School of Natural Sciences and Mathematics

Computer Science

CS-312 Machine Learning and Artificial Intelligence

Tredtin Hall DSC TTh 11:30A-12:45P

Credits: #3 Section: #1 Term: Spring 2025

Instructor Information

Instructor: Kelly Gaither

Email: kelly.gaither@chaminade.edu

Phone: 512-775-1537

Virtual Office: Zoom (Coordinates provided in Canvas)

Virtual Office Hours: M-F 10AM-11AM HST or by appointment

Communication: Email, slack or text. I will respond within 3 days.

Course Description & Materials

Catalog Course Description

This course will introduce machine learning and artificial intelligence (AI). This course will include lectures, discussions, assignments, hands-on experiences, and a project. The goal of the course will prepare and provide students with machine learning and AI knowledge, techniques, and skills. Students in this course will learn and implement various machine learning algorithms, such as trees, models, clustering, and networks. Prerequisites: EN 102, COM 101, and CS 202 or CS 205.

Course Overview

This course will cover a range of topics under the umbrella of machine learning and artificial intelligence, including clustering, classification, decision trees, statistical models, and neural networks. The emphasis will be on hands-on programming assignments, written and executed in Python.

Credit Hour Policy

This is a three-credit hour course requiring 135 clock hours of student engagement, per the official CUH Credit Hour Policy. Over the 15 weeks of this course, students will spend 37.5 hours in class, 40 hours programming the final project over the course of the semester, 40 hours programming homework assignments, and 17.5 hours conducting research, data collection and course-readings, averaging 9 hours each week for both in-class and out-of-class responsibilities.

Required Materials

No textbook is required. Relevant reading materials will be provided prior to each class meeting. These include PowerPoint PDF slides, tutorials, websites, articles, Python applications, Google Drive, Zoom video conference application, consider.it application, and Microsoft applications.

Course Website

All assignments and materials will be submitted via Canvas Course Management System unless stated otherwise. The assignments are to be clear, professional quality, and must be submitted in the requested format or the work will receive zero points. Please familiarize yourself with Canvas and visit the site

regularly as materials, grades, announcements, and submission of assignments will be on Canvas. **Chaminade University Data Science Program Website:** https://chaminade.edu/nsm/data-science/

Canvas (https://chaminade.instructure.com)

Canvas is Chaminade University of Honolulu's official learning management system. For easy access, bookmark https://bit.ly/CUHCanvasLinks to an external site. or type "bit.ly/CUHCanvas" in your browser's address bar to log in directly to CUH Canvas. Additionally, you can search for help on specific topics at help.instructure.com. Chat live with Canvas Support 24/7/365. Watch this video to get you started with online guides and tutorials. Contact the Chaminade IT Helpdesk for technical issues: helpdesk@chaminade.edu, or call (808) 735-4855

Learning Outcomes

Program Learning Outcomes (PLOs)

Upon completion of the undergraduate B.S. program in Data Science, Analytics & Visualization (DSAV), students will be able to:

1. Apply collection, storage, or cleaning of datasets;
2. Apply technologies to collect or manage data, analyze data, or program an application;
3. Analyze data using mathematics, statistics, prediction models, visualization, or other forms of analytics to support decision-making;
4. Apply effective data communication approaches for stakeholders and the public;
5. Integrate an awareness of ethical issues and collective standards to positively influence the application of data science to service, justice and peace in working towards solutions for societal problems.

Upon completion of the undergraduate B.S. program in Computer Science, students will:

1. Describe foundational computer organization, architecture, computing resources, and system;
2. Describe foundational mathematical concepts and operations towards design, development, and analysis of applications;
3. Apply programming language towards application development;
4. Integrate an awareness of ethical issues and collective standards to positively influence the application of computer science to service, justice, and peace in working towards solutions for societal problems and opportunities;

Course Learning Outcomes (CLOs)

Upon completion of CS312, students will achieve the following course outcomes shown in the tables below. Table 1 shows course learning outcomes mapped to the program learning outcomes for the Bachelor of Science in Computer Science. The mapping for program learning outcomes for the Bachelor of Science in Data Science is shown in Table 2:

Table 1: Course Learning Outcomes Mapped to Computer Science Program Learning Outcomes

Course Learning Outcomes	CS PLO 1	CS PLO 3	CS PLO 3	CS PLO 4
1. Explain Machine Learning	X	X		
2. Explain Artificial Intelligence	X	X		
3. Identify and describe ML/AI Algorithms	X	X		

