ELECTRICAL AND COMPUTER ENGINEERING: MACHINE LEARNING AND SIGNAL PROCESSING, M.S.

This is a named option in the Electrical and Computer Engineering M.S. (http://guide.wisc.edu/graduate/electrical-computer-engineering/electrical-computer-engineering-ms/)

The Electrical and Computer Engineering Department (ECE) offers the Electrical and Computer Engineering M.S.-Machine Learning and Signal Processing (MLSP) named option program which is intended for students looking for an advanced entry into a data science career in industry.

Students will learn quantitative thinking, practical problem-solving, computer programming, and applications to a variety of domains. It is designed to deepen the student’s technical knowledge and sharpen their professional skills for a well-prepared entry into industry. The program provides a practical focus through a course-only curriculum, an accelerated and predictable 16-month completion time, and a professional development hands-on project requirement. Well-prepared students and UW–Madison undergraduates may find it feasible to complete the program in 12 months.

The required coursework draws upon foundational and cutting-edge methods in MLSP, and is taught by faculty conducting pioneering research in the field. Successful students will have some experience with linear algebra, statistics, and programming. The combined focus on the mathematical foundations of data science and their practical application to real-world problems will prepare graduates to be ready to immediately contribute in a variety of different jobs across data science, machine learning, and signal processing.

The focus of the MLSP program differs from the traditional research-based M.S. program. MLSP students do not conduct independent research and prepare a thesis, but rather have an accelerated course plan focused in the MLSP area with a professional development hands-on project, either via an internship/co-op or an independent project. Students also have the opportunity to take select courses from Engineering Professional Development. If you are interested in research and advanced concept development, you are better served pursuing a research-based M.S. program or a Ph.D. program. If you want to complete your degree within 16 months and enter the workforce, then the MLSP program is right for you.

MLSP students cannot be simultaneously enrolled in another graduate program at UW–Madison while completing this program.

After completing the program, students will earn a diploma stating “Master of Science in Electrical and Computer Engineering,” and the transcript will include the indication “Named Option: Machine Learning and Signal Processing.”

For more information on this specific degree plan, please visit the program website (https://www.engr.wisc.edu/department/electrical-computer-engineering/academics/master-of-science-spml/).

ADMISSIONS

Please consult the table below for key information about this degree program’s admissions requirements. The program may have more detailed admissions requirements, which can be found below the table or on the program’s website.

Graduate admissions is a two-step process between academic programs and the Graduate School. Applicants must meet the minimum requirements (https://grad.wisc.edu/apply/requirements/) of the Graduate School as well as the program(s). Once you have researched the graduate program(s) you are interested in, apply online (https://grad.wisc.edu/apply/).

<table>
<thead>
<tr>
<th>Requirements</th>
<th>Detail</th>
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</thead>
<tbody>
<tr>
<td>Fall Deadline</td>
<td>December 15*</td>
</tr>
<tr>
<td>Summer Deadline</td>
<td>This program does not admit in the summer.</td>
</tr>
<tr>
<td>GRE (Graduate Record Examination)</td>
<td>Not required but may be considered if available.</td>
</tr>
<tr>
<td>English Proficiency Test</td>
<td>Every applicant whose native language is not English or whose undergraduate instruction was not in English must provide an English proficiency test score and meet the Graduate School minimum requirements (<a href="https://grad.wisc.edu/apply/requirements/#english-proficiency">https://grad.wisc.edu/apply/requirements/#english-proficiency</a>).</td>
</tr>
<tr>
<td>Other Test(s) (e.g., GMAT, MCAT)</td>
<td>n/a</td>
</tr>
<tr>
<td>Letters of Recommendation Required</td>
<td>3</td>
</tr>
</tbody>
</table>

• Complete applications as of December 15 are guaranteed to be reviewed, but applicants are welcomed up to March 15 and will be reviewed as space is available.

