

TO: Randy Smith, Vice Provost for Academic Programs

FROM: Graduate School Curriculum Services

DATE: 2/5/2025

RE: Proposal to **Establish an Embedded Graduate Certificate in Machine Learning and Computer Vision** in **The College of Engineering**.

The **Department of Electrical and Computer Engineering in the College of Engineering** is proposing an **Embedded (3B) Graduate Certificate in Machine Learning and Computer Vision**.

The proposal was received by the Graduate School on 12/09/2024. The combined GS/CAA subcommittee first reviewed the proposal on 1/09/2025 and requested revisions. The revised file was received on 1/17/2025. The revised file is supported for review by the Council on Academic Affairs.



Memo

To: Dean Maria Miriti, Graduate School
From: Rosie Quinzon-Bonello, Assistant Dean for Curriculum and Assessment
Date: December 9, 2024
Re: Proposal to Establish a Graduate Embedded Certificate in Machine Learning and Computer Vision

Attached is a proposal submitted by the Department of Electrical and Computer Engineering to establish a graduate embedded certificate in Machine Learning and Computer Vision.

On December 5, 2024, the College Committee on Academic Affairs voted unanimously to approve this proposal.

Yours sincerely,

Rosie Quinzon-Bonello

Proposal for a Graduate Embedded Certificate in Foundations of Machine Learning

January 23, 2025

Betty Lise Anderson, Department of Electrical and Computer Engineering

I. Program Definition

A. Title of program

Graduate Embedded Certificate in Machine Learning and Computer Vision

B. Certificate category and justification

3b: Embedded Graduate Certificate. Machine learning is becoming increasingly important tools to solve problems in autonomous vehicles, robotics, radar, power distribution, circuit design, optics, medical imaging, biomedical sensing, and many other engineering fields.

C. Purpose of program

This certificate can be completed by graduate students in colleges of engineering or arts and sciences currently pursuing MS/PhD degrees at Ohio State, who wish to gain proficiency in foundations of machine learning.

D. Methods of delivery

The courses are primarily offered in-person currently.

E. Timing

Desired start up is Autumn 2025.

F. Goals

The goal is to provide a mechanism for graduate students to acquire competency in machine learning and computer vision, in addition to their major degree.

G. Outcomes

Upon completion of this academic certificate, learners will be better prepared to:

1. Be competent designing and training prediction models for machine-learning and computer-vision tasks in engineering.
2. Be competent implementing machine-learning and computer vision methods in Python.
3. Gain experience applying concepts from linear algebra, probability, statistics, and optimization to engineering tasks.

H. Minimum requirements

A minimum GPA of 3.0 in the certificate courses is required for completion. Only grades of B or better may be counted toward the certificate.

Completion of the certificate requires a minimum of 12 credit hours.

I. Methods of delivery

Number	Title	Online	In-Person	In-person or online
ECE 5307	Introduction to Machine Learning for ECE		X	
ECE 5500	Nonlinear and Dynamic Programming for ECE		X	
ECE 5460	Image Processing		X	
ECE 6500	Convex and Stochastic Optimization		X	
ECE 7202	Reinforcement Learning		X	
ECE 7866	Computer Vision		X	
ECE 8001	Statistical Learning Theory (proposed to obtain a permanent number as ECE 7007)		X	
ECE 8101	Non-convex Optimization for Machine Learning		X	
ECE 8101	Online Learning and Optimization		X	
ECE 8201	High-dimensional Probability for Data Science		X	

J. MOU with ODEE
Not required.

K. List of required and elective courses

1. Required:

None

2. Pick two of four:

ECE 5307 Introduction to Machine Learning for ECE (4 credits)

Prereq: CSE 1222 or Engr 1281.xx, and Math 2568 and Stat 3470, and enrollment in ECE major; or Grad standing in ECE.

Offered spring and autumn.

ECE 5500 Nonlinear and Dynamic Programming for ECE (3 credits)

Prereq: MATH 2568 and MATH 2415; or Grad standing in Engineering or Math and Physical Sciences. [This is a prerequisite change currently in progress]

Offered every autumn.

ECE 5460 Image Processing (3 credits)

Prereq: MATH 2568 and Stat 3470; or Grad standing in Engineering, Biological Sciences, Statistics, Bioinformatics, or Math and Physical Sciences. [This is a prerequisite change currently in progress]
Offered every spring.

ECE 6500 Convex and Stochastic Optimization (3 credits)

Prereq: ECE 6001 Probability and Random Variables and Graduate standing in Engineering or Math
Offered every other spring (typically odd years).

3. Other elective courses

ECE 7202 Reinforcement Learning (3 credits)

Prereq: ECE 6001 Probability and Random Variables and Graduate standing in Engineering or Math
Offered every year once (typically autumn).

ECE 7866 Computer Vision (3 credits)

Prereq: Graduate standing in Engineering or Math
Looking for a new instructor for this course.

ECE 8001 Statistical Learning Theory (3 credits)

Prereq: ECE 6001, STATS 6801, or permission of instructor
Offered Sp18, Au19, and Au21. Will be offered every third semesters.