4. Implement ML/AI Algorithms in Python			X	
5. Identify and Describe Ethical Issues in ML/AI				X

Table 2: Course Learning Outcomes Mapped to Data Science Program Learning Outcomes

Course Learning Outcomes	DS PLO 1	DS PLO 3	DS PLO 3	DS PLO 4	DS PLO 5
1. Explain Machine Learning				X	
2. Explain Artificial Intelligence				X	
3. Identify and describe ML/AI Algorithms			X	X	
4. Implement ML/AI Algorithms in Python	X	X		X	
5. Identify and Describe Ethical Issues in ML/AI				X	X

Alignment of Natural Sciences Courses with Marianist and Hawaiian Values of the University

The Natural Sciences Division provides an *integral, quality education:* sophisticated integrative course content taught by experienced, dedicated, and well-educated instructors.

- We *educate in family spirit* – every classroom is an *Ohana* and you can expect to be respected yet challenged in an environment that is supportive, inclusively by instructors who take the time to personally get to know and care for you.
- We *educate for service, justice and peace*, since many of the most pressing global issues (climate change, health inequity, poverty, justice) are those which science and technology investigate, establish ethical parameters for, and offer solutions to.
- We *educate for adaptation and change*. In science and technology, the only constant is change. Data, techniques, technologies, questions, interpretations and ethical landscapes are constantly evolving, and we teach students to thrive on this dynamic uncertainty.

The study of science and technology can be formative, exploring human creativity and potential in the development of technologies and scientific solutions, the opportunity to engage in the stewardship of the natural world, and the opportunity to promote social justice. We provide opportunities to engage with the problems that face Hawai'i and the Pacific region through the Natural Sciences curriculum, in particular, those centered around severe challenges in health, poverty, environmental resilience, and erosion of traditional culture. The Marianist Educational Values relate to Native Hawaiian ideas of *mana, na'auao, ohana*, *aloha* and *aina*. We intend for our Natural Sciences programs to be culturally-sustaining, rooted in our Hawaiian place, and centered on core values of *Maiau,* be neat, prepared, careful in all we do; *Makawalu*, demonstrate foresight and planning; *`Ai,* sustain mind and body; *Pa`a Na`au*, learn deeply.

Course Activities

Discussions

Discussions will be conducted on topics over the course of the semester. Participation in these discussions will be graded.

Homework
Readings will be given prior to class with the expectation that students will read the material and come prepared to participate in in-class discussion.

Quizzes and Exams
This course is primarily project based. Quizzes and exams will not be given.

Team Projects
There will be no team project assignments. Teams may only work on the final project with prior approval of the instructor.

Individual Projects
Individual projects will be given as programming assignments to gain proficiency in machine learning and AI algorithms.

Final Project
Students will conduct a semester-long machine learning/AI project on real-world data in a domain of their choosing for their final project. All individual projects will serve as preparatory components for the final project.

Grading and Assessment

Assessments	Points
Communication and Class Participation	5
Programming Assignments (6)	40
Final Project Proposal	5
Final Project Progress Check	5
Final Project Submission	30
Final Project Presentation	15

Topics & Due Dates

Week	Date	Lesson	Due Dates
1	1/7 - 1/9	• Student Introductions • Syllabus Review • ***Introduction to Machine Learning and AI Basics*** • TACC Accounts and Jupyter Notebooks • Overview and Refresh of Python	
2	1/14 - 1/16	• Git and GitHub Co-Pilot • Data Types and One-Hot Encoding • Metrics and Evaluation • Using Python's Scikit-Learn	Assignment 1 Due 1/17 11:59 PM
3	1/21 - 1/23	• ***Introduction to Supervised Learning*** • ML Best Practices (Train/Test/Split, Normalization) • Classifiers	Final Project Proposal Due 1/24 11:59 PM
4	1/28 – 1/30	• Logistic Regression • Decision Trees	

