

**Course Syllabus**  
**IE 4395 and IE/SE/MFG 5390: Special Topics (Industrial data analytics)**  
**Spring 2023**

*(Class will be delivered online, Asynchronously, class materials will be posted on Blackboard)*

<b>Instructor</b>	Dr. Md Fashiar Rahman
<b>Location and Time</b>	Online and Asynchronous via Blackboard
<b>Instructor's Office</b>	A 243
<b>Instructor's Office Hours</b>	Monday and Wednesday: 12.00 PM – 1.00 PM
<b>Email</b>	<a href="mailto:mrahman13@utep.edu">mrahman13@utep.edu</a>
<b>Teaching Assistant</b>	TBD

**1 Course web page**

This course will be offered online and asynchronously. This means there will be no fixed class time, and all the course instructions and materials will be delivered online. We will use Blackboard as the platform to conduct this course. So, students must check the course homepage regularly through Blackboard using the following link using their UTEP credentials.

<https://blackboardlearn.utep.edu/>

**2 Course Motivation**

The 21st century has been called by many “The Century of Data.” We see more and more data collected with the expectation (justified by empirical evidence!) that analyzing these data will give organizations a competitive edge and help them excel. The amount of data collected is enormous and growing. Mark Twain wrote once, “A man who does not read has no advantage over a man who cannot read.” A similar sentence is true: “A company who does not analyze its data has no advantage over a company who has no data.” Methods for analyzing data, called collectively “data analytics,” are, therefore, crucial for businesses to gain a competitive advantage.

Data analytics, also called Knowledge Discovery in Databases (KDD), is discovering novel and potentially useful information from large amounts of data. Data analytics (data mining) has been applied in many fields, including retail sales, bioinformatics, healthcare, manufacturing, and counterterrorism. It is an important, fast-growing field that has quickly become a key basis of productivity growth, innovation, and consumer surplus. There is an increasing need for analytics-savvy employees who can think uniquely across disciplines to transform data into relevant insights for making better business decisions. It is a highly interdisciplinary area representing the confluence of machine learning, statistics, operations research, database systems, and high-performance computing, among other fields.

**3 Course Description (3 Credits)**

This course is an introductory course open to both graduate and senior undergraduate students. As an introductory course on data analytics, this course introduces the concepts, algorithms, techniques, and systems of data mining, including (1) an introduction to data analytics, (2) data preprocessing, (3) mining frequent patterns and correlation, (4)

classification, (5) cluster analysis, and (6) learning about the software used in data mining and (7) demonstration of how to apply data analytics techniques using Python. The course will give students a basic understanding of common data analytics techniques and their applications.

#### **4 Prerequisites**

Basic engineering statistics and basic calculus, and linear algebra. Having basic programming knowledge would be an advantage. However, this is not a course of mathematical statistics or advanced calculus.

#### **5 Course Objectives**

The objective of this course is to develop a solid understanding of data analytics algorithms and techniques to enhance students' competency in providing data-driven solutions. In this course, students will learn about the most widely used data analytic techniques and tools to analyze data. The course will enhance students' confidence in applying common data analytic algorithms and performing data mining experiments. Upon completing this course, students will:

- a. Understand the applications and implications of data analytics for industry-specific problems.
- b. Gain expertise in the most widely used data analytics algorithms using python programming.
- c. Able to build data analytics models to solve specific problems and extract useful information.
- d. Able to explain the underlying assumptions and present the outcomes using graphical presentations, tables, and charts for effective decision-making.

Therefore, the specific learning outcomes of this course are:

1. Ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.
2. Ability to develop and conduct appropriate experimentation, analyze, interpret data, and use engineering judgment to conclude.
3. Ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

#### **6 Textbook**

There is no required textbook. Necessary reading materials will be provided during the semester. However, some useful references are:

- a. Data Mining: Concepts and Techniques, 3rd edition, by Jiawei Han, Micheline Kamber, and Jian Pei.
- b. An Introduction to Statistical Learning, written by Daniela Witten, Trevor Hastie, and Robert Tibshirani
- c. Python for data analysis: Data wrangling with Pandas, Numpy, and IPython, by Willian Mckinney

Materials from outside the textbook will be provided in lecture notes.

