

University California, Berkeley
Professional Masters in Molecular Simulation and Software Engineering
Online Degree

Chem 274B, 3 Units

Introduction to Software Engineering

Fall 2021

Dr. Tony Drummond

274 Stanley Hall

thg@berkeley.edu

Course description:

This course will advance students' understanding of fundamental knowledge and techniques for developing complex software. Students will gain an in-depth view of computer system architecture as well as abstraction techniques as means to manage program complexity. Students will collaboratively develop a software engineering package, thus gaining experience in all aspects of the software development process. This course serves as a prerequisite to later MSSE courses: Data Science, Machine Learning Algorithms, Software Engineering for Scientific Computing, Numerical Algorithms Applied to Computational Quantum Chemistry, and Applications of Parallel Computers.

Contribution of this course to the broader curricular objectives:

Required course for all MSSE students.

Prerequisites:

MSSE's Introduction to Programming Languages – C++ and Python.

Course format:

Five hours Faculty-led, asynchronous, web-based instruction, four hours of web-based discussion and two hours of web-based, synchronous lab per week to complete the course in 8 weeks. The GSI will grade lab submissions and homework assignments and will post assignment answer guides. A central part of the course will be the development of a software package using all aspects of software development covered in the course. Students will be given deadlines to complete different milestones set at the beginning of the project. All students will be required to participate. Outside class work should comprise about 9 hours per week for a total of eighteen hours per week.

Grading:

30% homework, 10% discussion participation, 10% lab submission, 50% project.

Resources:

C++ reference: <https://en.cppreference.com/>.

Introduction to Algorithms (third edition) by Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein: <https://mitpress.mit.edu/books/introduction-algorithms-third-edition>.

Course Schedule

Week 1: Computer systems. Basic units (processing, storage, I/O), memory layout, virtual memory, processes and threads, system calls, the OS interface, interacting with the OS, kernel space, user space, multi-computer systems, communication between computers, sockets and protocols TCP/IP.

Week 2: Software design with C++. Multiple source files, compilation, linking, Makefile, procedural programming vs object oriented programming vs functional programming, exceptions, virtual functions, inheritance, polymorphism, templates.

Week 3: Complexity Analysis. Big O notation, time complexity, space complexity, average case complexity, worst case complexity, amortized analysis.

Week 4: Data structure I. Vector, linked list, FIFO and queue, LIFO and stack.

Week 5: Data structure II. Hash table, tree, set, map, priority queue.

Week 6: Algorithms I. Divide and conquer, recursion, memoization, binary search.

Week 7: Algorithms II. Quick sort, merge sort, greedy algorithms, gradient descent.

Week 8: Algorithms III. Graph, depth first search, breadth first search, graph partitioning.