A submitted online application (https://apply.grad.wisc.edu) is required, consisting of:

• Resume/CV;
• Statement of purpose; see the suggested guidelines provided by the Graduate School (https://grad.wisc.edu/apply/prepare/);
• Most up to date unofficial transcript(s) from all previous higher education institutions, regardless of whether or not a degree was earned (official transcripts are requested of only recommended applicants); international academic records must be in the original language accompanied by an official English translation.
• Test scores and three letters of recommendation as detailed above.

Applications must be entirely complete by the deadline, including test scores and letters of recommendation. Please note that it is highly advised to take the GRE and TOEFL/IELTS tests well in advance of the application deadline in order to ensure time for receiving and processing of the scores. Please do not mail any paper copies of application materials, except IELTS scores. They will not be reviewed.
Information for international students, including proof of funding and visa information, can be found on the International Student Services website (https://iss.wisc.edu/students/admissions/).

The department welcomes applications from scientific, engineering, and mathematical disciplines other than ECE. Applicants with a bachelor’s degree may apply directly to the Ph.D. program.

REENTRY ADMISSIONS

If you were previously enrolled as a graduate student at UW–Madison, but have had a break in enrollment for at least one fall or spring semester, you will need to apply to resume your studies.

For applicants previously enrolled in a graduate program other than ECE, you must complete a new online application, including all materials, for admission.

For applicants previously enrolled in ECE as a graduate student, you must complete a reentry application. Reentry applicants may apply for the fall term with a deadline of June 1.

In order to apply as a reentry applicant, you must:

- complete the online application (https://apply.grad.wisc.edu (https://apply.grad.wisc.edu/)), including the personal information section, program and term selection, and supplementary application;
- Provide the following documents to the ECE Graduate Admissions Team (ecegradadmission@engr.wisc.edu):
  - CV/Resume
  - Statement of Purpose
  - Any new unofficial transcripts from previous higher education institutions
  - Three letters of recommendation if the break in enrollment equals or is greater than four semesters (fall, spring). Letters of recommendation should be emailed directly from the recommender.

CURRENT GRADUATE STUDENT ADMISSIONS

Students currently enrolled as a graduate student at UW-Madison, whether in or other than ECE, wishing to apply to this degree program should contact the ECE Graduate Admissions Team (ecegradadmission@engr.wisc.edu) to inquire about the process and respective deadlines several months in advance of the anticipated enrollment term. Current students may apply to change or add programs for any term (fall, spring, or summer).

QUESTIONS?

Please review the frequently asked questions answered by the Graduate School here (https://grad.wisc.edu/apply/).

If you have any admissions questions, please do not hesitate to contact the ECE Graduate Admissions Team at ecegradadmission@engr.wisc.edu.

FUNDING

GRADUATE SCHOOL RESOURCES

Resources to help you afford graduate study might include assistantships, fellowships, traineeships, and financial aid. Further funding information (https://grad.wisc.edu/funding/) is available from the Graduate School.

Be sure to check with your program for individual policies and restrictions related to funding.

PROGRAM RESOURCES

Students enrolled in this program are not eligible to receive tuition remission from graduate assistantship appointments at this institution.

TUITION SCHOLARSHIPS FOR ACCELERATED MS PROGRAMS

The Department of Electrical and Computer Engineering offers a limited number of scholarships for highly qualified students that are accepted to the department’s accelerated MS programs. The scholarships are merit-based and awarded during the admission period.

Eligibility Requirements

- Must enroll in one of the Department’s two named options programs:
  - Electrical and Computer Engineering: Machine Learning and Signal Processing
  - Electrical and Computer Engineering: Professional

Scholarship Amounts

- The amount of the scholarship is indicated when the student is notified of the award.

Additional Information

- Students who meet the above criteria are automatically eligible for this scholarship. No formal application by the student is necessary.
- Students will be notified of scholarship award after acceptance to the program.

REQUIREMENTS

MINIMUM GRADUATE SCHOOL REQUIREMENTS

Review the Graduate School minimum academic progress and degree requirements (http://guide.wisc.edu/graduate/#policiesandrequirementstext), in addition to the program requirements listed below.