#### **7 Technology Requirements:**

This course has been designated as a laptop course. Most of the course activities will be conducted using laptops. You will need your laptop to conduct course activities unless

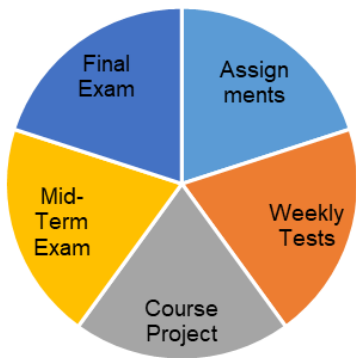
otherwise noted explicitly. I assume that each student has a laptop with the appropriate software. You will need access to a computer/laptop, scanner, webcam, and microphone. You will need to download or update the software, including Microsoft Office, Adobe Acrobat Reader, Windows Media Player, QuickTime, and Java. Check that your computer hardware and software are up-to-date and able to access all parts of the course. Suppose you do not have word-processing software. You can download Word and other Microsoft Office programs (including Excel, PowerPoint, Outlook, and more) for free via UTEP's Microsoft Office Portal. Click the following link for more information about [Microsoft Office 365](#) and follow the instructions.

Students also need to install Python on their laptops. Python is an open-source and free programming language compatible with any operating system. Click the following to download and install [Python](#). Further installation guidelines will be provided during the class. IMPORTANT: If you encounter technical difficulties beyond your scope of troubleshooting, please contact the [UTEP Help Desk](#) as they are explicitly trained in assisting with the technological needs of students. Please do not contact me for this type of assistance. The Help Desk is much better equipped than I am to assist you!

### 8 How Will the Course Be Conducted?

This course comprises twelve (12) short modules covered in sixteen (16) weeks. As the course will be conducted online and asynchronously, there will be no fixed class time. However, each week (by Monday noon), the instructor will upload new course materials to the Blackboard, including recorded videos, PowerPoint Slides, weekly tests, and other module-related materials. Some modules will have assignments/homework. The students must review the recorded videos and PowerPoint materials and complete the weekly test by the end of each Sunday (more details are discussed in the Weekly Test Section). You can review the weekly recorded video at your own pace and convenience; however, it is your responsibility to go through the materials. If you have any questions/concerns, you can join my online office hours (please refer to the Office Hours Section to know details) to ask questions or discuss your concerns. If you need additional time, you can send me an email requesting an additional meeting time. Please remember that the additional meeting is not guaranteed to schedule an appointment upon request. It will depend on the instructor's availability.

Your overall performance will be assessed using five measurable activities – 1) Weekly Tests, 2) Assignments, 3) Mid-Term Exam, 4) Final Exam, and 5) Course project, as shown in the following figure. To know more about each category, please refer to the following subsections.



Undergraduate Student		Graduate Student	
Assignment	20%	Assignment	20%
Weekly Test	20%	Weekly Test	20%
Mid-Term Exam	20%	Mid-Term Exam	20%
Final Exam	20 %	Final Exam	20 %
Course Project ( <b>Group</b> )	20%	Course Project ( <b>Individual</b> )	20%

### **8.1 Homework/assignments and Make-Up Work Policy (20%)**

There will be four (4) homework/assignments in this course, which will be posted at least one week before the due date. You will be required to submit your work through the Blackboard submission link. The instructor will create the submission link and notify you in due time. To prepare your assignment submission, you can compose your answer using a computer or handwrite your answer on paper. If you write your answer, you need to take clear photos and compile them in a word file or scan them into a pdf file. Remember that I will accept only pdf or word files for your submission (no image file will be acceptable).

