TEXAS TECH UNIVERSITY

Department of Computer Science

Course Syllabus

Course Name: Pattern Recognition	**Number:** CS5341	**Semester: Spring** 2025
Instructor: Dr. Maaz Amjad	**Office: EC** 211B	**Email:** maaz.amjad@ttu.edu
Office Hours: MON 3:30 – 5:30 pm, WED 3:30 – 4:30 pm or by appointment (M-F)	**Location: EC** 211B	**Link:** See Blackboard **Credit:** 3 Credits
TA/Grader:		**Email:**
TA/Grader Office Hours:		**TA/Grader Office:**

If you write me an email for this class, please start the email subject with [CS5341].

Course Description: This course introduces students to the concepts and applications of pattern recognition and emphasizes machine learning and deep learning techniques to build and evaluate computational models by integrating foundational knowledge with hands-on practical implementation.

Textbooks:

1. Christopher M. Bishop. Pattern recognition and machine learning. Springer, 2006. (*Recommended*) (PDF will be provided on Blackboard)
2. Aurélien Géron, *Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow* (2nd edition). O'Reilly, 2019. (*Recommended*) (PDF will be provided on Blackboard)
3. Sebastian Raschka, Yuxi (Hayden) Liu, and Vahid Mirjalili, *Machine Learning with PyTorch and Scikit-Learn*, Packt, 2022. (*Recommended*) (PDF will be provided on Blackboard)
4. Sowmya Vajjala, Bodhisattwa Majumder, Anuj Gupta, and Harshit Surana (1st edition), *Practical Natural Language Processing: A Comprehensive Guide to Building Real-World NLP Systems*, O'Reilly, 2019. (*Recommended*) (PDF will be provided on Blackboard)

Course Objectives:

1. Understand foundational concepts in pattern recognition
2. Learn and implement machine learning and deep learning techniques
3. Apply machine learning and deep learning techniques to real-world tasks
4. Learn and implement evaluation techniques to improve model performance

Key Topics:

1. Foundations of Pattern Recognition
2. Machine Learning Techniques
   a. Supervised Learning
   b. Unsupervised Learning
3. Feature Engineering and Data Preprocessing
4. Deep Learning Foundations
5. Natural Language Processing (NLP)
6. Model Evaluation and Optimization
7. Explainability in AI

Expected Prior Knowledge and Skills: The ability to read and write in Python programming, knowledge of data structures and algorithm analysis, and knowledge of statistical and probabilistic mathematics.

Learning Outcomes & Assessment Methods: Students who have completed this course should have the ability to:

Objective	Assessment Methods
Understand foundational concepts in pattern recognition	Assignments/Projects
Learn and implement machine and deep learning techniques to real-world tasks	Assignments/Projects
Perform feature engineering and preprocessing for effective modeling	Assignments/Projects
Evaluate and optimize computational models	Assignments/Projects
Understand and apply explainability techniques in AI	Assignments/Projects

Methods of Assessment of Learning Outcomes: The expected learning outcomes for the course will be assessed through assignments (including surprise assignments) and projects.

Assignment Submission: All assignments must be submitted via TTU Blackboard. No assignments should be submitted via email. Any assignment submitted via email will not be graded and will receive zero grade. In case you have any issues submitting assignments via TTU Blackboard, please contact tech support and resolve the problem.

Grading Policy: The final grade for this course will be based on the items described below:

- **Assignments**: **40%**
  - Assignments will be programming or written assignments to be done outside of class.
  - Occasionally, in-class assignments will be assigned with minimal or no warning (surprise assignments) which is due before the end of the class it was assigned.
- **Projects** **60%**
  - Projects will be long programming or written assignments to be done outside of class. They may also consist of giving presentations to the instructor or the class.

Criteria for Grading: All assignments will be graded within two weeks of the due date unless unforeseen circumstances prevent timely grading. Table 1 shows the grading scale and breakdown of grade components.

Table 1: Scores are not rounded

letter grade	lower bound	upper bound
A	90%	100%
B	80%	89%
C	70%	79%
D	60%	69%
F	0%	59%

For example, if you receive an 89.9 score, it will be considered 89%, and you will still receive a B grade.

