Molecular Science and Software Engineering

The MSSE degree is a remotely delivered, two-year, part-time program that prepares students for careers and leadership roles in the fields of computational science and machine learning. The program is designed to formally train scientists, engineers, and computer scientists in computational and data science, and to provide them with the tools, software engineering practices, leadership, management, and entrepreneurial skills needed to create or lead science- or engineering-based enterprises.

While the degree focuses on the molecular sciences, its content is suitable for any student pursuing software engineering or data science roles in other science-based industries, or in other areas that require advanced machine learning, complex mathematical modeling and simulations, or high-performance computing.

One of the central missions of MSSE is to develop a workforce that is highly prepared to work in a multidisciplinary environment. Another central mission is to develop a diverse workforce in fields that have traditionally had low participation of women, ethnic minorities, and other underrepresented groups.

MSSE-Specific Requirements

The Master of Molecular Science and Software Engineering program is designed for recent science or engineering graduates and individuals with several years of professional experience. To qualify for admission you must have:

- B.A. or B.S. in a science, engineering, or computer science discipline from an accredited institution.
- Prior coursework in linear algebra, multivariable calculus, and in either chemistry, materials, or physics.
- Prior experience programming in a high-level language such as Python, Java, or C/C++.
- Minimum grade-point average (GPA) of 3.0 (B) on a 4.0 scale.

Minimum Requirements for Admission

The following minimum requirements apply to all graduate programs and will be verified by the Graduate Division:

1. A bachelor's degree or recognized equivalent from an accredited institution;
2. A grade point average of B or better (3.0);
3. If the applicant has completed a basic degree from a country or political entity (e.g., Quebec) where English is not the official language, adequate proficiency in English to do graduate work, as evidenced by a TOEFL score of at least 90 on the iBT test, 570 on the paper-and-pencil test, or an IELTS Band score of at least 7 on a 9-point scale (note that individual programs may set higher levels for any of these); and
4. Sufficient undergraduate training to do graduate work in the given field.

Applicants Who Already Hold a Graduate Degree

The Graduate Council views academic degrees not as vocational training certificates, but as evidence of broad training in research methods, independent study, and articulation of learning. Therefore, applicants who already have academic graduate degrees should be able to pursue new subject matter at an advanced level without the need to enroll in a related or similar graduate program.

Programs may consider students for an additional academic master's or professional master's degree only if the additional degree is in a distinctly different field.

Applicants admitted to a doctoral program that requires a master's degree to be earned at Berkeley as a prerequisite (even though the applicant already has a master's degree from another institution in the same or a closely allied field of study) will be permitted to undertake the second master's degree, despite the overlap in field.

The Graduate Division will admit students for a second doctoral degree only if they meet the following guidelines:

1. Applicants with doctoral degrees may be admitted for an additional doctoral degree only if that degree program is in a general area of knowledge distinctly different from the field in which they earned their original degree. For example, a physics PhD could be admitted to a doctoral degree program in music or history; however, a student with a doctoral degree in mathematics would not be permitted to add a PhD in statistics.
2. Applicants who hold the PhD degree may be admitted to a professional doctorate or professional master's degree program if there is no duplication of training involved.

Applicants may apply only to one single degree program or one concurrent degree program per admission cycle.

Required Documents for Applications

1. **Transcripts:** Applicants may upload *unofficial* transcripts with your application for the departmental initial review. Unofficial transcripts must contain specific information including the name of the applicant, name of the school, all courses, grades, units, & degree conferral (if applicable).
2. **Letters of recommendation:** Applicants may request online letters of recommendation through the online application system. Hard copies of recommendation letters must be sent directly to the program, by the recommender, not the Graduate Admissions.
3. **Evidence of English language proficiency:** All applicants who have completed a basic degree from a country or political entity in which the official language is not English are required to submit official evidence of English language proficiency. This applies to institutions from Bangladesh, Burma, Nepal, India, Pakistan, Latin America, the Middle East, the People's Republic of China, Taiwan, Japan, Korea, Southeast Asia, most European countries, and Quebec (Canada). However, applicants who, at the time of application, have already completed at least one year of full-time academic course work with grades of B or better at a US university may submit an official transcript from the US university to fulfill this requirement. The following courses will not fulfill this requirement:
    - courses in English as a Second Language,
    - courses conducted in a language other than English,

- courses that will be completed after the application is submitted, and
- courses of a non-academic nature.

Applicants who have previously applied to Berkeley must also submit new test scores that meet the current minimum requirement from one of the standardized tests. Official TOEFL score reports must be sent directly from Educational Test Services (ETS). The institution code for Berkeley is 4833 for Graduate Organizations. Official IELTS score reports must be sent electronically from the testing center to University of California, Berkeley, Graduate Division, Sproul Hall, Rm 318 MC 5900, Berkeley, CA 94720. TOEFL and IELTS score reports are only valid for two years prior to beginning the graduate program at UC Berkeley. Note: score reports can not expire before the month of June.

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 Tracks

Beginning in the Fall of the second year of the program, 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 whose objective is 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 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 designing project deliverables, planning and meeting project deadlines, giving presentations, writing technical communications and providing constructive feedback to peers. They will be supervised to complete building a professional MSSE software portfolio, which meets the best software engineering practices. Given the wide variety of student backgrounds, professional interests and Computational Sciences topics covered in the MSSE program, the Capstone projects are classified in one of the following three professional interdisciplinary tracks:

- **Scientific Problem**. A Capstone project focuses 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.
- **Large Scale Computing**. A Capstone Project focuses on the development of large scale software tools or computational applications relevant to Molecular Sciences. The product 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.
- **Software Engineering and Algorithms**. 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 an in-person course that begins the last two weeks of the Spring semester in the second year. This bootcamp is an intensive course that introduces program participants to the leadership, management and entrepreneurial skills necessary in today's professional environment. Using the capstone project as a baseline, 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. The MSSE provides students with the tools, software engineering practices, leadership, management, and entrepreneurial skills needed to create or lead science- or engineering-based enterprises.

While the 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