

CSCI 4520 MACHINE LEARNING

Instructor:	Dr. Weitian Tong Associate Professor in Computer Science
Email:	wtong@georgiasouthern.edu
Website:	http://www.weitianong.com/teaching/Machine-Learning/
Office:	IT 2305
Office hours:	TR 8:00 am – 11:00 am; or by appointment
Lecture class:	TR 2:00 pm – 3:15 pm • Site Synchronous Instruction at Newton Building 2207 and Newton Building 2207
Important Dates:	Please refer to University Calendar for details. • January 13, Class begins and Attendance Verification • January 13 – 16 , Drop/Add • January 20, Martin Luther King Jr. Holiday – No classes • March 10, Last day to withdraw without academic penalty • March 17 – 22, Spring break for students – No classes • May 5, Last day of classes • May 6 – 10, Final Exams (Refer to Final Exam Schedule)
CRN and Credits:	CRN 13505 & CRN 13506, 3.0 credit hours
Prerequisite(s):	A minimum grade of “C” in CSCI 3341 or CSCI 3232 and MATH 2130 or CSCI 2625.
Course Content:	Developing advanced applications using diverse machine learning and computational intelligence algorithms for pattern recognition, classification and decision-making, including decision trees, neural networks, Bayesian learning, clustering, and kernel-based techniques. Multiple projects and a term project encompassing some or all of these concepts.
Textbook:	There are no required textbooks for this class.
Materials:	• All course materials (such as syllabus, slides, and homework descriptions) are available on Folio. • The actual course schedule will be updated timely on our course website: “http://www.weitianong.com/teaching/Machine-Learning/”
Assessments:	• Assignments: 30% • Coding Competitions: 40% • Project: 30%
Grading Scale:	A: [90, 100]; B: [80, 90); C: [70, 80); D: [60, 70); F: [0, 60).

Objectives:

- Introduce foundational concepts of machine learning, including supervised, unsupervised, and reinforcement learning.
- Provide an understanding of the mathematical principles underlying machine learning algorithms.
- Develop proficiency in implementing basic machine learning algorithms using modern tools and frameworks.
- Teach students to evaluate and interpret the performance of machine learning models.
- Promote ethical awareness in the application of machine learning to real-world problems.
- Encourage collaborative problem-solving and effective communication of technical results.

Outcomes:

- Apply mathematical concepts such as linear algebra, probability, and statistics to analyze machine learning problems.
- Design and implement machine learning models for regression, classification, and clustering tasks using tools such as Python, Scikit-learn, or TensorFlow.
- Preprocess and analyze datasets, including handling missing data, normalizing features, and performing feature selection, to prepare them for machine learning workflows.
- Assess model performance using metrics such as accuracy, precision, recall, and F1-score, and optimize models through hyperparameter tuning.
- Demonstrate the ability to apply machine learning solutions to real-world problems by developing a complete, end-to-end pipeline from data collection to model evaluation.
- Identify and discuss the ethical and societal implications of machine learning, including addressing bias, fairness, interpretability, and data privacy concerns.
- Communicate the methodology and results of machine learning projects effectively through written reports, oral presentations, and visualizations.
- Collaborate in teams to solve machine learning problems, demonstrating effective communication, task delegation, and integration of contributions.
- Recognize limitations of machine learning models and propose strategies for improving performance or adapting solutions to new contexts.
- Demonstrate awareness of the broader impacts of machine learning technologies in society, including both their potential benefits and risks.

Topics:

Please follow the course website: "<http://www.weitianong.com/teaching/Machine-Learning/>" for *timely updated course schedule*.

- Introduction to machine learning: concepts, types (supervised, unsupervised, reinforcement learning), and applications.
- Python programming essentials for machine learning, including Jupyter Notebooks and the Anaconda environment.
- Data handling and visualization using NumPy, Pandas, and Matplotlib.
- Core machine learning algorithms: linear regression, logistic regression, decision trees, and clustering (e.g., k-means).

