

# Machine Learning: Design and Deployment

2 Credits

BU.330.775.51

Monday 2:30pm-5:30pm

10/28/2024-12/16/2024

Fall 2024

Washington, DC.

## Instructor

Minghong Xu, PhD.

## Contact Information

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## Office Hours

Tuesday 11:30 am-1:30 pm, and by appointment

## Teaching Assistant

TBA

## Required Texts & Learning Materials

There is *no required* textbook: all class materials will be available on our Canvas website. However, some machine learning books are very useful.

## Recommended Texts

* **Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems**3rd Edition – Aurelien Geron, O’Reilly, 2022, **ISBN-13**: 978-1098125974

<https://github.com/Akramz/Hands-on-Machine-Learning-with-Scikit-Learn-Keras-and-TensorFlow>

## Introduction to Machine Learning with Python: A Guide for Data Scientists – Andreas Muller and Sarah Guido, O’Reilly, 2016, ISBN-13: 978-1449369415

<https://github.com/amueller/introduction_to_ml_with_python>

## Technology Requirements

In this course, we will be using Google Colab for Python programming. Details on how to use it will be provided during the first class.

## Course Description

This course is designed to help students gain proficiency in creating robust machine learning models and deploying them in business environments. Throughout this course, students will delve into the core principles of machine learning, with a focus on model design and development for business applications. Topics covered include data preprocessing, feature selection, supervised and unsupervised machine learning, reinforcement learning, as well as model training, evaluation, and optimization.

This course takes a hands-on approach. By leveraging Python libraries such as scikit-learn, TensorFlow, Keras, and PyTorch, students will gain experience in designing, training, and validating predictive models that are scalable, maintainable, and adaptable to business requirements.

By the end of this course, students will possess the essential knowledge and practical skills needed to utilize machine learning in various business contexts.

## Prerequisite(s)

None

## Learning Objectives

By the end of this course, students will be able to:

1. Obtain a solid foundation in the principles and concepts of machine learning.
2. Demonstrate the ability to leverage Python libraries and tools for machine learning.
3. Demonstrate sophisticated understanding of the concepts and methods; know the scope and possible limitations of each method.
4. Conduct advanced analyses using scientific methods and establish meaningful connections between techniques and business problems.
5. Develop the capability to make better business decisions by employing advanced techniques in machine learning.

Attendance  
Attendance and class participation are part of each student’s course grade. Students are expected to attend all scheduled class sessions. Failure to attend class will result in an inability to achieve the objectives of the course. Excessive absence will result in loss of points for participation. Regular attendance and active participation are required for students to successfully complete the course.

Class participation is an important part of learning. If you have a question, it’s likely that others do as well. I encourage *active* participation, and course grades will take into account students who make particularly strong contributions.

## Assignments

| **Assignment** | **Learning Objectives** | **Weight** |
| --- | --- | --- |
| Attendance and participation in class discussion | 1, 3, 4, 5 | 5% |
| Homework | 1, 2, 3, 4 | 60% |
| Final Exam | 1, 2, 3, 4, 5 | 35% |
| Total |  | 100% |

*Homework*: there are six individual homework assignments. Please refer to the tentative schedule table below. All homework assignments should be submitted through the Canvas links.

*Final Exam*: the final exam is individual exam. It will be administered via Respondus LockDown Browser (<https://download.respondus.com/lockdown/download.php?id=123533816>).

*Late submission* including assignments, projects and exams will *not* be accepted.

## Grading

The grade of A is reserved for those who demonstrate extraordinary performance as determined by the instructor. The grade of A- is awarded only for excellent performance. The grades of B+ and B are awarded for good performance. The grades of B-, C+, C, and C- are awarded for adequate but substandard performance. The grades of D+, D, and D- are not awarded at the graduate level. The grade of F indicates the student’s failure to satisfactorily complete the course work. For Core/Foundation courses, the grade point average of the class should not exceed 3.35. For Elective courses, the grade point average should not exceed 3.45.

**Policy on Generative AI**

Academic integrity is a cornerstone of the Carey Business School. Generative artificial intelligence (AI) tools such as ChatGPT are widely available, and these technologies present a number of exciting opportunities in the classroom. In this course, you may use generative AI tools on homework following the instructions. Use of generative AI tools for final exam is strictly prohibited.

## Tentative Course Calendar

Instructors reserve the right to alter course content and/or adjust the pace to accommodate class progress. Students are responsible for keeping up with all adjustments to the course calendar.

| **Week** | **Topic** | **Hands-on Learning** | **Due** |
| --- | --- | --- | --- |
| 1 | Introduction to Machine Learning and Programming Basics | Python tutorial | Homework 1 release |
| 2 | Data Preprocessing and Exploratory Data Analysis | Explore and clean a housing dataset for machine learning algorithms | Homework 1 due  Homework 2 release |
| 3 | Design of Supervised Machine Learning Models and Training (I)  Regularization and Evaluation | Deploy supervisied machine learning models on MNIST dataset | Homework 2 due  Homework 3 release |
| 4 | Design of Supervised Machine Learning Models and Training (II)  Ensemble and Boosting | Deploy supervised machine learning models on breast cancer dataset | Homework 3 due  Homework 4 release |
| 5 | Design of Unsupervised Learning Models (I)  Dimensionality Reduction and Feature Engineering | Deploy unsupervised machine learning models on breast cancer dataset | Homework 4 due  Homework 5 release |
| 6 | Design of Unsupervised Learning Models (II)  Clustering and Applications | Deploy unsupervised machine learning models on MNIST dataset | Homework 5 due  Homework 6 release |
| 7 | Reinforcement Learning and  Final Review | Reinforcement learning using gymnasium | Homework 6 due |
| 8 | Final Exam |  |  |

## Carey Business School Policies and General Information

Please note that failure to become acquainted with Carey policies will not excuse any student from adhering to these policies.