ECE 8101 Non-convex Optimization for Machine Learning (3 credits)

Prereq: ECE 6001 Probability and Random Variables, background in linear algebra
Offered Sp22. Will be offered autumn in even years.

ECE 8101 Online Learning and Optimization (3 credits)

Prereq: ECE 6001 Probability and Random Variables
Offered once every three years.

ECE 8201 High-dimensional Probability for Data Science (3 credits)

Prereq: ECE 6001 Probability and Random Variables and Graduate standing in Engineering, Statistics, or Math
Offered Sp20 and Sp24. Will be offered spring of even years.

Topics courses will repeat the same contents. They will turn into permanent courses.

L. Length of program compared to similar programs

Twelve-credits is a typical length of an embedded graduate certificate.

M. Semesters of offering

Number	Title	Aut	Spr	Sum
ECE 5307	Introduction to Machine Learning for ECE	X	X	
ECE 5500	Nonlinear and Dynamic Programming for ECE	X		
ECE 5460	Image Processing	X		
ECE 6500	Convex and Stochastic Network Optimization	?		
ECE 7202	Reinforcement Learning	X		
ECE 7866	Computer Vision	?		
ECE 8001	Statistical Learning Theory	every third semesters (Au, Sp)		
ECE 8101	Non-convex Optimization for Machine Learning	X		
ECE 8101	Online Learning and Optimization	?		
ECE 8201	High-dimensional Probability for Data Science		X	

N. Transfer credits

All courses in the Certificate must be taken at Ohio State.

O. Arranged/individual study courses

Arranged individual study courses may not be applied to the certificate.

P. Overlap

All credits for the certificate may also count toward to the MS/PhD degree.

II. Enrollment

A. Projected enrollment

We have no experience with this certificate yet, but we guess it would be around 20 per year.

1. Will there be problems if too many students enroll in the certificate program?

No, since all labs are online.

2. Will there be problems if too few students enroll in the certificate program?

No.

B. Opportunities for graduates

Graduates working in **arts and sciences** and engineering will be more employable with the addition of this skill set.

C. Admission requirements

Initially admitted to the university as part of an **MS or PhD degree program**. An embedded certificate program is “declared” in a similar path to majors.

III. Sufficient resources

A. Adequacy and availability of facilities and staff

All courses listed above exist and are already offered. They run on the schedule listed under Section I.M.

B. Projected resource needs and plans to meet those needs

The certificate can run and serve students immediately.

IV. Justifiable expenses

A. Additional Faculty

None.

B. Course additions or deletions

No new courses are needed at this time.

C. Necessary budget adjustments

We can run the certificate with existing resources.

D. Available and anticipated funding

None.

V. Adequate demand

A. Evidence of sufficient demand by students faculty, general public, and/or business

We regularly enroll about 85 students/semester in our machine-learning course ECE-5307, 40 students/semester in our computer-vision course ECE-5460, and 30 students/semester in our optimization course ECE-5500.

Duration of demand (long/short term)

To be determined. Since no additional resources are required to run this certificate, we can try it and see.

B. Ability of other programs to meet demand

The Statistics and CSE departments teach machine-learning courses (STAT-4620 and CSE-5523), but those courses are frequently wait-listed and involve prerequisite chains that are too long for students outside those departments. The CSE department teaches a course on “computer vision for human-computer interaction” (CSE-5524), but the syllabus is very different than ECE-5460 and not as useful to the applications we are targeting. The ISE department teaches an undergrad optimization course ISE-3210, but only for ISE and EngPhys majors.

VI. Competitiveness with other institutions: limited overlap within the University

A. Overlap with other programs or departments

The COE offers an online “AI Boot Camp” (<https://eng-bootcamps.osu.edu/artificial-intelligence>) for \$12k whose goal is to “leverage AI and machine learning to solve business problems and to discuss the latest innovations in AI with key stakeholders.” The COE also offers a “Certificate in Practice of Data Analytics,” consisting of 5 online modules that cost about \$1k each and are offered once per year.

Our certificate targets nonoverlapping audience who are currently registered graduate students at Ohio State. The courses will be offered freely for enrolled graduate students as in-person lectures. Our certificate focus more on mathematical foundation (optimization, theoretical analysis) and applications in ECE (image processing and computer vision), which contrasts the above two programs that offer hands on learning opportunity on applying machine learning techniques to applications with minimum coverage of mathematical foundations. Therefore, we do not observe any potential conflicts or overlap with the existing programs on machine learning related topics.

B. Duplication of effort by other areas in the University, another university or another school

We are not aware of any duplication of this proposed certificate.

C. Similar programs at other universities in Ohio, or in the United States, and their levels of success

The University of Akron offers an 11-credit certificate in Artificial Intelligence and Machine Learning, which consists entirely of computer science courses.

University of Maryland Global Campus has an embedded UG certificate in Machine Learning (but not Computer Vision), which is online and can be applied to the UG degree in Data Science.

Princeton recently converted its “very popular” certificate in Statistics and Machine Learning to a minor.

MSOE offers a 9-credit certificate in AI for Emerging Applications.

None include Computer Vision