NAMED OPTION REQUIREMENTS

MODE OF INSTRUCTION

Face to Face | Evening/Weekend | Online | Hybrid | Accelerated
---|---|---|---|---
Yes | No | No | No | Yes

Mode of Instruction Definitions

Accelerated: Accelerated programs are offered at a fast pace that condenses the time to completion. Students typically take enough credits aimed at completing the program in a year or two.

Evening/Weekend: Courses meet on the UW–Madison campus only in evenings and/or on weekends to accommodate typical business schedules. Students have the advantages of face-to-face courses with the flexibility to keep work and other life commitments.

Face-to-Face: Courses typically meet during weekdays on the UW-Madison Campus.
Hybrid: These programs combine face-to-face and online learning formats. Contact the program for more specific information.

Online: These programs are offered 100% online. Some programs may require an on-campus orientation or residency experience, but the courses will be facilitated in an online format.

CURRICULAR REQUIREMENTS

<table>
<thead>
<tr>
<th>Requirement/Detail</th>
<th>Minimum Credit Requirement</th>
<th>Minimum Residence Credit Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>30 credits</td>
<td>23 credits</td>
</tr>
</tbody>
</table>

Minimum 15 credits must be graduate-level coursework. Details can be found in the Graduate School's Minimum Graduate Coursework (50%) policy (https://policy.wisc.edu/library/UW-1244/1).

Overall 3.00 GPA required.

Graduate GPA Requirement policy (https://policy.wisc.edu/library/UW-1203 (https://policy.wisc.edu/library/UW-1203/)).

Other Grade Requirements

1. A grade of B or better in any graduate course is acceptable.
2. A grade of BC in an E C E course is acceptable, provided the total cumulative GPA for graduate E C E courses is greater than or equal to 3.00.
3. A grade of BC or C in a non-E C E course is acceptable only if approved by the Graduate Committee.

Assessments and Examinations

A specified course sequence must be completed.

Language Requirements

Non-native speakers of English who enroll in the M.S. program must take the ESLAT test on arrival at the university and then take any recommended courses based on the exam results. In addition, if a student's advisor believes that his or her technical writing ability needs improvement, the student may be required to undertake remedial work.

REQUIRED COURSES

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>E C E 610</td>
<td>Seminar in Electrical and Computer Engineering</td>
<td>1</td>
</tr>
<tr>
<td>E C E 697</td>
<td>Capstone Project in Machine Learning and Signal Processing</td>
<td>1-5</td>
</tr>
<tr>
<td>E C E 702</td>
<td>Graduate Cooperative Education Program</td>
<td></td>
</tr>
</tbody>
</table>

At least one course in Machine Learning: 3

E C E/COMP SCI M E 532  Matrix Methods in Machine Learning
E C E/COMP SCI M E 539  Introduction to Artificial Neural Networks

At least 15 credits from the following: 15

E C E 431  Digital Signal Processing
E C E 533  Image Processing
E C E 539  Introduction to Artificial Neural Networks
E C E 561  Probability and Information Theory in Machine Learning
E C E 601  Special Topics in Electrical and Computer Engineering (as approved by faculty advisor)
E C E 717  Linear Systems
E C E 719  Optimal Systems
E C E 729  Information Theory
E C E 730  Probability and Random Processes
E C E 734  VLSI Array Structures for Digital Signal Processing
E C E 735  Signal Synthesis and Recovery Techniques
E C E 736  Wireless Communications
E C E 738  Advanced Digital Image Processing
E C E 760  Machine Learning
E C E 761  Mathematical Foundations of Machine Learning
E C E 817  Nonlinear Systems
E C E 830  Estimation and Decision Theory
E C E 861  Theoretical Foundations of Machine Learning
E C E 901  Special Topics in Electrical and Computer Engineering (as approved by faculty advisor, max of 3 credits)
Additional courses from the previous list, or up to 7-9 credits of relevant coursework numbered 300 or above in other departments with approval from faculty advisor

Typically in COMP SCI, MATH, STAT, or E P D (Engineering Professional Development)

Up to 3 credits of independent study (such as E C E 699 or equivalent in other department)

Total Credits 30

1
All on-campus E C E graduate students must register for 1 credit of E C E 610 during their first semester of graduate studies.

