# Course Syllabus

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# CS 422/522 Introduction to Machine Learning

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## Instructor

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## Teaching Assistant

Eleni Adam

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Office Hours: Monday, 8:30 am - 9:30 am (Other times by appointment),
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## Prerequisites (Professional Knowledge and Technological Skills)

Knowledge of precalculus (variables and functions), linear algebra (matrices and vectors), and probabilistic theory (random variable, common distributions, and probability calculus). Basic computer skills and programming experience with Python.

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## Course Description

This course provides a broad introduction to machine learning, focusing on practical aspect of various learning techniques with light mathematics involved. Topics cover a full stack of learning techniques

that are popular among practical applications. These include data preprocessing methods (normalization), data representation learning algorithms (principal component analysis, non-negative matrix factorization, and t-SNE), supervised learning methods (k-nearest neighbors, linear regression, logistic regression, support vector machine, Naïve bayes classifiers, decision trees, and neural networks) and their evaluation, and clustering algorithms (k-means, hierarchical clustering, DBSCAN) and their evaluation.

This course is instructed along with many examples programmed in Python. Not only do the students get exposure to popular machine learning techniques but also gain hands-on programming experience with Python packages related to machine learning, e.g., Scikit-learn, NumPy, Pandas, and Matplotlib. The students are also provided with the opportunity to put learned concepts in action through a course project, working on a practical machine learning applications of their choice.

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## Approaches

The course consists of **module contents, assignments, quizzes, a course project, two semi-exams and a final exam.** Module contents on Canvas pages serve as the vehicle for the instructor to introduce concepts and knowledge to students. Homework provides the opportunity to students for them to practice what they learn. Quizzes and exams are used to test if certain basic concepts have been mastered. A course project will be used for students to get profound hands-on experience by applying machine learning methods learned in class to an interesting dataset or exploring a new machine learning topic.

Students are encouraged to form study groups to work on the course project. Each group as a team is expected to consist of up to two students. Each team can choose to either apply the machine learning methods discussed in class to an interesting dataset or explore a new machine learning topic. At the end of the semester, each team is required to present the project in classroom and submit a report in typical research paper format. Students are encouraged to identify a project themselves. When needed, the instructor will also prepare a list of projects that students can choose from. This exercise will help students gain deep insights into certain algorithms and promote collaborations among team members.

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## Course Learning Objectives (CLOs)

CLO1: Define machine learning and differentiate different learning problems
CLO2: Describe how introduced machine learning algorithms work
CLO3: Identify pros and cons of introduced machine learning algorithms
CLO4: Recall the metrics and describe how these metrics can be applied to evaluate models trained with or without supervision
CLO5: Apply introduced learning algorithms to solve practical learning problems

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# Schedule

Course Map

| Module | Topics | Matched CLOs | Assessments |
|---|---|---|---|
| M1<br>Aug. 23 ~ Sep. 3 | Prerequisite Review | CLO2, CLO5 | 1.1.5 Assignment: Math Exercise (https://canvas.odu.edu/courses/187678/assignments/2867066)<br>1.2.3 Assignment: Programming Exercise (https://canvas.odu.edu/courses/187678/assignments/2867067) |
| M2<br>Sep. 4 ~ Sep. 12 | Introduction and KNN | CLO1, CLO2, CLO3, CLO5 | 2.1.3 Discussion (https://canvas.odu.edu/courses/187678/assignments/2867063)<br>2.1.4 Popup Quiz (https://canvas.odu.edu/courses/187678/assignments/2867068)<br>2.2.3 Popup Quiz (https://canvas.odu.edu/courses/187678/assignments/2867069)<br>2.3.3 Popup Quiz (https://canvas.odu.edu/courses/187678/assignments/2867070)<br>2.3.4 Assignment: Programming Exercise (https://canvas.odu.edu/courses/187678/assignments/2867071) |
| M3<br>Sep. 13 ~ Sep. 26 | Linear Models and Naïve Bayes Classifiers | CLO2, CLO3, CLO5 | 3.1.3 Popup Quiz (https://canvas.odu.edu/courses/187678/assignments/2867072)<br>3.2.2 Popup Quiz (https://canvas.odu.edu/courses/187678/assignments/2867074)<br>3.1.4 Assignment: Programming Exercise (https://canvas.odu.edu/courses/187678/assignments/2867073)<br>Semi-Exam 1 (https://canvas.odu.edu/courses/187678/assignments/2867092) |

