CSCI 4130 : Introduction to Machine Learning

2023 Summer Session	
Total Class Sessions: 25	**Instructor: Staff**
Class Sessions Per Week: 5	**Classroom: TBA**
Total Weeks: 5	**Office Hours: TBA**
Class Session Length (Minutes): 145	**Language: English**
Credit Hours: 4	

Course Description:

Practically, machine learning means developing computer programs that automatically improve their performance through experience. Machine learning is a subject that requires interdisciplinary knowledge, including statistics, algebra, and optimization.

This course, as an introductory machine learning course for undergraduate students will introduce the concepts and techniques which involve algorithms that learn by example. Topics covered in this class include the linear models for regression, Logistic regression, nonparametric methods, neural networks, support vector machines and clustering. The course is programming-intensive and a large emphasis will be placed on tying machine learning techniques to specific real-world applications through hands-on experience.

Learning objectives:

By taking this course, the students are supposed to acquire 1) a detailed understanding of different types of learning algorithms, 2) the ability to apply the learning algorithms to solve an existed problem, and 3) the ability to present their ability of critical thinking and analyze their own work and the results while finishing the programming projects.

Course Materials:

Textbooks:

1.Pattern Recognition and Machine Learning,

Christopher M. Bishop, 2006

2.Introduction to Machine Learning,

Ethem Alpaydin, 2014

3.An Introduction to Statistical Learning,

Gareth James, Daniela Witten, Trevor Hastie, and Robert Tibshirani, 2013

Course Format and Requirements:

The sessions of this course are mainly lecturing and computer programming lab, and the materials of which will be assigned and handed out by the instructors before each class. Students

are supposed to be present at each class, and there are chances for students to make in-class discussions towards certain topics and ask questions. To get a thorough understanding of the information presented, students are supposed to finish all the assigned readings before the class.

Attendance:

Students are supposed to be presented at all class sessions. Notifications about absence reasons to the instructor should be done in advance if students are not able to attend classes. More than three absences will fail this course. Active participation in all classroom activities is also very important for students to achieve success in this course.

Course Assignments:

Homework Assignment: Students will be assigned one piece of homework each week, mainly about the implementations of machine learning algorithms and testing them on data. The students are supposed to work individually on this assignment. Each piece of homework is worth 5% of the students' final grade. The homework is due before class. No late work will be accepted, and for each late work there will be 10 points (100 points in total) taken off.
Programming Projects: Throughout the semester, students will be assigned 3 programming projects, and students are supposed to accomplish these tasks by working in groups. Before each project is released, students will be put into groups of three or four. In order to work more efficiently, students need to collaborate in order to get a better score. Students will be graded on both the correctness of the code and their analysis of the results.
Exams : That will be one midterm exam and one final exam for the course throughout the semester, both are close-book and take place in class. The content of the exams is mainly covered in the lectures and required readings. Class before the midterm exam and the final exam will be left for review and Q&A.

Course Assessment:

Homework assignments	20%
Programming projects	25%
Midterm Exam	25%
Final Exam	30%
Total	**100%**

Grading Scale (percentage):

A+	A	A-	B+	B	B-	C+	C	C-	D+	D	D-	F
98-100	**93-97**	**90-92**	**88-89**	**83-87**	**80-82**	**78-79**	**73-77**	**70-72**	**68-69**	**63-67**	**60-62**	**<60**

Academic Integrity:

Students are encouraged to study together, and to discuss lecture topics with one another, but all other work should be completed independently.

Students are expected to adhere to the standards of academic honesty and integrity that are described in the Chengdu University of Technology's *Academic Conduct Code.* Any work suspected of violating the standards of the *Academic Conduct Code* will be reported to the Dean's Office. Penalties for violating the *Academic Conduct Code* may include dismissal from the program. All students have an individual responsibility to know and understand the provisions of the *Academic Conduct Code*.

Special Needs or Assistance:

Please contact the Administrative Office immediately if you have a learning disability, a medical issue, or any other type of problem that prevents professors from seeing you have learned the course material. Our goal is to help you learn, not to penalize you for issues which mask your learning.

Course Schedule:

Topics	Assignments
Week 1	
● Class overview, course textbook, course topics, course software , course policy, etc. ● Introduction to Machine Leaning: What is ML? Why Study ML? ● Linear Regression Simple linear regression Multiple linear regression Other considerations in the regressions model Comparison of linear regressions with K-Nearest Neighbors	Homework assignment 1
Week 2	
● Multilayer Perceptrons The perceptron Training a perceptron Multilayer perceptron Backpropagation algorithm Training procedure	Homework assignment 2 Programming project 1
Week 3	
● Logistic Regression Discriminant functions	Homework assignment 3 Midterm exam

Probabilistic generative models Probabilistic discriminative models ● Nonparametric Methods (K-Nearest Neighbor) Kernel density estimators Nearest-neighbor methods	
Week 4	
● Linear Model Selection and Regularization Shrinkage methods ▪ Ridge regression ▪ The lasso ▪ Selecting the tuning parameter ● Neural Networks Feed-forward network functions Network training Error backpropagation	Homework assignment 4 Programming project 2
Week 5	
● Support Vector Machines Maximal Margin Classifier Support vector classifiers Multiclass SVM ● Clustering Mixture densities K-means clustering Expectation-maximization Algorithm Supervised learning after clustering Choosing the number of clusters ● Review for final exam	Homework assignment 5 Programming project 3 Final exam