Molecular Science and Software Engineering

UC Berkeley's Master of Molecular Science Engineering (MSSE) is an online professional master's program focused on teaching scientists and engineers to use computation and machine learning to solve real-world problems in the molecular sciences and beyond. The program is designed for students with backgrounds in chemistry, physics, biology, math, engineering, and computer science, or from other science disciplines who want to learn computational science, data science, machine learning, and software engineering.

The MSSE's curriculum teaches computational molecular science with a focus on advanced machine learning, complex mathematical modeling and simulations, software engineering, and high-performance computing. MSSE prepares graduates for roles such as software engineer, data scientist, machine learning engineer, and research scientist in a wide range of science-based industries including biotechnology, pharmaceuticals, material science, energy, and agriculture.

The online degree program can be taken either full-time or part-time. Full-time students can finish the degree in 9 months, and part-time students can finish the degree in 2+ years.

Program-Specific Requirements

The Master of Molecular Science and Software Engineering program is designed for both recent science or engineering graduates and individuals with several years of professional experience.

To qualify for admission you must meet the following requirements in addition to the minimum requirements for admission outlined below:

- B.A. or B.S. in a science, engineering, or computer science discipline
- Prior coursework in chemistry, materials, or physics
- Advanced coursework in mathematics

More details are available at: https://msse.berkeley.edu/apply/

Applying for Graduate Admission

Thank you for considering UC Berkeley for graduate study! UC Berkeley offers more than 120 graduate programs representing the breadth and depth of interdisciplinary scholarship. The Graduate Division hosts a complete list (https://grad.berkeley.edu/admissions/choosing-your-program/list/) of graduate academic programs, departments, degrees offered, and application deadlines can be found on the Graduate Division website.

Prospective students must submit an online application to be considered for admission, in addition to any supplemental materials specific to the program for which they are applying. The online application and steps to take to apply can be found on the Graduate Division website (https://grad.berkeley.edu/admissions/steps-to-apply/).

Admission Requirements

The minimum graduate admission requirements are:

1. A bachelor's degree or recognized equivalent from an accredited institution;

2. A satisfactory scholastic average, usually a minimum grade-point average (GPA) of 3.0 (B) on a 4.0 scale; and

3. Enough undergraduate training to do graduate work in your chosen field.

For a list of requirements to complete your graduate application, please see the Graduate Division's Admissions Requirements page (https://grad.berkeley.edu/admissions/steps-to-apply/requirements/). It is also important to check with the program or department of interest, as they may have additional requirements specific to their program of study and degree. Department contact information can be found here (https://guide.berkeley.edu/graduate/degree-programs/).

Where to apply?

Visit the Berkeley Graduate Division application page (http://grad.berkeley.edu/admissions/apply/).

Candidates are required to maintain a grade-point average (GPA) of 3.0 (B) on a 4.0 scale in the program as well as a 3.0 (B) or better in the following courses:

CHEM 274A	Programming Languages for Molecular Sciences: Python and C++	3
CHEM 274B	Software Engineering Fundamentals for Molecular Sciences	3
CHEM 277B	Machine Learning Algorithms	3
CHEM 278	Ethical Topics for Professional Software Engineering	1
CHEM 279	Numerical Algorithms applied to Computational Quantum Chemistry	3
CHEM 280	Foundations of Programming and Software Engineering for Molecular Sciences	2
CHEM 281	Software Engineering for Scientific Computing	3
CHEM 282	MSSE Leadership Bootcamp (In-person class)	2
CHEM 283	MSSE Capstone Project Course	3
DATA C200	Principles and Techniques of Data Science	3
COMPSCI C267	Applications of Parallel Computers	3
Total Units		**29**

Capstone Project

Beginning in their second-to-last semester, MSSE students will begin to identify a topic that they'd like to focus on for their capstone. The MSSE capstone is a 16-week project designed to provide MSSE students with a multifaceted experience managing a project of their choice involving the application and development of high-end computational software for computational sciences with an emphasis on molecular sciences. Students will exercise their leadership and team-building skills through individual class assignments, peer reviews, and a final capstone project report. This course is designed to provide students with tools and practices for designing project deliverables, planning and meeting project deadlines, giving presentations, writing technical communications, and providing constructive feedback to peers. Additionally, students will complete and polish a professional MSSE software portfolio that meets software engineering best practices and standards. Given the wide variety of student backgrounds, professional interests, and computational sciences topics covered in the MSSE program, capstone projects will fall into one of the following three professional interdisciplinary tracks:

- <u>Scientific Problem</u>. A capstone project focused on the research and development of a computational science application. The product is a publication-quality research paper in a computational sciences journal or conference. Results need to be reproducible.

- <u>Large Scale Computing</u>. A capstone project focused on the development of large-scale software tools or computational applications relevant to molecular sciences. The project includes a software package, corresponding documentation, computational scalability analysis, and scientific relevance of the accomplishments. The product is a publishable research paper in a high-performance journal or conference. Results need to be reproducible.

- <u>Software Engineering and Algorithms</u>. Work focuses on the development of a library or software package for computational sciences. The final project is a high-quality software package, well documented, and integrates relevant auto-tests, examples, and user interfaces. The product is a software package that can be distributed and maintained through a widely available software repository (e.g. GitHub, GitLab, etc)

Leadership Bootcamp

The Leadership Bootcamp is a two-week intensive course that introduces program participants to the leadership, management, and entrepreneurial skills necessary in the professional environment. This course aims to provide program participants an understanding of the key aspects of management and leadership disciplines; team and organization dynamics; leading and participating in cross-functional teams; engineering economic, finance, and accounting concepts; as well as effective communication skills and project management.

By the end of the Leadership Bootcamp, students will be able to:

- Apply the various leadership and management techniques to enhance a technology professional's ability to achieve desirable performance objectives

- Effectively communicate, negotiate with, and present to stakeholders of all disciplines

- Apply the basic concept of cross-functional teams to enhance the ability of a technology professional's contribution to a cross-functional team

- Use engineering economic principles to help assess the effectiveness of a business investment, such as a research project or product development initiatives

- Analyze project risks and prepare technical proposals

- Establish a project plan, manage/participate in a project and assess project performance

- Identify the key cost elements of a business operation and the effects of a technology professional on these cost elements

- Use the various financial statements to assess the health of a business.

The Berkeley MSSE degree prepares students for careers in computational science, data science, machine learning, and software engineering. The program is designed to train students with backgrounds in chemistry, physics, biology, computer science, or from other physical science disciplines. MSSE provides students with the tools and software

engineering practices, as well as leadership, management, and entrepreneurial skills needed to create or lead science- or engineering-based enterprises.

While the MSSE degree focuses on the molecular sciences, the skills it provides are suitable for any student pursuing careers both in science and or non-science-based industries that require advanced machine learning, complex mathematical modeling and simulations, software engineering, or high-performance computing.

Careers that the MSSE graduates will be prepared for include:

- Computational Scientist
- Machine Learning Engineer
- Software Engineer
- Computational Chemist
- Computational Biologist
- AI Engineer
- Bioinformatics Engineer
- Quantum Computing Engineer