		• Random Forests	
5	2/4 – 2/6	• Bagging and Boosting • Naïve Bayes • ***Introduction to Unsupervised Learning***	Assignment 2 Due 2/7 11:59 PM
6	2/11 – 2/13	• Clustering • Principal Component Analysis • Natural Language Processing	
7	2/18 – 2/20	• Image and Video Analysis • Anomaly Detection • ***Introduction to Reinforcement Learning***	Assignment 3 Due 2/21 11:59 PM
8	2/25 – 2/27	• Gaming and game theory • Robotics • ***Introduction Neural Networks and Deep Learning***	
9	3/4 – 3/6	• Neural Networks and Activation Functions • Convolutional Neural Networks • Recurrent Neural Networks	Assignment 4 Due 2/28 11:59 PM
10	3/11 – 3/13	• Long Short-Term Memory • Transfer Learning • Applications	Final Project Progress Check Due 3/14 11:59 PM
Week of March 17: SPRING BREAK (NO CLASS)			
11	3/25 – 3/27	• ***Introduction to Generative AI*** • Large language models • Generative Pre-Trained Transformer (GPT)	Assignment 5 Due 3/28 11:59 PM
12	4/1 – 4/3	• Prompt Engineering • Image Generation • Code Generation • Music Generation	
13	4/8 – 4/10	• ***Introduction to the Ethical Considerations for AI*** • Mitigating Bias in AI Systems • Transparency	Assignment 6 Due 4/11 11:59 PM
14	4/15 – 4/17	• Misinformation/Disinformation • Deep Fakes • ***Introduction to Explainable AI*** • Transparency	
15	4/22 – 4/24	• Interpretability • Causality • Fairness • Trustworthiness	
16	FINALS WEEK	Final Project Presentations and Final Project Submission	

Course Policies

Attendance

Attendance will be taken for this class and will factor into the class participation grade. We will be discussing new concepts and conducting activities during class and attendance is an important part of mastering the subject matter. Lectures will be recorded and saved on instructor's google drive for access outside of class for the duration of the course.

Extra Credit

Extra credit work may be given during the course semester. This work is intended to enhance learning of topic areas and students will be asked to adhere to documented instructions. Late extra credit work will not be accepted without appropriate documentation.

Changes to the Syllabus

While the provisions of this syllabus are as accurate and complete as possible, instructor reserves the right to change any provision herein at any time. Every effort will be made to keep you advised of such changes, and information about such changes will be available from your instructor.

Final Grades

Final grades are submitted to Self-Service:

A = 90% and above

B = 80-89%

C = 70-79%

D = 60-69%

F = 59% and below

Additional Departmental and University Policies

Late Work Policy

Requests for extensions due to extenuating circumstances (medical problems, for example) will be considered, but work received after the deadline will not be graded. Computer problems are not an excuse for late work.

Grades of "Incomplete"

Students and instructors may negotiate an incomplete grade when there are specific justifying circumstances. An Incomplete Contract (available form the Divisional Secretary and the Portal) must be completed. When submitting a grade, the "I" will be accompanied by the alternative grade that will automatically be assigned after 90 days. These include IB, IC, ID, and IF. If only an "I" is submitted the default grade is F. The completion of the work, evaluation, and reporting of the final grade is due within 90 days after the end of the semester or term. This limit may not be extended.

Writing Policy

Paper requirements and formatting will be discussed during the course when the assignment is given.

Instructor and Student Communication

Questions for this course can be emailed to the instructor at [kelly.gaither@chaminade.edu]. Online, in-person and phone conferences can be arranged. Response time will take place up to 3 days.

The University provides a Chaminade email address for all students. Official Chaminade communications will be sent to the students' Chaminade email address and instructors will use only this email to

communicate with students. It is the responsibility of the student to check their email frequently. Report email-related problems to the Helpdesk at 808-735-4855 or helpdesk@chaminade.edu

Cell phones, tablets, and laptops

Music Devices and Cellular Phones: Unless specifically permitted by your instructor, use of music devices and cell phones is prohibited during all Natural Science and Mathematics classes, as it is discourteous and may lead to suspicion of academic misconduct. Students unable to comply will be asked to leave class. Out of consideration for your classmates, please set your cell phone to silent mode during class. Students are encouraged to bring laptops or tablets to class as the instructor will assign online activities and readings that will require the use of a laptop or tablet. Laptops and tablets should not be misused, such as checking distracting websites. Use your best judgment and respect your classmates and instructor.

Disability Access

Chaminade University of Honolulu offers accommodations for all actively enrolled students with disabilities in compliance with Section 504 of the Rehabilitation Act of 1973, the Americans with Disabilities Act (ADA) of 1990, and the ADA Amendments Act (2008).