Make-up work will be given only in the case of a documented emergency. Note that make-up work may be in a different format than the original work, may require more intensive preparation, and may be graded with penalty points. You will receive a zero if you miss an assignment and the reason is not considered excusable. It is, therefore, important to reach out to me—in advance if possible—and explain with proper documentation why you missed the due date. Once a deadline has been established for make-up work, no further extensions or exceptions will be granted.

### **8.2 Weekly Tests (20%)**

You will be required to complete ten (10) weekly tests. The test will be computerized and conducted via blackboard. All weekly tests are equally weighted. The test will be open at noon every Monday and due on the following Sunday at the end of the day. Thus, you will get a week to complete a test. You can complete the test at your convenience before the due date. There is no time restriction to complete the test. However, remember that you can retake the test three times, and the points from your last attempt will be considered for grading. The test will not be available once the due date is passed. Each test will have 10 to 20 short questions such as multiple-choice (MCQs), true/false, fill-in-the-blanks, word pooling, calculated numeric, etc. The test questions will be set based on the materials of the current week. For example, consider that in Week 7, we cover the linear regression technique, so the test of Week 9 will be based on regression techniques. You can take help from PPT slides and recorded videos to complete the test. Therefore, keeping pace with the learning module is important to maintain a good grade. You will receive a zero if you miss a test, and the reason is not considered excusable. There will be no make-up tests.

### **8.3 Mid-Term (20%) and Final (20%) Exams**

There will be two (2) major exams in this course. The mid-term exam will be conducted on March 20, 2023, and the final exam will be on May 08, 2023. Both exams will be computerized and conducted via blackboard from 7.00 PM to 10.00 PM (MST) on the specified date. Thus, you will get three hours to complete the exams. There will be 25 to 30 questions, including multiple-choice (MCQs), true/false, short answer questions, fill-in-the-blanks, word pooling, calculated numeric, etc. The exam will be in the open-book format, i.e., you will be allowed to use your hand notes, PPT slides, Homework, or any other materials. However, discussing/sharing answers with your peers is strictly prohibited. Any indication/proof of peer discussion and sharing answers will be considered a violation of academic integrity. If there are any changes, the exam date will be announced well ahead of time, so manage your schedule accordingly. There will be no make-up exams.

### **8.4 Course Project (20%)**

All students are required to complete a project in this course. Graduate students must do the project individually, whereas undergraduate students will complete this as a group.

Hence, if you are an undergraduate student, you will be required to form a group of 2 to 3 members. The purpose of the term project is to provide an opportunity to apply and further explore data analytics algorithms for a real-world problem. The case study of this course project is adapted from the 2021 QSR Data Challenge Competition organized by INFORMS titled “In-Situ Quality Process Monitoring in Additive Manufacturing.”

As you know, Additive Manufacturing (AM) technologies entail a layer-wise production paradigm that permits the collection of a large amount of information, both in-situ and in-line, during the manufacturing of parts. This information is in the form of, among others, sensor signals, images, and videos. Such information can be effectively used for the quick detection of anomalies and in-line qualification of complex, highly customized shapes. With this motivation, the QSR Data Challenge Competition provides the data collected from two photodiodes acquired during a Laser Powder Bed Fusion (L-PBF) process, in which anomalies were purposively introduced by designing overhanging areas within bulk specimens.

The objective of this project is to use the dataset from the QSR Data Challenge Competition and apply the various data analytics algorithms to identify the anomaly layers and extract useful information. However, remember that this is not a research project, so the data will be simplified to apply for the general purpose in class settings.

The project will have four (4) deliverables. Please refer to the tentative course schedule to see the due date of these deliverables.

- a. A self-recorded video of an introductory presentation using YuJa Video Assignments. It will be an introductory presentation on the project topic (The full-length paper will be provided). The presentation length should be 4-5 minutes (3 points)
- b. A self-recorded video on project progress. The purpose of this deliverable is to provide an update on your project progress. The students will be required to provide an update up to this time. (3 points)
- c. A final project report. The report writing guidelines and template will be provided. The project report will be due by the end of the semester. (10 points)
- d. A python programming file. The source code guideline and template will be provided. It will be due by the end of the semester. (4 points)

Each student needs to complete this project individually and submit all the deliverables through the Blackboard. The instructor will host two online synchronous sessions to advise on project work. The meeting time will be predetermined and announced at least one week before. As we progress through the semester, more detailed information and instructions will be provided.

