**CSCI 59000 : Machine Learning**

**Spring 2017**

**Class Time:** 1:30-2:45pm, TR
**Room:** SL 050
**Credits:** 3 Cr.

**Instructor:** Murat Dundar (email: mdundar@iupui.edu)
**Telephone:** 278-6488
**Office:** AOC 5027
**TA:** Halid Ziya Yerebakan (email: hzyereba@umail.iu.edu)
**Course URL:** http://cs.iupui.edu/~dundar/ML2017.htm

**Textbook:** Pattern Recognition and Machine Learning by Christopher M. Bishop (PRML)

**Prerequisites:**
You should have had some level of exposure to probability and random variables. You should also have a solid understanding of calculus (differentiation, integration, functional optimization etc.) and linear algebra (eigenvalues, vector-matrix multiplication etc.). You should also have some familiarity with Matlab or other programming languages as there will be a lot of emphasis on implementation. **A quiz will be given during the first lecture of the semester about these topics. All students who fail the quiz are strongly encouraged to withdraw.**

**Description:** CSCI 590: Machine Learning

This course will provide an mid to advanced-level coverage of concepts and techniques in machine learning with more emphasis given on statistical aspect of machine learning. Topics to be discussed include: Generative and discriminative models for classification and regression, posterior distributions and inference, conjugate distributions, model generalizability, kernel machines, dimensionality reduction, introduction to probabilistic topic models, graphical models and belief propogation, expectation-maximization, deterministic and stochastic inference. Prerequisites: Calculus, linear algebra, probability and random variables, basic knowledge of optimization techniques. Matlab/R programming.

**Class Schedule:**

Week 1: The fundamental problem in ML. Brief review of probability theory.
Week 2: Frequentist vs Bayesian, maximum likelihood estimation and sufficient statistics, Bayes' classifier

Week 3: Bayes rule and Bayesian inference, posterior distributions.
**Assignment 1**
**Challenge description out**
Week 4: Nonparametric methods, K-nearest neighbors, linear regression, ridge regression
Week 5: Bayesian regression, Linear classification methods, Fisher's linear discriminant, perceptron algorithm
Week 6: Probabilistic discriminative models, logistic regression, Newton-Raphson optimization, probit regression, Laplace approximation, Bayesian logistic regression
**Assignment 2**
**Project proposals due**
Week 7: Dimensionality reduction and data summarization: PCA, SVD, NNMF and LDA
Week 8: Support vector machines, sparse SVM, kernel methods
Week 9: Bagging, boosting, ensembles
**Assignment 3**
Week 10: Probabilistic graphical models, conditional independence, factor graphs
Week 11: Inference in graphical models, the sum-product and max-sum algorithms, Markov random fields
Week 12: Expectation-maximization, approximate inference, variational lower bound
Week 13: Markov-chain monte carlo sampling
**Assignment 4**
**Midterm**
Week 14: Neural networks and deep learning
Week 15: Project presentations
**Final reports due**

**Grading:**

20% Assignments
50% Class project (10% proposal, 30% report, 10% presentation, 10% progress, 40% final results and rank)
30% Midterm exam

**Assignments:**

There will be four assignments each of which will be worth 5% of your final grade. The assignments should be completed using a typesetting program. LATEX is highly recommended. Send your assignments by email to TA. Late assignments will be penalized by 10 points for each day it is submitted late. Submissions will not be accepted after one week. You can discuss homeworks with other students but you should produce your own results and write your own report.

**Class Project:**

At the end of week 3 a machine-learning challenge will be announced. Each student will formulate a solution to tackle this problem and submit a proposal by the end of week 6. Students are expected to submit at least three predictions per week starting with week 6. Each student will do a presentation during week 15. Final reports will be due at the end of week 15. Final report and results will be separately graded. Final reports will be graded on the basis of justification and description of the approach, novelty, and writing/organization. Results will be graded based on the relative rank of each student in the class.