Additional Information

1. The final project score will replace your lowest project grade if it is higher**.** However, the final project cannot replace the grade of a project that was not completed or submitted.

2. All project presentations must be conducted in person, within the designated time, and in the assigned classroom on the TTU campus. **Presentations are not allowed to be conducted online, remotely, or off-campus (**not valid for distance students**)**. Any attempt to present outside the designated time or classroom will result in a grade of zero.
3. Deadlines will not be extended due to system failures or disk crashes. Please backup your files securely in the cloud (OneDrive is free for TTU students) to prevent the loss of work.
4. Do not save your work to publicly available GIT repos – this increases your risk of being plagiarized. This includes REPL.it or other online compilers that, by default, make your code publicly available. Failure to abide by this rule will subject you to academic penalties even if your online code is used without your knowledge or permission.
5. Late work will only be accepted within 72 hours of the due date/time with the following deductions unless prior arrangements have been made with the professor or otherwise stated in class:
    - 10% deduction for the first 24 hours
    - 25% deduction for the second 24 hours
    - 40% deduction for the third 24 hours
6. Some assignments will not be accepted late and will be marked as such on Blackboard.
7. Students are not permitted to make up or submit any item once the grading process has begun or after graded items have been returned to any student.
8. All questions concerning graded material must be submitted **in writing** along with the graded material by the last day of classes as marked in the Academic Calendar.

COURSE SPECIFIC POLICIES

Attendance Policy

Regular and punctual **attendance is not mandatory** for this course. However, as a student, you are required to attend all scheduled lecture sessions. These sessions are pivotal to your learning and provide crucial instruction on the course material. Furthermore, all announcements, assignments, and lecture materials covered in each session will be your responsibility, regardless of whether or not you were present in the lecture sessions.

1. **Responsibility for Class Material**: If you miss a lecture, you are still responsible for all course content covered, including any announcements made, assignments given, and material discussed during the lecture. It is recommended that you collaborate with fellow students to receive any missing lecture materials or learn of any announcements covered during the lecture. Contact the instructor by email or approach the instructor during office hours to discuss any possible make-up opportunities assuming you are in accordance with the rest of this policy.
2. **Notification of Absence**: If you must be absent from class for any reason, you are required to notify the instructor in writing either prior to the absence or within a 48-hour window following the missed lecture. This notification should include the reason for your absence and a plan for making up any missed coursework. If you need to be absent for more than one week, please check these guidelines.
3. **Make-Up Work**: In cases of notified absences, arrangements for make-up work will be made on a case-by-case basis. This may include, but is not limited to, make-up assignments or an alternative exam schedule. Please note that it is at the discretion of the instructor to provide make-up work opportunities. In certain cases, the student may not be allowed to make up for the missed coursework at all. Please note that it is at the discretion of the instructor to provide make-up work opportunities.

Extra Credit and Grading Curves

This policy outlines the guidelines for the allocation of extra credit opportunities and the application of grading curves in this course. It is designed to foster consistent attendance active class participation and preserve the standards of our academic community as described in the Attendance and Expanded Academic Integrity policies.

1. **Eligibility for Extra Credit and Grading Curves**
    a. *Course Attendance*
    Regular attendance is essential for academic success. Students must attend at least 70% of the course lectures to qualify for extra credit assignments and to benefit from any grading curves implemented in this course. Attendance will be strictly monitored for each class session using in-class attendance sheet or/and using other platforms (e.g., TopHat). This requirement is waived for Distance Learning students taking courses specifically marked as for Distance Learning.
    b. *Academic Integrity*
    Students who are involved in an academic integrity investigation may not be eligible for extra credit or grading curves. If a student is found to be in violation of the academic integrity policy, their eligibility for extra credit or grading curve advantages will be revoked for the duration of the academic term.
    c. *Class Participation*
    Students who are actively involved in class discussions and actively participate in discussing the assigned reading materials and take part in class questions answer sessions may be eligible for extra credit or grading curves.
2. **Extra Credit**
    d. Extra credit assignments are intended to provide students with an opportunity to improve their grades by demonstrating a deeper understanding of the course material. However, these opportunities are contingent upon meeting the attendance and academic integrity requirements stated above.
3. **Grading Curves**
    e. When deemed appropriate, grading curves will be employed to more accurately reflect the student's comprehension of the course material. However, the advantage of grading curves will only be accessible to those students who meet the previously mentioned attendance and academic integrity requirements.