### Canvas Site

A Canvas course site is set up for this course. Each student is expected to check the site throughout the semester as Canvas will be the primary venue for outside classroom communications between the instructor and students. Students can access the course site at <https://canvas.jhu.edu/>.

### Technical Support

24/7 technical support for questions regarding Canvas, Zoom, and other technical issues is available. Please refer to Carey’s [Academic Resources webpage](https://carey.jhu.edu/student-experience/academic-resources) for contact information and other details.

### Students with Disabilities - Accommodations and Accessibility

Johns Hopkins University values diversity and inclusion. We are committed to providing welcoming, equitable, and accessible educational experiences for all students. Students with disabilities (including those with psychological conditions, medical conditions, and temporary disabilities) can request accommodations for this course by providing an Accommodation Letter issued by [Student Disability Services](https://carey.jhu.edu/student-experience/services-resources/student-disability-support-services). Please request accommodations for this course as early as possible to provide time for effective communication and arrangements. For further information or to start the process of requesting accommodations, please contact [Student Disability Services](mailto:carey.disability@jhu.edu) at the Carey Business School.

### Academic Ethics Policy

Carey expects graduates to be exemplary global citizens in addition to innovative business leaders. The Carey community believes that honesty, integrity, and community responsibility are qualities inherent in an exemplary citizen. The objective of the Academic Ethics Policy (AEP) is to create an environment of trust and respect among all members of the Carey academic community and hold Carey students accountable to the highest standards of academic integrity and excellence.

It is the responsibility of every Carey student, faculty member, and staff member to familiarize themselves with the AEP and its procedures. Failure to become acquainted with this information will not excuse any student, faculty, or staff member from the responsibility to abide by the AEP. Please contact the [Office of Student Affairs](mailto:carey.student@jhu.edu) if you have any questions. For the full policy, please visit the [Academic Ethics Policy webpage](https://carey.jhu.edu/student-experience/school-policies/academic-ethics-policy).

### Student Conduct Code

The fundamental purpose of the Johns Hopkins University’s regulation of student conduct is to promote and to protect the health, safety, welfare, property, and rights of all members of the University community as well as to promote the orderly operation of the University and to safeguard its property and facilities. Please contact the [Office of Student Affairs](mailto:carey.student@jhu.edu) if you have any questions regarding this policy. For the full policy, please visit the [Student Conduct Code webpage](https://studentaffairs.jhu.edu/policies-guidelines/student-code).

### Commitment to Respect

Respectful behavior creates an environment within the Carey Business School where all are valued and can be productive. Carey defines respectful behavior as conduct that, at a minimum, demonstrates consistent courtesy for others, including an effort to understand differences. As such, all in the community agree to the Carey Commitment to Respect, which states that we all strive to show that we value each other’s human dignity and our differences, and to choose behavior and language that demonstrates mutual respect. Please visit the [Commitment to Respect webpage](https://carey.jhu.edu/student-experience/school-policies/carey-business-school-community-commitment-respect) to learn more about the expectations and resources available.

### Classroom Policies for All On-Site and Remote-Live Classes

Carey is committed to maintaining the highest standards of excellence in all forms of instruction. To that end, we have developed [policies and procedures for all classes offered in on-site and remote-live formats](https://carey.jhu.edu/student-experience/school-policies/policies-procedures-on-site-remote-live-classes). These policies will govern all courses occurring in these formats, and all students are expected to familiarize themselves with and adhere to these policies.

### Student Success Center

The Student Success Center offers assistance in core writing and quantitative courses. For more information, visit the [Student Success Center webpage](https://carey.jhu.edu/student-experience/academic-support/student-success-center).

### Other Important Policies and Services

Students are encouraged to consult the [Student Handbook and Academic Catalog](https://carey.jhu.edu/student-experience/services-resources/student-handbook) and [Student Services and Resources](https://carey.jhu.edu/student-experience/services-resources) for information regarding other policies and services. For your convenience, there is a singular website students can visit to learn about all [JHU and Carey policies](https://carey.jhu.edu/student-experience/policies).

### Copyright Statement

Unless explicitly allowed by the instructor, course materials, class discussions, and examinations are created for and expected to be used by class participants only. The recording and rebroadcasting of such material, by any means, is forbidden. Violations are subject to sanctions under the [Academic Ethics Policy](https://carey.jhu.edu/student-experience/school-policies/academic-ethics-policy).