CSE 455
Introduction to Pattern Recognition
Lecture times: T, R 11:10am - 12:25pm
Credits: 3

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Course Description: Pattern recognition handles the problem of identifying object characteristics and categorizing them, given its noisy representations using computer algorithms and pattern visualization. While pattern recognition, machine learning and data mining are all about learning to label objects, pattern recognition researchers are interested in learning the intrinsic signal patterns and ways to visualize them. Pattern recognition workflow involves iterating between data acquisition, preprocessing, feature extraction, feature selection, model selection, training, and evaluation. While traditional pattern recognition mostly concerns feature selection and model training, the availability of big data and neural network frameworks such as Tensorflow and Torch also makes automatic feature extraction as a pattern recognition topic. In this introductory course, we will be covering the concepts of traditional and modern pattern recognition, probabilistic methods to offer AI based solutions to several real-world problems, and prepare students for advanced research/industrial projects in this field.

Course Prerequisites: Python Programming), Linear Algebra, Calculus

Zoom Class Link:
`https://buffalo.zoom.us/j/91764109652?pwd=RUN1cmVwRDJJVkorVTJWaFBjSkxJZz09`
Every enrolled student should possess a laptop with webcam that may be used for video monitoring in a remote testing situation.

Requirements: The course grade will be based on written homework assignments, semester project, mid-term, class quizzes and a final exam. Homework is due before class on the due date.

Grading Policy & Other Course Details: The following items are designed to make your life easier and to give you some flexibility for planning your work:

- Grades are NON-NEGOTIABLE per UB policy.
- If the class average is greater than 85%, we will follow absolute grading, else it will be relative grading.
- The course webpage is: `https://cse.buffalo.edu/~sreyasee/CSE4555/`, check for regular updates on Reading materials for every topic. You will also get it within the course slides.
- Class recordings will be available at least 24 hours before the class. You should go through the materials, set your questions to clarify in the class. Meetings in the class hour will be more like the Q/A sessions. Class participation is graded.
- The lowest written assignment scores will be dropped.
- You get 7 flexible extension days for handing in assignments, with max of 2 per assignment. Use them wisely!

- Your ≈ biweekly written assignments will need to be clearly written, succient and accurate.
- You will need to submit your work in UBLearn.
- There will be small quizzes (almost) after every class, which will be associated with a class lecture video and be open in UBLearn *for the next* 24 *hours*. Student is supposed to finish going through the video and then do the quiz associated with it.
- Incomplete homework assignments can be turned in for partial credit.
- Please refer to the FAQ in Piazza resource section first to get an answer, before raising a question in Piazza. This helps TA, as they do not need to answer the same question multiple times and use their time on clarifying your doubts instead.

Textbook/Refrence Books:

- Pattern Classification, 2nd Edition, by Richard O. Duda, Peter E . Hart, and David G. Stork (DHS)
- Pattern Recognition and Machine Learning, by Chris Bishop (2006).

Other Supporting Materials (will continue to be extended later on):

- Data Clustering: 50 Years Beyond K-Means, Pattern Recognition Letters, Vol. 31, No. 8, pp. 651-666, June 2010, by A. K. Jain
- Algorithms for Clustering Data, Prentice-Hall, 1988, by A. K. Jain, R. C. Dubes
- Deep learning with Python, by Francois Chollet
- Deep learning, by Ian Goodfellow
- Building Probabilistic Graphical Models with Python, by Kiran R Karkera
- Introduction to support vector machines and other kernel-based learning methods, by Cristianini and Shawe-Taylor
- Brief Introduction to Graphical Models and Bayesian Networks, by Kevin Murphy.

Grade Composition:

Semester Project	25%
Written Assignments	20%
Class Participation & Quizzes	10%
Mid-term	20%
Final	20%
AI Ethics	5%

Rough schedule (each topic will take up 1-2 weeks)

1. Introduction, Bayesian Decision Theory
2. Maximum Likelihood, Bayesian Parameter Estimation
3. Parameter Estimation, Component Analysis, and Discriminents
4. Non-Parametric Techniques Discriminant Functions
5. Support Vector Machines and Kernel Methods
6. Stochastic Methods, Graphical Models
7. Neural Networks
8. Deep Learning
9. Unsupervised Learning and Clustering
10. Time Series

Accessibility Resources: If you have any disability which requires reasonable accommodations to enable you to participate in this course, please contact the Office of Accessibility Resources, 25

Capen Hall, 645-2608, and also the instructor of this course .. The office will provide you with information and review appropriate arrangements for reasonable accommodations. http://www.student-affairs.buffalo.edu/ods/

Academic Integrity:
(Short) Don't cheat! You will be caught and punished. Our department is serious about graduating ethical and upstanding computer scientists. The policy has recently been updated and will be enforced.
(Long) All academic work must be your own. Plagiarism, defined as copying or receiving materials from a source or sources and submitting this material as one's own without acknowledging the particular debts to the source (quotations, paraphrases, basic ideas), or otherwise representing the work of another as one's own, is never allowed. Collaboration, usually evidenced by unjustifiable similarity, is never permitted in individual assignments. Any submitted academic work may be subject to screening by software programs designed to detect evidence of plagiarism or collaboration. Also, do not post any of the course material outside of the Course piazza page. It will be interpreted as an attempt to get non-approved help. For the complete policy please see:
https://engineering.buffalo.edu/computer-science-engineering/information-for-faculty-and-staff/academic-integrity.html

Approved Resources:

1. Any material posted in the slides.
2. Material from the text-book (will copy relevant content to slides). Note, the code solutions from the book's website are NOT approved unless they are explicitly posted on the piazza page.
3. Sites (one click away) from the approved resources list on the Piazza page. I will add to them as appropriate for throughout the semester.

Working with others: Please do help each other! This material is fun, but can be challenging. Discussing it with peers can deepen your understanding. You can talk *about* the homework problems and ways of approaching them, however, every person must write up solutions and code separately. We will compare all submissions with each other AND non-approved sources. If you can find something online, so we can we.