Expanded Academic Integrity Policy

This course strongly advocates for an atmosphere of academic integrity and intellectual honesty. All students are encouraged to discuss ideas and problem-solving strategies with the Teaching Assistant, Instructor, and other students, but any form of academic dishonesty will not be tolerated. All submitted codes and assignments are subject to random checks for plagiarism.

1. **Code and Answers Sharing**
    Unless explicitly stated otherwise by the instructor, you are strictly prohibited from sharing, using, or looking at code or answers obtained from online sources, classmates, or friends. This also includes sharing, using, or viewing unauthorized solutions from previous iterations of the course or utilizing ChatGPT or other AI software to write code, generate any information or devise pseudocode for you.
2. **Understanding Academic Dishonesty**
    It is your responsibility to educate yourself about what constitutes academic dishonesty. This extends beyond plagiarism and may include unauthorized collaboration, falsification, multiple submissions, and facilitating academic dishonesty.
3. **Clarifying Doubts**
    If you are unsure about the legitimacy of a specific action or behavior, it is essential to discuss it with the instructor before proceeding. This proactive approach can help avoid any unintentional violations of this policy.
4. **Penalties for Violation**
    a. *Graduate Students:*
    Penalties for academic dishonesty will depend on the severity and frequency of the violations.
        - For a first-time violation on an assignment, the student will receive a score of '0' on the assignment in question.

- Any student caught (1) violating this rule on project, (2) committing multiple violations, or (3) committing a severe enough violation as deemed by the professor will receive a grade of 'F' for the course and their actions will be reported to the Office of Student Conduct.

TEXAS TECH UNIVERSITY POLICIES / STATEMENTS

Academic Integrity and Plagiarism Statements:
Academic integrity is taking responsibility for one's own class and/or course work, being individually accountable, and demonstrating intellectual honesty and ethical behavior. Academic integrity is a personal choice to abide by the standards of intellectual honesty and responsibility. Because education is a shared effort to achieve learning through the exchange of ideas, students, faculty, and staff have the collective responsibility to build mutual trust and respect. Ethical behavior and independent thought are essential for the highest level of academic achievement, which then must be measured. Academic achievement includes scholarship, teaching, and learning, all of which are shared endeavors. Grades are a device used to quantify the successful accumulation of knowledge through learning. Adhering to the standards of academic integrity ensures grades are earned honestly. Academic integrity is the foundation upon which students, faculty, and staff build their educational and professional careers. [Texas Tech University ("University") Quality Enhancement Plan, Academic Integrity Task Force, 2010].

Texas Tech University expects students to "understand the principles of academic integrity and abide by them in all class and/or course work at the University" (OP 34.12.5). Plagiarism is a form of academic misconduct that involves (1) the representation of words, ideas, illustrations, structure, computer code, other expression, or media of another as one's own and/or failing to properly cite direct, paraphrased, or summarized materials; or (2) self-plagiarism, which involves the submission of the same academic work more than once without the prior permission of the instructor and/or failure to correctly cite previous work written by the same student. This video, retrieved from the University of Kansas Libraries website, provides an example of a plagiarism definition as well as examples of plagiarism and how to avoid it. Please review Section B of the TTU Student Handbook for more information related to other forms of academic misconduct, and contact your instructor if you have questions about plagiarism or other academic concerns in your courses. To learn more about the importance of academic integrity and practical tips for avoiding plagiarism, explore the resources provided by the TTU Library and the School of Law.

Although students are encouraged to discuss ideas and problems with the instructor, assistant, and other students, academic dishonesty will not be tolerated. You are not allowed to share code or answers, use or even look at code or answers obtained from online sources, friends, or classmates. Posting, publishing, or otherwise sharing questions or answers to exams, quizzes, tests, finals, or other assignments without the explicit permission of the instructor is a serious violation of the code of conduct and will result in serious repercussions.

