

THE UNIVERSITY OF TEXAS AT EL PASO
COLLEGE OF SCIENCE
DEPARTMENT OF MATHEMATICAL SCIENCES

Course #: STAT 5494 (CRN 26860)
DS 6494 (CRN 27763)
Course Title: Statistical Machine Learning II
Credit Hours: 4 (Lecture plus Lab)
Term: Spring 2023 (Instruction 01/16/2024 – 05/02/2024)
Course Meetings & Location: Class MW 12:00 noon – 1:20 pm, Bell Hall 130
Lab MW 1:30 pm – 2:20 pm, Bell Hall 130

The course will be held asynchronously online. Course materials can be accessed via Blackboard, and I am available on Zoom during class/office hours: <https://utep-edu.zoom.us/j/83368416424>

Prerequisite Courses: STAT 5380, STAT 5474 or Instructor Approval.
Instructor: Xiaogang Su
Office Location: Bell Hall 320
Contact Info: Phone: (915) 747-6860 [O]
Email: xsu@utep.edu
Fax: (915) 744-6502
Office Hours: 12:00 noon – 2:00 pm Tuesday or by appointment
Class Web page: Blackboard
Textbook(s), Materials: Required: Hastie, T., Tibshirani, R., and Friedman, J. H. (2008), *Elements of Statistical Learning*, 2nd Edition Chapman and Hall. ISBN-13: 978-0387848570
<http://www-stat.stanford.edu/~tibs/ElemStatLearn/>
Suggested:

- Vapnik, V. N. (1998). *Statistical Learning Theory*. Wiley
- Clarke, B., Fokoue, E., and Zhang, H. (2009). *Principles and Theory for Data Mining and Machine Learning*. Springer. ISBN-13: 978-0387981345
- Bishop, C. M. (1996). *Neural Networks for Pattern Recognition*. Oxford University Press: USA. ISBN-13: 978-0198538646.

Course Description and Learning Outcomes: Data Mining emerges as an interdisciplinary field with joint inputs from statistics, computer science, machine learning, and artificial intelligence. This course is intended to cover some commonly used data mining techniques, with more focus on the most technical part - statistical learning algorithms. The materials are arranged in two main categories: unsupervised learning and supervised learning. A tentative outline of the specific topics is provided below.

- Topic Outline
1. An Overview of Data Mining
 2. Intro to Optimization
 3. Intro to Reproducing Kernel Hilbert Space (RKHS)

Part I: Unsupervised Learning

4. Association Rules: Market Basket Analysis; the Apriori Algorithm; Generalized Association Rules.
5. Outlier Detection: Statistical Discordance Tests, Nearest Neighbor and Distance-Based; Partitioning-Based; Influential Points.
6. Non-Negative Matrix Factorization: Archetypal Analysis.
7. Web Mining: Google PageRank

Part II: Supervised Learning

8. Parametric Nonlinear Regression: Numerical Optimization methods
9. Nonparametric Smoothing I - the Kernel Method: K-nearest neighbor (KNN); kernel regression;
10. Nonparametric Smoothing II - the Spline Method: Polynomial Regression and Piecewise Polynomials; (Natural) Cubic Splines; B-Splines; Smoothing Splines - the penalized likelihood.
11. Generalized Additive Models (GAM): Additive Models and GAM.
12. Multivariate Adaptive Regression Splines (MARS); Generalization to different types of responses.
13. Projection Pursuit Regression (PPR): the backfitting algorithm
14. Artificial Neural Networks - I: Multilayer Perceptron (MLP): ANN history and architectures; Single-Layer Perceptron and MLP; Back Propagation (Backprop) and other optimization methods; deep learning
15. Artificial Neural Networks - II: Radial Basis Function Networks (RBF): Ordinary RBF and Normalized RBF.
16. Support Vector Machines (SVM)

Part II: Additional Topics (if time allows)

17. Hidden Markov Models (HMM)
18. Reinforcement Learning

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| Course Schedule: | 01/15 | Martin Luther King Day |
| | 03/28 | Course Drop Date |
| | 03/29 | Cesar Chavez Holiday |
| | 05/06 -05/10 | Final Exam Week |

Course Activities/Assignments: Presentations and projects will be assigned throughout the semester.

Assessment of Course Objectives: Each student will be evaluated by the quality of his/her own assigned presentations as well as their contribution to the discussions during other students' presentations.

Grading Policy: There will be several computer assignments and a final project. The assignments make up 70% and the final project makes up 30% to your final score. For the final project, students are given the freedom to select data from whatever field they are interested in. Students should make their own plans to collect data, raise interesting research questions, and consult the instructor for the adequacy of the project. Also, each student will have the opportunity to present their work in class.

To promote a strong work ethic, late unexcused submissions will be penalized by 10% deduction per day (e.g., 10% for 0-24 hours late, 20% for 24-48 hours late, etc.). Letter grades are determined according to the following scale:

| Grade | Score |
|-------|-------|
| A | 90 + |
| B | 80-89 |
| C | 70-79 |
| D | 60-69 |
| F | <60 |

Make-up Policy: All other assignments must be turned in on time.

Attendance Policy: If the course is taught face-to-face, class attendance is REQUIRED and helpful to decide borderline grades. If a student must be absent from a particular class, he/she will be responsible for catching up with course material. A late arrival of 15 minutes or more will be considered as an absence. Students will be dropped for four or more unjustified absences from class or lab session. Your academic advisor will be consulted before final action is decided and taken. Any unjustified absences from class or lab session will cause loss of eligibility of receiving extra credits. If you expect to miss up to 10 class hours for ANY REASON, then please do not consider taking this course.

Academic Integrity Policy: Please see <http://academics.utep.edu/Default.aspx?tabid=23785>

Civility Statement: This is a class where participation is required. You will be participating in classroom discussions. All students will be treated with respect.

Disability Statement: If you have a disability and need classroom accommodations, please contact The Center for Accommodations and Support Services (CASS) at 747-5148, or by email to cass@utep.edu, or visit their office located in UTEP Union East, Room 106. For additional information, please visit the CASS website at www.sa.utep.edu/cass.

Military Statement: If you are a military student with the potential of being called to military service and /or training during the course of the semester, you are encouraged to contact me as soon as possible.

UTEP College of Science
Policies

Watch out for the UTEP drop/withdraws deadline for the semester. The College of Science will remain aligned with the University and not approve any drop requests after that date.

All grades of Incomplete must be accompanied by an Incomplete Contract that has been signed by the instructor of record, student, departmental chair, and the dean. Although UTEP will allow a maximum of one year to complete this contract, the College of Science requests it be limited to month based upon completion data. A grade of Incomplete is only used in extraordinary circumstances confined to a limited event such as a missed exam, project, or lab. If the student has missed a significant amount of work (e.g. multiple assignments or tasks), a grade of Incomplete is not appropriate or warranted.

COVID-19 Precaution
Statement

Please stay home if you have been diagnosed with COVID-19 or are experiencing COVID-19 symptoms. If you are feeling unwell, please let me know as soon as possible, so that we can work on appropriate accommodations. If you have tested positive for COVID-19, you are encouraged to report your results to covidaction@utep.edu, so that the Dean of Students Office can provide you with support and help with communication with your professors. The Student Health Center is equipped to provide COVID-19 testing.

The Center for Disease Control and Prevention recommends that people in areas of substantial or high COVID-19 transmission wear face masks when indoors in groups of people. The best way that Miners can take care of Miners is to get the vaccine. If you still need the vaccine, it is widely available in the El Paso area, and will be available at no charge on campus during the first week of classes. For more information about the current rates, testing, and vaccinations, please visit epstrong.org.