**Midterm:**

There will be an in-class, open-book/open-notes midterm. The midterm will be comprehensive and will cover material covered through Week 13.

**Statements of Academic Integrity & Honor Code**

**Policy on Academic Dishonesty in the Department of Computer and Information Science at IUPUI**

The faculty in the Department of Computer and Information Science (henceforth, referred to as the department) values academic honesty to be absolutely essential and expects all students to conform to it. Any violation of academic integrity is considered a serious offense and will result in severe consequences.

The policy against violations of academic integrity will be enforced at the departmental level across all courses.

If a student does not abide by this policy then, for the first violation, he/she will receive zero points for the component of the course on which academic misconduct occurred and will be reported to the Department Chairperson. If the violation is not related to a specific assignment or exam, the course instructor reserves the right to impose the zero-point penalty to any component of the course.

For a second violation of academic integrity (occurring anywhere in the graduate or undergraduate curriculum, in the same or a different semester, in the same or a different course), the student will receive a failing grade for the course where the second violation occurred, as enforced by the Department Chair and the School of Science Dean's Office, and, in addition, an official reporting process will be initiated by the Department Chair as per IUPUI's Student Conduct Policies: http://studentaffairs.iupui.edu/student-rights/student-code/.

For a third violation, the department will initiate dismissal request from the program in which the student is enrolled.

In all cases of academic integrity violation, the involved student will be notified in writing at the time the offense is observed and acknowledge the receipt of such notice in writing.

This is the minimal policy and the department reserves the right to impose more severe penalties for the first and/or second offense of academic misconduct.

The student will have opportunities to file appeals at the department, the school, and the university levels, to contest the academic dishonesty finding and/or the imposed penalty.

At the department level, any appeal will be made to the department's graduate or undergraduate committees respectively, depending on whether the student is a graduate or an undergraduate student. The graduate or undergraduate committee chair will substitute any committee members involved in the penalty imposition process with other faculty members with no conflicts of interest before processing the appeal. If desired, a student can pursue a further appeal to the School of Science Appeals Committee. Finally, the student can also submit an appeal to the IUPUI Appeals Committee.

Proper credit (in the form of correct citations and references) should be given wherever applicable and direct cutting-and-pasting must be avoided, unless indicated as verbatim (e.g., putting the text in quotation marks). A short tutorial about plagiarism is located at:
[http://ulib.iupui.edu/files/pdf/tutorials/AvoidingPlagiarismTutorial.pdf||IUPUI Tutorial].

In addition, there is a professional code of ethics for computer scientists specified by the main professional society, Association for Computing Machinery (ACM). ACM's Code of Ethics is found here:
[http://www.acm.org/about/code-of-ethics||ACM Code of Ethics].

**Administrative Withdrawal:** A basic requirement of this course is that you will participate in all class meetings and conscientiously complete all required course activities and/or assignments. Keep in touch with me if you are unable to attend, participate, or complete an assignment on time. If you miss more than half of the required activities within the first 25% of the course without contacting me, you may be administratively withdrawn from this course. Example: *Our course meets twice per week; thus if you miss more than four classes in the first four weeks*, you may be withdrawn. Administrative withdrawal may have academic, financial, and financial aid implications. Administrative withdrawal will take place after the full refund period, and if you are administratively withdrawn from the course you will not be eligible for a tuition refund. If you have questions about the administrative withdrawal policy at any point during the semester, please contact me.

**Adaptive Educational Services (AES) Policy:** Every attempt will be made to accommodate students with disabilities (e.g. mental health, learning, chronic health, physical, hearing, vision, neurological etc.). You must have established your eligibility for support services through the Adaptive Educational Services office that serves students with disabilities. Note that services are confidential, may take time to put into place and are not retroactive; Captions and alternate media

for print materials may take three or more weeks to get produced. Please contact AES office as soon as possible if accommodations are needed. AES is located in room 100 Taylor Hall, 317-274-3241.