It is your responsibility to educate yourself about actions that constitute academic dishonesty. If you are not sure whether a specific action is allowed, talk to the instructor. All submitted codes and assignments will be checked for plagiarism. Students may be asked to explain the work they have submitted. Academic dishonesty of any kind, if discovered, will result in one or more of the following sanctions: a grade of 0 for the corresponding graded item, a grade of "F" in the course, and further action according to the TTU operating procedures: http://www.depts.ttu.edu/opmanual/OP34.12.pdf.

AI Use Policy:
You may use generative AI tools (such as ChatGPT, Claude, Grammarly, Copilot, or similar tools) to support your learning and understanding of concepts. However, *any code or content that is generated, debugged, or obtained through AI tools cannot be submitted as your own work, even with proper citation*. Submitting AI-generated content (e.g., code, text, information, or images) as your own work violates academic integrity and may result in referral to the Office of Student Conduct. If you have any questions about this policy, please feel free to contact me.

Ethical Conduct
Students are expected to comply with the Texas Tech Code of Student Conduct in all aspects of this class. The Code of Student Conduct may be found in the Student Handbook and/or Office of Student Conduct (https://www.depts.ttu.edu/dos/Studenthandbook2022forward/Student-Handbook-2023-2024.pdf).

In order to assure that all students have the opportunity to gain from time spent in class, unless otherwise approved by the instructor, students are prohibited from engaging in any other form of distraction, such as working on other classes, taking cell phone calls, text messaging, and working on laptop computers. Inappropriate behavior in the classroom shall result, minimally, in a request to leave class. Violations of conduct, including academic dishonesty, foul language, and classroom citizenship, are eligible to be reported to the Student Conduct Office.

ADA Statement
Any student who, because of a disability, may require special arrangements in order to meet the course requirements should contact the instructor as soon as possible to make any necessary arrangements. Students should present appropriate verification from Student Disability Services during the instructor's office hours. Please note: instructors are not allowed to provide classroom accommodations to a student until appropriate verification from Student Disability Services has been provided. For additional information, please contact Student Disability Services in Weeks Hall or call 806-742-2405.

Religious Holy Days
"Religious holy day" means a holy day observed by a religion whose places of worship are exempt from property taxation under Texas Tax Code §11.20. A student who intends to observe a religious holy day should make that intention known in writing to the instructor prior to the absence. A student who is absent from classes for the observance of a religious holy day shall be allowed to take an examination or complete an assignment scheduled for that day within a reasonable time after the absence. A student who is excused under section 2 may not be penalized for the absence; however, the instructor may respond appropriately if the student fails to complete the assignment satisfactorily. Please check the university policy on excused absences for religious holidays.

Absence due to Officially Approved Trips
Students planning an approved absence must notify the instructor of their departure and return dates prior to the trip to obtain advance permission; please check these guidelines.

Accommodation for Pregnant Students
To support the academic success of pregnant and parenting students and students with pregnancy related conditions, the University offers reasonable modifications based on the student's particular needs. Any student who is pregnant or parenting a child up to age 18 or has conditions related to pregnancy may contact Alex Faris, the Texas Tech University designated Pregnancy and Parenting Liaison, to discuss support available through the University. The Liaison can be reached by emailing alfaris@ttu.edu. Should a student communicate with the instructor that they are pregnant or have a pregnancy related condition or may need additional resources related to pregnancy or parenting, the instructor will communicate that student's information to the Title IX Coordinator, who will work with the student and others, as needed, to ensure equal access to the University's education program or activity.

For more information regarding supportive measures, please contact pregnancy & parenting liaison Alex Faris (alfaris@ttu.edu | 806.834.3420) or visit https://www.depts.ttu.edu/titleix/PregnancyandParenting/. You can also visit https://www.depts.ttu.edu/titleix/PregnancyandParenting/ to submit a request to Alex Faris for assistance.

