structures and Algorithms are not language dependent, we will be implementing them using object-oriented design techniques in C++. We choose C++ so that you can learn the low-level details of the algorithms as well as the importance of designing interfaces for other programmers to use so that they do not have to worry about these details themselves.

Job interviews in our field often revolve around questions concerning Data Structures and Algorithms. Industry programmers design, implement and manipulate these tools every day and it is very important that you have a solid grasp of these concepts before graduating.

Contact Info – How Do I Contact You?

Instructor: Lonnie Bowe (you can call me Mr. Bowe or Professor Bowe)

E-mail: lbowe@concord.edu

Office: 100E Science Building

Office Hours: MWF 9am - 11am, M F 12pm - 1pm, TR 11am - 1pm

These are guaranteed times that I will be present in my office. However, I am usually present in my office more than that. I have an Open Door Policy, which follows:

If my office door is open (and I am there), you are welcome and encouraged to come in to chat or ask questions, even if it is not during my official office hours.

What is the Course Website?

The course website is available at: http://math.concord.edu/moodle2/

If you have problems accessing the course, please contact the instructor.

Grades – What do I have to do to get a good grade in this course?

Assignments **30%**

Assignments will mostly consist of programming projects designed to give you experience with data structures programming and to demonstrate concepts discussed in class. Written assignments on theoretical material will also be given. Assignments will be graded during personal meetings with the instructor and may include a verbal portion.

Exams **20%**

Data Structures and Algorithms form a very important part of job interviews in this field. To simulate the process, written, timed exams will be given. When possible the instructor will take exam questions from job interview preparation resources.

2 Presentations **20%**

You will read and present material in order to learn how to properly present technical information to an audience. Material may come from class texts or recent research papers.

Final Project & Presentation **20%**

You will complete a sizeable project demonstrating what you have learned during the semester and present the project to the class.

Chapter Summaries **10%** - Lectures go better when you read the material.

Materials – What do I need to buy?

None! All materials will be provided, free of charge, including the texts.

Text:

There are many good references on this topic freely available online. During the semester we will be pulling from several. A C++ reference book is also recommended; the text from Math 202 and Math 240 should suffice.

Data Structures and Algorithm Analysis by Clifford A. Shaffer

Available for free at: http://people.cs.vt.edu/~shaffer/Book/

Data Structures and Algorithms with Object-Oriented Design Patterns in C++ by B.R. Preiss

Available for free at: http://www.brpreiss.com/books/opus4/

Open Data Structures (in C++) by Pat Morin

Available for free at: http://opendatastructures.org/ods-cpp.pdf

Data Structures and Program Design in C++ by Robert L. Kruse

Available for free at: http://www.cs.hartford.edu/~rosiene/CS220/KRUSE-CD/linux/front.pdf

Other references and resources will be given as needed.

Course and University Policies:

Plagiarism & Academic Dishonesty

Plagiarism is stealing or passing off as one's own, ideas or words of another, whether or not copyrighted. Plagiarism will be penalized by the instructor according to the degree of dishonesty the instructor judges is involved. Students guilty of academic dishonesty are subject to disciplinary action. Disciplinary action may include, but is not limited to: reduction of a grade on an assignment or examination, reduction of a grade for the class, suspension or expulsion from the University. Students may appeal disciplinary action taken against them by filing a grievance.

NOTE: It is YOUR responsibility to keep a copy of ALL your work. Also, keep a backup copy of any course work completed on a computer. CU will not be responsible for any loss of materials.

Attendance

Attendance is encouraged, but not required. Active participation and attendance will benefit you. If I notice a pattern of non-attendance, I may require you to have a meeting with me to discuss the problems.

Inclement Weather

I follow the official University policy on student safety. Inclement Weather conditions will be taken into
consideration in regard to the attendance policy.

Contact Policy

I will use e-mail for class announcements. Please check your e-mail at least once a day.

Feedback Policy

It is my goal to give you timely, constructive feedback on your performance in this class. However, I cannot know how I am performing without feedback from you. I encourage you to let me know how I am doing, what you like and dislike about the course.

This feedback will in no way impact your grade. Do not suffer in silence. If speaking to me in person about these matters makes you uncomfortable, I will also periodically provide anonymous surveys on Moodle for you to express your opinions.