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|---|---|---|---|
| M4<br>Sep. 27 ~ Oct. 10 | Decision Tree, Ensemble Learning, and Neutral Networks | CLO2, CLO3, CLO5 | **4.1.3 Popup Quiz** (https://canvas.odu.edu/courses/187678/assignments/2867075)<br>**4.2.4 Popup Quiz** (https://canvas.odu.edu/courses/187678/assignments/2867077)<br>**4.1.4 Assignment: Programming Exercise** (https://canvas.odu.edu/courses/187678/assignments/2867076)<br>**Assignment: Course Project Proposal** (https://canvas.odu.edu/courses/187678/assignments/2867089) |
| M5<br>Oct. 11 ~ Oct. 24 | Evaluation of Models Trained with Supervision | CLO5 | **5.5 Popup Quiz** (https://canvas.odu.edu/courses/187678/assignments/2867079)<br>**5.6 Assignment: Programming Exercise** (https://canvas.odu.edu/courses/187678/assignments/2867080)<br>**Semi-Exam 2** (https://canvas.odu.edu/courses/187678/assignments/2867093) |
| M6<br>Oct. 25 ~ Nov. 7 | Unsupervised learning Intro and K-means | CLO2, CLO3, CLO5 | **6.1.4 Popup Quiz** (https://canvas.odu.edu/courses/187678/assignments/2867081)<br>**6.2.3 Popup Quiz** (https://canvas.odu.edu/courses/187678/assignments/2867082) |
| M7<br>Nov. 8 ~ Nov. 21 | Hierarchical Clustering, DBSCAN, and Evaluation of Clustering | CLO2, CLO3, CLO4, CLO5 | **7.1.3 Popup Quiz** (https://canvas.odu.edu/courses/187678/assignments/2867084)<br>**7.2.4 Popup Quiz** (https://canvas.odu.edu/courses/187678/assignments/2867086) |
| M8<br>Nov. 22 ~ Dec. 5 | Representation Learning | CLO2, CLO5 | **8.3 Popup Quiz** (https://canvas.odu.edu/courses/187678/assignments/2867087)<br>**Assignment: Course Project** (https://canvas.odu.edu/courses/187678/assignments/2867088)<br>**Final Exam** (https://canvas.odu.edu/courses/187678/assignments/2867091) |

# Textbook

Introduction to Machine Learning with Python: A Guide for Data Scientists by Andreas C. Muller and Sarah Guido, ISBN-10: 1449369413

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# Attendance Policy

No regular class attendance is needed.

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# Grading Policy

Grading

| Item | Weight |
|---|---|
| Module 02 Discussion | 2% |
| Popup Quizzes (Thirteen quizzes) | 26% |
| Assignments (Six math/programming exercises) | 20% |
| Course Project Proposal | 10% |
| Course Project Final Product | 20% |
| Exams (Two semi exams and one final exam) | 22% |

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# Due Date Extension Policy

Any submission that is more than THREE days past due will NOT be graded.

Everyone gets ONE time free 3-day extension.

After that, all past-due submissions will be graded with this formula: $0.5^N$ x $g$, where $N$ is the number of days past due and g is the grade of the submission as if it were on time.

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# Honor Code

This course requires a lot of interaction, and thus discussions of ideas are encouraged. However, for all homework assignments, students are expected to write their OWN code, simple sharing and copying from other students, ChatGPT, and similar tools are prohibited, which will be considered as a violation of honor code.

Students are expected to follow the ODU Honor Code for all assignments and tests. Any violations will be dealt with strictly according to university policy. Despite that this course requires a lot of interaction, and thus discussions of ideas are encouraged, the work submitted must be students' own. Similar wise, ChatGPT and such tools may be used to get some ideas, but the work submitted must be students' own.

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# Drop Policy

As per University guidelines. See the University Calendar for drop dates.

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# Accessibility

Old Dominion University is committed to ensuring equal access to all qualified students with disabilities in accordance with the Americans with Disabilities Act. The Office of Educational Accessibility (OEA) is the campus office that works with students who have disabilities to provide and/or arrange reasonable accommodations.

- If you experience a disability which will impact your ability to access any aspect of my class, please present me with an accommodation letter from OEA so that we can work together to ensure that appropriate accommodations are available to you.
- If you feel that you will experience barriers to your ability to learn and/or testing in my class but do not have an accommodation letter, please consider scheduling an appointment with OEA to determine if academic accommodations are necessary.

The Office of Educational Accessibility is located at 1021 Student Success Center and their phone number is (757)683-4655. Additional information is available at the OEA website: **http://www.odu.edu/educationalaccessibility/ (http://www.odu.edu/educationalaccessibility/)**

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# Academic Dishonesty

Old Dominion University is committed to students' personal and academic success. In order to achieve this vision, students, faculty, and staff work together to create an environment that provides the best opportunity for academic inquiry and learning. All students must be honest and forthright in

their academic studies. Your work in this course and classroom behavior must align with the expectations outlined in the Code of Student Conduct, which can be found at www.odu.edu/oscai. The following behaviors along with classroom disruptions violate this policy, corrupt the educational process, and will not be tolerated.

**Cheating**: Using unauthorized assistance, materials, study aids, or other information in any academic exercise.

**Plagiarism**: Using someone else's language, ideas, or other original material without acknowledging its source in any academic exercise.

**Fabrication**: Inventing, altering or falsifying any data, citation or information in any academic exercise.

**Facilitation**: Helping another student commit, or attempt to commit, any Academic Integrity violation, or failure to report suspected Academic Integrity violations to a faculty member.

Academic dishonesty will be reported to the Office of Student Conduct & Academic Integrity and may result in sanctions up to and including expulsion from the University.

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