Late Arrival, Late Return, and Early Departure Policy
The Computer Science department strictly follows the official academic calendars and requires students who are enrolled in face-to-face sections to be on campus by the first class day of each semester and leave campus no earlier than the last day with scheduled course activities. The only exception we make is for incoming new international students who often need more time to obtain the necessary paperwork, including a study visa, and in such cases, we accommodate late arrival for up to the 12th class day of their first semester. No exceptions will

be made for late return or early departure requests from current students in general. If it is because of an unforeseen and uncontrollable situation, a student needs early departure or late return; then the student must obtain in-advance approval from the academic advisors and instructors of all enrolled courses for an excused absence of four (4) or fewer weekdays and an additional in-advance approved Extended Absence Verification* from the Office of the Dean of Students for an extended absence of five (5) or more weekdays. If a student has unexcused absences, then the student must take full responsibility for any missed classes, missed academic work, or any financial issues caused.

*Extended Absence Verification Request to be verified by Office of the Dean of Students: https://cm.maxient.com/reportingform.php?TexasTechUniv&layout_id=6

DISCRIMINATION, HARASSMENT, AND SEXUAL VIOLENCE

Beginning January 1, 2020, Texas Education Code, Section 51.252 (formerly known as Senate Bill 212) requires all employees of Texas universities, including faculty, to report to the Title IX Office any information regarding incidents of sexual harassment, sexual assault, dating violence, or stalking that is disclosed to them. Texas law requires that all employees who witness or receive information about incidents of this type (including, but not limited to, written forms, applications, one-on-one conversations, class assignments, class discussions, or third-party reports) must report it to the Title IX Coordinator. Before talking with me, or with any faculty or staff member about a Title IX-related incident, please remember that I will be required to report this information.

Texas Tech University is committed to providing and strengthening an educational, working, and living environment where students, faculty, staff, and visitors are free from gender and/or sex discrimination of any kind. Sexual assault, discrimination, harassment, and other Title IX violations are not tolerated by the University. Report any incidents to the Office for Student Rights & Resolution (806)-742-SAFE (7233) or file a report online at titleix.ttu.edu/students. Faculty and staff members at TTU are committed to connecting you to resources on campus. Some of these available resources are TTU Student Counseling Center, 806- 742-3674, https://www.depts.ttu.edu/scc/(Provides confidential support on campus.) TTU 24-hour Crisis Helpline, 806-742-5555, (Assists students who are experiencing a mental health or interpersonal violence crisis. If you call the helpline, you will speak with a mental health counselor.) Voice of Hope Lubbock Rape Crisis Center, 806-763-7273, voiceofhopelubbock.org (24-hour hotline that provides support for survivors of sexual violence.) The Risk, Intervention, Safety and Education (RISE) Office, 806-742-2110, https://www.depts.ttu.edu/rise/ (Provides a range of resources and support options focused on prevention education and student wellness.) Texas Tech Police Department, 806-742- 3931, http://www.depts.ttu.edu/ttpd/ (To report criminal activity that occurs on or near Texas Tech campus.). If you would like to have more information about reporting options and resources, I encourage you to visit the TTU website for more information or to contact the professional staff: https://www.depts.ttu.edu/titleix/students/Report_an_Incident.php.

Civility in the Classroom

Texas Tech University is a community of faculty, students, and staff that enjoys an expectation of cooperation, professionalism, and civility during the conduct of all forms of university business, including the conduct of student-student and student-faculty interactions in and out of the classroom. Further, the classroom is a setting in which an exchange of ideas and creative thinking should be encouraged and where intellectual growth and development are fostered. Students who disrupt this classroom mission with rude, sarcastic, threatening, abusive, or obscene language and/or behavior will be subject to appropriate sanctions according to university policy. Likewise, faculty members are expected to maintain the highest standards of professionalism in all interactions with all constituents of the University (www.depts.ttu.edu/ethics/matadorchallenge/ethicalprinciples.php). If you exhibit distractive or inappropriate behavior (without explicit consent of the instructor), you may be asked to leave the class session and be subject to attendance-related penalties.

COVID-19 Statement

The University will continue to monitor CDC, State, and TTU System guidelines concerning COVID-19. Any changes affecting class policies or temporary changes to delivery modality will be in accordance with those guidelines and announced as soon as possible. Students will not be required to purchase specialized technology

to support a temporary course modality change, though students are expected to have access to a computer to access course content and course-specific messaging as needed. If you test positive for COVID-19, report your positive test through TTU's reporting system. Once you report a positive test, the portal will automatically generate a letter that you can distribute to your professors and instructors. Reporting system Link: https://www.depts.ttu.edu/communications/emergency/coronavirus/.