2
These courses are taken in Summer.

3
Please keep written communication (emails are acceptable) of approvals from your faculty advisor.

The following courses are not allowed: E C E 611 Introduction to Doctoral Research in Electrical & Computer Engineering or E C E 790 Master’s Research, E C E 890 Pre-Dissertator’s Research.

Students in this program may not take courses outside the prescribed curriculum without faculty advisor and program director approval. Students in this program cannot enroll concurrently in other undergraduate, graduate or certificate programs.

POLICIES

GRADUATE SCHOOL POLICIES

The Graduate School’s Academic Policies and Procedures (https://grad.wisc.edu/acadpolicy/) provide essential information regarding general university policies. Program authority to set degree policies beyond the minimum required by the Graduate School lies with the degree program faculty. Policies set by the academic degree program can be found below.

NAMED OPTION-SPECIFIC POLICIES

PRIOR COURSEWORK

Graduate Work from Other Institutions

This program follows the Graduate School’s policy for Satisfying Requirements with Prior Graduate Coursework from Other Institutions. (https://policy.wisc.edu/library/UW-1216/)

UW–Madison Undergraduate*

With program approval, UW–Madison courses numbered 400 or above can be counted toward the minimum graduate degree credit requirement. E C E courses numbered 700 or above can be counted toward the minimum graduate coursework (50%) requirement. No credits can be counted toward the minimum graduate residence credit requirement. Coursework earned five or more years prior to admission to a master’s degree is not allowed to satisfy requirements.

*ABET-Accredited Undergraduate Credit from Other Institutions: With program approval, students may count undergraduate coursework from a bachelor of science degree in Electrical Engineering, Computer Engineering, Electrical and Computer Engineering, Electrical Engineering and Computer Science, or Computer Science from an ABET-accredited program at other institutions (not UW–Madison) toward fulfillment of minimum degree requirements. No credits from other institutions can be counted toward the minimum graduate residence credit requirement. Coursework earned five or more years prior to admission to a master’s degree is not allowed to satisfy requirements.

UW–Madison University Special

With program approval, students are allowed to count coursework numbered 400 or above, taken as a UW–Madison University Special student, toward the minimum graduate residence credit requirement, and the minimum graduate degree credit requirement. Courses numbered 700 or above taken as a UW–Madison Special student can count toward the minimum graduate coursework (50%) requirement. Coursework earned five or more years prior to admission is not allowed to satisfy requirements.

(Up to 7 credits total of prior coursework can be used from the categories above.)

PROBATION

This program follows the Graduate School’s Probation policy. (https://policy.wisc.edu/library/UW-1217/)

See program policies under "Other,” below, for more details.

ADVISOR / COMMITTEE

New students must declare a course plan approved by an advisor by the end of the second week of classes in the first semester.

CREDITS PER TERM ALLOWED

Students will be required to enroll in at least nine credits per semester of relevant MLSP courses chosen from i) a list of courses inside the department, ii) or relevant courses outside the department with faculty adviser approval as specified in the graduate program handbook. In the final semester, students only need to enroll in enough credits to graduate.

Enrollment in the summer term is required.

TIME LIMITS

Students are expected to complete the degree requirements and graduate within 3 academic semesters.

Otherwise, this program follows the Graduate School’s Time Limits policy. (https://policy.wisc.edu/library/UW-1221/)

GRIEVANCES AND APPEALS

These resources may be helpful in addressing your concerns:

- Bias or Hate Reporting (https://doso.students.wisc.edu/bias-or-hate-reporting/)
- Graduate Assistantship Policies and Procedures (https://hr.wisc.edu/policies/gapp/#grievance-procedure)
- Hostile and Intimidating Behavior Policies and Procedures (https://hr.wisc.edu/hib/)
  - Office of the Provost for Faculty and Staff Affairs (https://facstaff.provost.wisc.edu/)
  - Dean of Students Office (https://doso.students.wisc.edu/) (for all students to seek grievance assistance and support)
  - Employee Assistance (http://www.eao.wisc.edu/) (for personal counseling and workplace consultation around communication and conflict involving graduate assistants and other employees, post-doctoral students, faculty and staff)
Extensions will be recorded with a note of explanation placed in the student’s file.