- Model evaluation and validation: accuracy, precision, recall, F1-score, ROC-AUC, and cross-validation.
- Data preprocessing techniques: handling missing values, normalization, standardization, and feature engineering.
- Overfitting and underfitting: concepts, detection, and solutions (e.g., regularization).
- Introduction to neural networks and their applications in tasks such as image and text classification.
- Basics of ensemble learning: bagging, boosting, and decision forests.
- Introduction to embeddings, transformers, and large language models (LLMs).
- Ethical considerations in machine learning: fairness, bias, interpretability, and data privacy.
- Introduction to deploying machine learning models and automated machine learning (AutoML).
- Collaborative machine learning projects: problem scoping, implementation, and presentation.

Course Policy:

- **Academic Honesty:** Consultation with fellow students is encouraged. However, directly copying another student's work (past or present) defeats the purpose of the assignments and exams and is an honor code violation. Unless otherwise noted, you are expected to complete all assignments **individually**. Violations of the Georgia Southern University academic honesty policy (including cheating and plagiarism) are taken very seriously. Any violation of this policy will become part of the student's permanent educational record. More information on the academic dishonesty policy and procedure can be found at: Academic Dishonesty.
- **Late Assignments, make-up work/tests:** **No** late work will be accepted and there is **no** make-up work available in this class, unless the absence is due to a situation that is beyond your control.
- **Grading disagreement:** Requests for re-evaluation of assignments and quizzes must be made by email **within one week** after the grades are available. Requests for re-evaluation of tests (i.e., Midterm and Final) must be made by email **within 24 hours** after grades are available.
- **Communication: Important news will be announced on Folio.** To ensure effective communication, you are required to check Folio or your university email (if the announcements are pushed to your email) for all communications related to this class. It is your responsibility to check your Folio account and university email daily, as many important communications will be done via email.
- **Distribution of course materials:** Lecture notes, assignments/quizzes/exams, as well as their sample solutions, are prepared for students in this course **only**. Any other use, distribution, or posting in places outside this course are prohibited without written permission from the instructor.
- **Disability-related Accommodations:** Georgia Southern University is committed to providing reasonable accommodations to students with documented disabilities as required under federal law. Disabilities may include ADD or AD/HD, autism spectrum disorders, brain injuries, chronic medical conditions, communication disorders, hearing impairment, learning disabilities, mobility impairment, psychological disorders and visual impairment. The purpose of disability accommodation is to provide equal access to the academic material and equal access to demonstrate mastery of the material. If you have a disability and need accommodations, please contact the Student Accessibility Resource Center (SARC). You will

need to meet with a SARC staff member who can help you gather documentation of your disability or refer you to an appropriate resource for assessment. Once documentation of the disability is approved, SARC staff will provide you with an accommodation letter detailing the approved accommodations which you should present to me so we can discuss and implement your accommodations. Disability accommodations work best starting at the beginning of the semester, but can be approved and started at any point in the semester. Accommodations start at the time the accommodation letter is presented to faculty within reasonable timelines; accommodations are not given retroactively. SARC on the Statesboro campus is located on the second floor of Cone Hall and the phone number is (912) 478-1566. SARC for Savannah and Liberty campuses is located on the second floor of Memorial College Center and the phone number is (912) 344-2572.

- **Equal Opportunity & Title IX:** Please refer to “Equal Opportunity & Title IX” for more information.
 - **Reporting:** Georgia Southern University does not discriminate on the basis of sex, race, color, sexual orientation, gender identity or expression, national origin, religion, age, veteran status, political affiliation, or disability. While students are encouraged to share with faculty any issues or concerns they may be having, please be aware there are reporting requirements which are a part of the job requirements at Georgia Southern University. For example, if you disclose an issue of sexual misconduct, the information will be kept as private as possible but faculty and staff are required to bring it to the attention of the institution's Title IX Coordinator/Director of Equal Opportunity and Title IX.
 - **Pregnant and Parenting Students:** Georgia Southern University does not discriminate against students who are pregnant, give birth, experience a false pregnancy, termination of pregnancy, or recovery therefrom. Students should work with their faculty as soon as possible to arrange appropriate accommodations based on this status; delays in reporting may impact available accommodations. Students will be treated similarly to other similarly situated students. Absences from class may be excused due to pregnancy or childbirth for as long as medically necessary. At the conclusion of medical leave, the student will be allowed to return to the same academic status. Medical certification may be requested from the student. Both students and faculty are able to consult with the Title IX Coordinator regarding any questions or issues which arise.

Enjoy the class!