Students are responsible for contacting Kokua Ike: Center for Student Learning to schedule an appointment. Verification of their disability will be requested through appropriate documentation and once received it will take up to approximately 2–3 weeks to review them. Appropriate paperwork will be completed by the student before notification will be sent out to their instructors. Accommodation paperwork will not be automatically sent out to instructors each semester, as the student is responsible to notify Kokua Ike via email at ada@chaminade.edu each semester if changes or notifications are needed.

Title IX Compliance

Chaminade University of Honolulu is committed to providing a learning, working and living environment that promotes the dignity of all people, inclusivity and mutual respect and is free of all forms of sex discrimination and gender-based violence, including sexual assault, sexual harassment, gender-based harassment, domestic violence, dating violence, and stalking. As a member of the University faculty, I am required to immediately report any incident of sex discrimination or gender-based violence to the campus Title IX Coordinator.

Nondiscrimination Policy & Notice Nondiscrimination

Chaminade University of Honolulu does not discriminate on the basis of sex and prohibits sex discrimination in any education program or activity that it operates, as required by Title IX and its regulations, including in admission and employment. Inquiries about Title IX may be referred to the University's Title IX Coordinator, the U.S. Department of Education's Office for Civil Rights, or both and contact information may be found at the Chaminade University Title IX Office Contact Information and Confidential Resources website. On-campus Confidential Resources may also be found here at CAMPUS CONFIDENTIAL RESOURCES.

The University's Nondiscrimination Policy and Grievance Procedures can be located on the University webpage at: https://chaminade.edu/compliance/title-ix-nondiscrimination-policies-procedures/.

To report information about conduct that may constitute sex discrimination or make a complaint of sex discrimination under Title IX, please refer to the Campus Incident Report form. Chaminade University of Honolulu prohibits sex discrimination in any education program or activity that it operates. The NOTICE of NONDISCRIMINATION can be found here: Notice of Nondiscrimination.

CUH Alert Emergency Notification

To get the latest emergency communication from Chaminade University, students' cell numbers will be connected to Chaminade's emergency notification text system. When you log in to the Chaminade portal, you will be asked to provide some emergency contact information. If you provide a cellphone number, you will receive a text from our emergency notification system asking you to confirm your number. You must respond to that message to complete your registration and get emergency notifications on your phone.

Assessment for Student Work

With the goal of continuing to improve the quality of educational services offered to students, Chaminade University conducts assessments of student achievement of course, program, and institutional learning outcomes. Student work is used anonymously as the basis of these assessments, and the work you do in this course may be used in these assessment efforts.

Kōkua 'Ike: Tutoring & Learning Services

Chaminade is proud to offer free, one-on-one tutoring and writing assistance to all students. Tutoring and writing help is available on campus at Kōkua 'Ike: Center for Student Learning in a variety of subjects (including, but are not limited to biology, chemistry, math, nursing, English, etc.) from trained Peer and Professional Tutors. Please check Kōkua 'Ike's website for the latest times, list of drop-in hours, and information on scheduling an appointment. Free online tutoring is also available via TutorMe. Tutor Me can be accessed 24/7 from your Canvas account. Simply click on Account > TutorMe. For more information, please contact Kōkua 'Ike at tutoring@chaminade.edu or 808-739-8305.

Attendance Policy

The following attendance policy is from the Academic Catalog: Students are expected to attend regularly all courses for which they are registered. Student should notify their instructors when illness or other extenuating circumstances prevents them from attending class and make arrangements to complete missed assignments. Notification may be done by emailing the instructor's Chaminade email address, calling the instructor's campus extension, or by leaving a message with the instructor's school office (Natural Science and Math 1 (808) 440-4204). It is the instructor's prerogative to modify deadlines of course requirements accordingly. Any student who stops attending a course without officially withdrawing may receive a failing grade.

Unexcused absences equivalent to more than a week of classes may lead to a grade reduction for the course. Any unexcused absence of two consecutive weeks or more may result in being withdrawn from the course by the instructor, although the instructor is not required to withdraw students in that scenario. Repeated absences put students at risk of failing grades.

Students with disabilities who have obtained accommodations from the Chaminade University of Honolulu ADA Coordinator may be considered for an exception when the accommodation does not materially alter the attainment of the learning outcomes. Federal regulations require continued attendance for continuing payment of financial aid. When illness or personal reasons necessitate continued absence, the student should communicate first with the instructor to review the options. Anyone who stops attending a course without official withdrawal may receive a failing grade or be withdrawn by the instructor at the instructor's discretion.

13.12. Academic Conduct Policy

See the current Undergraduate Academic Catalog and the Student Handbook available from Student Affairs.