Students desiring confidentiality of their circumstances should consult with the Associate Chair for Graduate Studies.

**Appeal of Previous Decisions**

Appeals of ECE Graduate Committee decisions may be pursued regarding any academic issue, including exceptions to program requirements, progress requirements, AGS and Qualifying Exam decisions. Appeals will only be considered if the student provides new information that was not available to the ECE Graduate Committee at the time the original decision was made. Appeals must be submitted within one month of the date the student was notified of the ECE Graduate Committee action being appealed.

If the student believes their appeal was not appropriately handled or resolved by the ECE Department, the student may further appeal to the College of Engineering by contacting the Assistant Dean for Graduate Affairs. Such appeals must be submitted within one month of the date the student was notified of the ECE Graduate Committee denial.

**Grievances**

The ECE Department, College of Engineering, and University of Wisconsin offer multiple avenues to resolve unfair or inappropriate treatment by faculty, staff, or another student. This includes hostile and intimidating research group climate, authorship disputes, unreasonable expectations, and disrespectful behavior. The manner in which the grievance is handled depends on the nature of the issue and specific concerns of the aggrieved student. Graduate Assistants in TA, PA and/or RA appointments may utilize the Graduate Assistantship Policies and Procedures (https://hr.wisc.edu/policies/gapp/) (GAPP) grievance process to resolve employment-related issues. Examples of matters appropriate for the GAPP grievance process include allegations of excessive work hours, violations of sick days or vacation policies, or disputes regarding the assignment of duties.

In some cases the best approach is for the aggrieved student to discuss their concern directly with the person responsible for the objectionable action.

If the student is uncomfortable making direct contact with the other individual or desires a confidential consultation about their concern, they may contact the ECE Associate Chair for Graduate Studies, the ECE Grievance Advisor, or the College of Engineering Assistant Dean for Graduate Affairs. These individuals work to resolve the concern while being sensitive to student confidentiality.

**Change of advisor**

Students who believe they are in a research environment that fails to meet ECE and College of Engineering standards for climate and culture should contact the ECE Associate Chair for Graduate Studies, the ECE Grievance Advisor, or the College of Engineering Assistant Dean for Graduate Affairs for additional consultation. They will work with the student to explore alternative advising arrangements and ensure continuity of financial support should the student need to leave the research group. Note that immigration status is NOT tied to a specific research advisor.

**Formal Written Complaint Process**

Issues that are not resolved to the student’s satisfaction may be pursued at the student’s discretion by submitting a written complaint to the
ECE Grievance Advisor. The steps described below are based on the Definition and Procedure section of the Graduate Assistantship Policies and Procedures (https://hr.wisc.edu/policies/gapp/) (GAPP) Grievance Procedure.

Step One: The grievant must file a written statement with the ECE Grievance Advisor specifying the grievant’s name, a clear and concise statement of the grievance and the issue(s) involved, the date(s) the incident or violation took place and the specific departmental, college, or university policies involved, and the relief sought. The grievance shall be signed and dated by the grievant(s) and representative (if any).

Within twenty (20) days of receipt of the written grievance, the ECE Grievance Advisor will meet with the grievant and their representative (if chosen) to hear the grievance and will return a written answer to the grievant and their representative (if chosen) no later than ten (10) days after this meeting. This answer will include a copy of the grievance procedure appeal process timeline, a list of resources and relevant contact information for future steps.

