DAY, TIME AND LOCATION
Wednesdays, 4:30 pm – 7:10 pm, Online Meetings via Blackboard Collaborate or Zoom

INSTRUCTOR INFORMATION
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TEACHING ASSISTANT INFORMATION
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DESCRIPTION AND LEARNING OBJECTIVES
Machine learning as a field is now incredibly pervasive with several applications such as homeland security, face recognition, self-driving car, social media, bioinformatics, etc. This course provides a broad introduction to machine learning and statistical pattern recognition. It introduces interdisciplinary machine learning techniques such as statistics, linear algebra, optimization, and computer science to create automated systems able to make predictions or decisions without human intervention. This class will familiarize students with a broad cross-section of models and algorithms for machine learning, and prepare students for research or industry application of machine learning techniques. The course also provides students with opportunities to gain hands-on experience with several machine learning tools. Topics include: (1) learning theory (e.g., bias/variance tradeoffs); (2) supervised learning (generative/discriminative learning, parametric/nonparametric learning, neural networks, and support vector machines); (3) unsupervised learning (clustering, dimensionality reduction, kernel methods); and (4) reinforcement learning. The course will also discuss applications of machine learning in security.

PREREQUISITES
Basic knowledge about probability theory, statistics, linear algebra and programming.

MATERIAL - Textbooks
- Duda and Hart, “Pattern Classification”, Wiley. (Recommended)

OTHER RESOURCES
- Python tutorial: https://docs.python.org/3/tutorial/
- Online discussion forum on Piazza
TENTATIVE STUDENT EVALUATION
- Examinations through Respondus Lockdown Browser
- Assignments: 25%, Tests + Final: 45%, Project: 30%

TENTATIVE COURSE OUTLINE
- **[09/01-2021]** - Lecture 2: Review of Linear Algebra. MATLAB tutorial. Applications of Supervised Learning; KNN-Classification.
- **[09/08-2021]** - Lecture 3: Decision Tree Learning: Representation, Learning Algorithm, Inductive Bias; Related Issues. [Kuhn - Chapter 3] - Assignment of HW #1
- **[09/22-2021]** - Lecture 5: Applications of Machine Learning: Recent Advances. Test #1. HW #1 due
- **[09/29-2021]** - Lecture 6: Introduction to Artificial Neural Networks (ANNs): Representations and Appropriate Problems. The Perception Training Rule, Back Propagation Algorithm and Related Convergence; Feedforward Networks. ANNs part2: Multi-Layers Perceptron and Backpropagation. Assignment of HW #2
- **[10/13-2021]** - Lecture 8: Kernel SVM. Applications of Ensemble Classifiers: Bootstrap, Bagging, Boosting and Adaboot. HW#2 due
- **[10/20-2021]** - Lecture 9: Generative Adversarial Networks and Applications in Cyber Security. Test #2
- **[10/27-2021]** - Lecture 10: Bayesian Learning, MAP, Bayes Optimal Classifier, Gibbs, Naive Bayes. Probabilistic Graphical Models: Bayesian Belief Networks with Applications in Security. Applications of BBNs to the security of fingerprint systems. Assignment of HW #3
- **[11/10-2021]** - Lecture 12: PCA, Applications of PCA to face recognition and for feature decorrelation in biometric-based cryptographic schemes LDA. HW #3 due
- **[11/24-2021]** - Thanksgiving
- **[12/08-2021]** – Final Exam - Student’s Project Presentation.
ADDITIONAL INFORMATION

- Students are permitted to interact on homework assignments, but your write-up must be your own. Assignments are intended to provide practical, hands-on experience with the ideas presented in the course.
- Religious observances are one common example of events that might impact students’ activities. Students are responsible for planning ahead. Please, refer to the GMU’s calendar of religious holidays at http://ulife.gmu.edu/religious_calendar.php.
- Academic Policy: All academic policies as given in the Honor System and code will be strictly followed. These are available at http://catalog.gmu.edu/content.php?catoid=19&navoid=4113.
- General Policies: All general policies defined in the University Catalog are in place for this course. You can access those at http://catalog.gmu.edu/content.php?catoid=19&navoid=4114.
- George Mason University is an Honor Code university. Please see the Office of Academic Integrity website http://oai.gmu.edu/the-mason-honor-code-2/ for a full description of the honor code and the honor committee process. All members of the Mason community are expected to uphold the principles of scholarly ethics. Similarly, graduating students are bound by the ethical requirements of the professional communities they join. On admission to George Mason University, students agree to comply with the requirements of the Mason Honor System and Code. The Honor Code will be strictly enforced in this course. Honor Code cases are heard by a panel consisting of students – students who meet the requirements are encouraged to nominate themselves to serve on the Honor Committee.
- Any use of the words or ideas of another person(s), without explicit attribution that clearly identifies the material used and its source in an appropriate manner, is plagiarism and will not be tolerated. The Instructor reserves the right to use manual and/or automated means (including such services as SafeAssign.com) to detect plagiarism in any work submitted by students for this course, and to direct Teaching Assistants and/or other faculty and/or staff members to do likewise in support of this course.
- Students with a documented learning disability or other condition that may affect academic performance should: (i) make sure this documentation is on file with Office of Disability Services (SUB I, Rm. 4205; 993-2474) to determine the accommodations they need; and (ii) talk with the instructor to discuss their accommodation needs. The Office of Disability Services (ODS) works with disabled students to arrange for appropriate accommodations to ensure equal access to university services. Any student with a disability of any kind is strongly encouraged to register with ODS as soon as possible and take advantage of the services offered. Accommodations for disabled students must be made in advance – ODS cannot assist students retroactively, and at least one week's notice is required for special accommodations related to exams. Any student who needs accommodation should contact the Instructor during the first week of the semester so the sufficient time is allowed to make arrangements.