

# The Second Major in Computer Science + Mathematics

The McKelvey School of Engineering and the College of Arts & Sciences have developed a new second major that efficiently captures the intersection of the complementary studies of computer science and math.

McKelvey Engineering students who declare this major must fulfill the core course requirements listed below and all other requirements for the Applied Science degree in the McKelvey School of Engineering. They must also complete Engr 310 Technical Writing and 8 units of courses designated as NSM (Natural Sciences & Math) from Anthropology (L48 Anthro); Biology and Biomedical Sciences (L41 Biol); Chemistry (L07 Chem); Earth, Environmental, and Planetary Sciences (L19 EPSc); Physics (L31 Physics); or Environmental Studies (L82 EnSt).

Arts & Sciences students who declare this major must fulfill the distribution requirements and all other requirements for an AB degree in addition to the specific requirements listed below.

## Core Requirements

Code	Title	Units
CSE 131	Introduction to Computer Science	3
CSE 240	Logic and Discrete Mathematics	3
CSE 247	Data Structures and Algorithms	3
Math 131	Calculus I	3
Math 132	Calculus II	3
Math 233	Calculus III	3
Math 309	Matrix Algebra	3
Math 310 or Math 310W	Foundations for Higher Mathematics Foundations For Higher Mathematics With Writing	3
SDS 3200 or ESE 326 or SDS 3211	Elementary to Intermediate Statistics and Data Analysis Probability and Statistics for Engineering Statistics for Data Science I	3
CSE 347	Analysis of Algorithms	3
<b>Total Units</b>		<b>30</b>

<sup>1</sup> Each of these core courses must be passed with a grade of C- or better.

<sup>2</sup> Students who complete the Math 203 Honors Mathematics I–Math 204 Honors Mathematics II sequence will be considered to have completed Math 131 Calculus I, Math 132 Calculus II, and Math 233 Calculus III. These students can also choose to take additional electives in place of Math 309 Matrix Algebra and Math 310 Foundations for Higher Mathematics.

## Electives

Eight upper-level courses from Math or CSE can be chosen from an approved list, with the following caveats:

1. At least three courses must be taken from CSE and at least three course must be taken from Math.
2. Up to two preapproved courses from outside both departments can be selected.
3. CSE 400 Independent Study or CSE 400E Independent Study may be taken for a maximum of 3 units and must be approved by a CS+Math review committee.

## List of Approved Electives Computer Science & Engineering

Code	Title	Units
CSE 217A	Introduction to Data Science	3
CSE 341T	Parallel and Sequential Algorithms	3
CSE 411A	AI and Society	3
CSE 412A	Introduction to Artificial Intelligence	3
CSE 416A	Data Science for Complex Networks	3
CSE 417T	Introduction to Machine Learning	3
CSE 427S	Cloud Computing with Big Data Applications	3
CSE 442T	Introduction to Cryptography	3
CSE 447T	Introduction to Formal Languages and Automata	3
CSE 457A	Introduction to Visualization	3
CSE 468T	Introduction to Quantum Computing	3
CSE 513T	Theory of Artificial Intelligence and Machine Learning	3
CSE 514A	Data Mining	3
CSE 515T	Bayesian Methods in Machine Learning	3
CSE 516A	Multi-Agent Systems	3
CSE 517A	Machine Learning	3
CSE 518A	Human-in-the-Loop Computation	3
CSE 533T	Coding and Information Theory for Data Science	3
CSE 534A	Large-Scale Optimization for Data Science	3
CSE 541T	Advanced Algorithms	3
CSE 543T	Algorithms for Nonlinear Optimization	3
CSE 544T	Special Topics in Computer Science Theory	3
CSE 546T	Computational Geometry	3
CSE 554A	Geometric Computing for Biomedicine	3
CSE 555T	Adversarial AI	3
CSE 559A	Computer Vision	3

CSE 581T	Approximation Algorithms	3
CSE 584A	Algorithms for Biosequence Comparison	3
CSE 587A	Algorithms for Computational Biology	3
CSE 659A	Advances in Computer Vision	3

## Mathematics

Code	Title	Units
Math 350	Topics in Applied Mathematics	3
Math 370	Introduction to Combinatorics	3
Math 371	Graph Theory	3
Math 407	An Introduction to Differential Geometry	3
Math 410	Introduction to Fourier Series and Integrals	3
Math 4111	Introduction to Analysis	3
Math 4121	Introduction to Lebesgue Integration	3
Math 4171	Topology I	3
Math 429	Linear Algebra	3
Math 430	Modern Algebra	3
Math 4351	Number Theory and Cryptography	3
Math 444	The Mathematics of Quantum Theory	3
Math 449	Numerical Applied Mathematics	3
Math 450	Topics in Applied Mathematics	3
Math 456	Topics in Financial Mathematics	3
Math 470	Topics in Graph Theory	3
Math 493C/SDS 493	Probability	3
Math 495C/SDS 495	Stochastic Processes	3

## Statistics and Data Science

Code	Title	Units
SDS 420	Experimental Design	3
SDS 434	Survival Analysis	3
SDS 439	Linear Statistical Models	3
SDS 459	Bayesian Statistics	3
SDS 460	Multivariate Statistical Analysis	3
SDS 461	Time Series Analysis	3
SDS 462	Mathematical Foundations of Big Data	3
SDS 475	Statistical Computation	3
SDS 493/Math 493C	Probability	3
SDS 494	Mathematical Statistics	3
SDS 495/Math 495C	Stochastic Processes	3

## Electrical & Systems Engineering

Code	Title	Units
ESE 4031	Optimization for Engineered Planning, Decisions and Operations	3
ESE 415	Optimization	3
ESE 417	Introduction to Machine Learning and Pattern Classification	3

ESE 427	Financial Mathematics	3
ESE 429	Basic Principles of Quantum Optics and Quantum Information	3
ESE 520	Probability and Stochastic Processes	3

## Economics

Code	Title	Units
Econ 4151	Applied Econometrics	3
Econ 467	Game Theory	3

## Biology and Biomedical Sciences

Code	Title	Units
Biol 5657	Biological Neural Computation	3

## Biomedical Engineering

Code	Title	Units
BME 470	Mathematics of Imaging Science	3

## Linguistics

Code	Title	Units
Ling 317	Introduction to Computational Linguistics	3
Ling 427	Computation and Learnability in Linguistic Theory	3

## Additional Departmental Requirements

Engr 310 Technical Writing	3
One themed writing course from the College Writing Program	3
Humanities and social sciences electives	18
Natural sciences electives	8

The College Writing Program, humanities, and social sciences requirements are those required of all students in the McKelvey School of Engineering. For information about how to fulfill the school's English proficiency requirement, please visit the Degree Requirements page of this Bulletin.

The natural sciences requirement is for 8 units designated NSM (Natural Sciences and Mathematics) from any of the following departments: Anthropology; Biology; Chemistry; Earth, Environmental, and Planetary Sciences; Environmental Studies; or Physics. The College Writing Program and natural sciences courses must be completed with a grade of C- or better.

All courses taken to meet any of the above requirements (with the exception of the humanities and social sciences electives) cannot be taken on a pass/fail basis.