Step Two: If the decision in Step One is not accepted by the grievant, the grievant shall have 10 days from receipt of the answer in Step One to file an appeal with the College of Engineering Assistant Dean for Graduate Affairs. The Assistant Dean for Graduate Affairs will meet with the grievant and their representative (if chosen) within twenty (20) days from receipt of the appeal of Step One and attempt to resolve the grievance. The Assistant Dean for Graduate Affairs will provide the grievant and their representative (if chosen) with a written response to the grievance no later than ten (10) days after this meeting.

Step Three: If the decision in Step Two is not accepted by the grievant, the grievant shall have 10 days from the receipt of the answer in Step Two to file an appeal with the Graduate School as described in Grievances and Appeals (https://grad.wisc.edu/documents/grievances-and-appeals/).

OTHER
Students enrolled in the MLSP program may not change their degree goal to different M.S. program or a Ph.D. without formally applying to and being accepted into the new program.

Students are strongly discouraged to pursue positions as Project Assistants, Teaching Assistants or Research Assistants during their time in this program, as the rigor and accelerated nature of this program may not accommodate those work time commitments. Students in this program will not receive the tuition remission that is typically part of the compensation package for a graduate assistantship.

PROFESSIONAL DEVELOPMENT

GRADUATE SCHOOL RESOURCES
Take advantage of the Graduate School’s professional development resources (https://grad.wisc.edu/pd/) to build skills, thrive academically, and launch your career.

DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING RESOURCES
UW–Madison, the College of Engineering, and ECE have an abundance of professional development opportunities for students to take advantage of in order to better prepare themselves for internships and job positions during and following their education. First of all, the ECE Department strongly encourages students to utilize the Graduate School’s professional development resources (https://grad.wisc.edu/professional-development/). Engineering Career Services (ECS) (http://ecs.wisc.edu) hosts multiple career fairs each semester where students can directly interact with prospective employers, schedule interviews, and find internships and full-time jobs. ECS also maintains job listings and hosts a variety of professional development workshops each semester. The ECE Department provides unique opportunities throughout the year for students to attend and participate in various lectures, workshops, and trainings. The ECE Graduate Student Association (GSA) organizes professional development opportunities for fellow students. Students are made aware of events and opportunities via email and other communications.

PEOPLE

PROFESSORS
Susan Hagness (Chair)
Nader Behdad
Daniel Botez
Azadeh Davoodi (Associate Chair for Undergraduate Studies)
John A. Gubner (Associate Chair for Operations)
Yu Hen Hu
Hongrui Jiang (Associate Chair for Graduate Studies)
Irena Knezevic
Bernard Lesieutre
Mikko Lipasti
Zhenqiang Ma
Luke J. Mawst
Robert Nowak
Parameswaran Ramanathan
Bulent Sarlioglu
William A. Sethares
Daniel van der Weide
Giri Venkataramanan
Amy E. Wndt
Zongfu Yu

ASSOCIATE PROFESSORS
Kassem Fawaz (Associate Chair for Research)
Mikhail Kats
Younghyun Kim
Daniel Ludois
Paul H. Milenkovic
Umit Ogras
Dimitris Papailiopoulos
Line Roald
Andreas Velten

ASSISTANT PROFESSORS
Joseph Andrews
Jennifer Choy
Grigoris Chrysos
Jeremy Coulson
Dominic Gross
Chirag Gupta
Tsung-Wei Huang
Robert Jacobberger
Akhilesh Jaiswal
Bhuvana Krishnaswamy
Kangwook Lee
Chu Ma
Pedro Morgado
Shubhra Pasayat
Jinia Roy
Joshua San Miguel
Manish Singh
Hihan Sun
Eric Tervo
Ramya Korlakai Vinayak
Ying Wang
Feng Ye
Lei Zhou

TEACHING FACULTY
Mark C. Allie
Eric Hoffman
Joe Krachey
Srđjan Milčić

TEACHING PROFESSOR
Eduardo Arvelo
Setareh Behroozi
Steven Fredette
Nathan Strachen

See also Electrical and Computer Engineering Faculty Directory (https://directory.engr.wisc.edu/ece/faculty/).