Safety and Wellness:
The Texas Tech University (TTU) and Edward E. Whitacre Jr. College of Engineering are committed to the safety and wellness of our students by providing various services and resources.

Make sure you register with Tech Alert to get emergency notifications by phone call, text, or email. You are encouraged to review the Emergency Action Plans (EAPs) and watch the videos of Know What To Do In Emergency Events and Surviving an Active Shooter Event Training to be prepared for those emergency situations. Additionally, due to the nature of laboratory or design courses, it is mandatory for you to follow the university safety policies and any additional safety protocols required by the course instructor(s).

For your well-being, various services are available at Student Counseling Center and Student Health Services. The Student Wellness Center provides convenient walk-in services M-F from 8 am to 5 pm. Furthermore, the Texas Tech Crisis HelpLine (806-742-5555) provides 24/7/365 assistance for students experiencing a crisis or distress.

Emergency/Crisis Phone Number

TTU Police (UPD) Emergency	911
TTU Police (UPD) Non-Emergency	806.742.3931
TTU Emergency Maintenance	806.742.4677
TTU EHS (M-F, 8 am – 5 pm)	806.742.3876
SafeRide	806.742.7433
TTU Crisis HelpLine	806.742.5555
Student Wellness Center (From Urgent Care to a Full-Service Pharmacy on site)	806.742.2848
Title IX Reporting	806.742.7233
The Dean of Students	806.742.2984

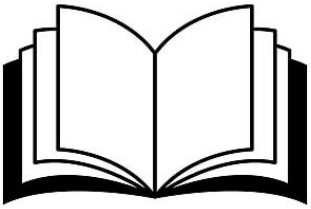
Course Resources/ Tools

Dr. Maaz Amjad

Blackboard LEARN

anthology

Learning Management System



Recommended Books

***Important Note*:** The topics (below table), the order in which they are presented, and the information presented in this complete syllabus are subject to change, expansion, and contraction or stasis during the semester at the instructor's discretion because of scheduling issues, developments in the discipline, or other contingencies. The copy of syllabus on Blackboard takes precedence in case of conflict between different versions of syllabus. This schedule is also tentative and subject to change.

Week of…	Monday	Wednesday	Friday
01/13/2025	X	Syllabus Overview & Course Introduction	Introduction to Pattern Recognition
01/20/2025	School Holiday	Machine Learning Foundation	Machine Learning Foundation
01/27/2025	Linear Models for Regression and Classification	Classification Algorithms	Classification Algorithms
02/03/2025	Ensemble Methods	Dimensionality Reduction and Feature Selection	Model Evaluation Metrics
02/10/2025	Feature Engineering & Data Preprocessing	Engineering Job Fair	Introduction to Text Classification
02/17/2025	Feature Extraction and Text Representation Techniques	Feature Extraction and Text Representation Techniques	Building Baseline ML Models
02/24/2025	CS Job Fair	Workshop/Guest Lecture	Building Baseline ML Models
03/03/2025	Deep Learning Foundation	Deep Learning Foundation	Midterm Exam
03/10/2025	Deep Learning Architectures	Deep Learning Architectures	Deep Learning Architectures
03/17/2025	School Holiday	School Holiday	School Holiday
03/24/2025	Workshop/Guest Lecture	Sequence Modeling and Contextual Representations	Sequence Modeling and Contextual Representations
03/31/2025	Advanced Techniques for NLP	Advanced Techniques for NLP	Advanced Techniques for NLP
04/07/2025	Advanced Techniques for NLP	Model Interpretability and Explainability	Model Interpretability and Explainability
04/14/2025	Workshop/Guest Lecture	Model Interpretability and Explainability	Ethical and Social Implications of AI
04/21/2025	School Holiday	Ethical and Social Implications of AI	Ethical and Social Implications of AI
04/28/2025	Applications of Machine and Deep Learning in Pattern Recognition	Applications of Machine and Deep Learning in Pattern Recognition	Review for Final Exam
05/05/2025	X	X	X
	Final Exam: Monday, May 12, 7:30 am – 10:00 am		