Class Conduct

Remember that there are other people in the class with you and adjust your behavior accordingly.
Be attentive and participate!
Do not be late to arrive or early to leave.
Do not converse with others while the instructor is talking or be disruptive.
Cell phones must be set to vibrate or turned off during class.

Americans with Disabilities Act Standards

Concord University is committed to responding to the needs of students with disabilities as defined by the Americans with Disabilities Act. Students who request academic accommodations or modifications related to a disability should first notify their instructor and then contact the Vice President and Academic Dean's Office. Social Justice Policy: Concord University's mission is to recognize the development of human potential which promotes cultural and ethnic diversity and understanding. The institution is committed to fairness and equality in all aspects of employment and campus life; for all persons regardless of age, race, color, national origin, sex, sexual orientation, religion, veteran status or documented disability legal status.

Concord University Honor Code:

As a member of the Concord University Community I will act with honesty and integrity in accordance with our fundamental principles and I will respect myself and others while challenging them to do the same.

Academic Resources

Drop-In Tutoring

Free tutoring available in the Library, Student Center Study Lounge (2nd floor), and Rahall atrium. For specific information, contact the Academic Success Center (asc@concord.edu; 304-384-6074). The schedule will be posted online: http://www.concord.edu/academics/academic-success-center/drop-tutoring

SMARTHINKING

Free **online tutoring** in most subjects, available 24/7; Sign up through MyCU Student Tab.

Departmental Tutoring

See the posted schedule in the Math department lobby.

Note: The instructor reserves the right to modify this syllabus. I will not make any modifications without good reason. Any changes will be announced in class.

Course Schedule (Programming Assignments are bolded)

Week 1:

Topics Covered: Introduction, Review of Linked Lists, Mathematical Preliminaries

Assignments Due: Chapter Summaries and **Linked List class**.

Conway's Game of Life Project assigned.

Week 2:

Topics Covered: Mathematical Preliminaries (cont), Analysis of Algorithms

Assignments Due: Chapter Summaries.

Week 3:

Topics Covered: Analysis of Algorithms (cont)

Assignments Due: Chapter Summaries, Preliminary Worksheet, **Chess.**

Week 4:

Topics Covered: Stacks, Queues and Deques, Shuffling Algorithms

Assignments Due: Chapter Summaries, Analysis Worksheet.

Solitaire Project assigned.

Week 5:

Topics Covered: Trees (Binary and General)

Assignments Due: Chapter Summaries, **Stack, Queue and Deque classes**

Week 6:

Topics Covered: Trees (cont), Binary Search, Sorting Algorithms

Assignments Due: Chapter Summaries, **Binary Tree class (with traversals)**

Week 7:

Topics Covered: Sorting Algorithm Presentations

Assignments Due: Presentation #1, **Conway's Game of Life Project**

Week 8:

Topics Covered: Review and Catch-up Week, Exam 1 on Friday.

Assignments Due: Chapter Summaries, **Game Trees project (Mancala, Tic-Tac Toe)**

Week 9:

Topics Covered: Tables and Information Retrieval

Assignments Due: Chapter Summaries, **Binary Search, Sorting Implementations**

Week 10:

Topics Covered: Tables and Information Retrieval (cont)

Assignments Due: **Solitaire project**

Week 11:

Topics Covered: Searching Algorithm Presentations

Assignments Due: Presentation #2, **Hash Table implementation**

Week 12:

Topics Covered: Graphs, Shortest Path Algorithms

Assignments Due: **Searching Algorithm Implementations**

"MapQuest" Project assigned.

Week 13:

Topics Covered: Graphs (cont), Algorithm Design Techniques

Assignments Due: Chapter Summaries

Week 14:

Topics Covered: Algorithm Design Techniques (cont), Limits to Computation

Assignments Due: Chapter Summaries

Week 15:

Topics Covered: Limits to Computation (cont), Semester Wrap-Up, Exam 2 on Friday

Assignments Due: Chapter Summaries, **"Mapquest" Project**

Finals Week:

Project Presentation occurs during the Finals time slot. Project implementation is due Friday at noon.