## 9 Assessment of Final Grade

Your final grade will be determined based on the points you achieved in the above-mentioned five categories of submissions – 1) Assignments/homework, 2) Weekly tests, 3) Mid-term exam, 4) Final exam, and 5) Course project. The points of each category will be scaled to 20% and thus will get a total of 100 points from the five categories. In the end, your final grade will be as follows:

Grade A	Grade B	Grade C	Grade D	Grade F
90 or above	80 to 89	70 to 79	60 to 69	0 to 59

## 10 Blackboard Submission

Students must submit all the assignments and deliverables through the Blackboard. Submission through email will only be accepted if it is asked for or pre-approved. I strongly suggest you submit your work with plenty of time to spare if you have a technical issue with the course website, network, and computer. If you are experiencing difficulties submitting your work through the course website, please get in touch with the UTEP Help Desk. It is your responsibility to submit the assignments on Blackboard before the due date.

## 11 The Use of Python Programming Language in Course

Python is an interpreted, object-oriented, high-level programming language with dynamic semantics. Its high-level built-in data structures, combined with dynamic typing and dynamic binding, make it very attractive for Rapid Application Development, as well as for use as a scripting or glue language to connect existing components. Python is a simple, easy-to-learn syntax that emphasizes readability and reduces the cost of program maintenance. Python supports modules and packages, which encourages program modularity and code reuse. The Python interpreter and the extensive standard library are available in source or binary form without charge for all major platforms and can be freely distributed. <https://www.python.org/>. The python installation guideline will be provided during the class.

## 12 Office Hours

The office hours are scheduled on each Monday and Wednesday from 12.00 PM and 1.00 PM. The instructor will host office hours both online and in person. The online meeting sessions will be hosted via Zoom video conferencing, and the links will be provided on Blackboard. If you prefer to meet me in person, you are welcome. My office number is A-243, located on the 2<sup>nd</sup> floor of the Engineering Building. You can take the stairs beside the dean's suite and turn left to find my office.

## 13 Contact Your Course Instructor

UTEP e-mail is the best way to contact me. I will make every attempt to respond to your e-mail within 24-48 hours of receipt. When emailing me, email from your UTEP student account, and please put the course number in the subject line. In the body of your e-mail, clearly state your question. At the end of your e-mail, be sure to put your first and last name and your university identification number. I am not active via MS Team. So, asking questions through MS Team will not guarantee my reply.

## 14 Netiquette

As we know, sometimes communication online can be challenging. It's possible to miscommunicate what we mean or to misunderstand what our classmates mean given the lack of body language and immediate feedback. Therefore, please keep this netiquette (network etiquette) guidelines in mind. Failure to observe them may result in disciplinary action.

- Always consider the audience. This is a college-level course; therefore, all communication should reflect polite consideration of others' ideas.
- Respect and courtesy must always be provided to classmates and the instructor. No harassment or inappropriate postings will be tolerated.
- When reacting to someone else's message, address the ideas, not the person. Post only what anyone would comfortably state in a face-to-face situation.

- Blackboard is not a public internet venue; all postings should be private and confidential. Whatever is posted in these online spaces is intended for classmates and professors only.

## **15 Accommodations Policy**

The University is committed to providing reasonable accommodations and auxiliary services to students, staff, faculty, job applicants, applicants for admissions, and other beneficiaries of University programs, services, and activities with documented disabilities to provide them with equal opportunities to participate in programs, services, and activities in compliance with sections 503 and 504 of the Rehabilitation Act of 1973, as amended, and the Americans with Disabilities Act (ADA) of 1990 and the Americans with Disabilities Act Amendments Act (ADAAA) of 2008. Reasonable accommodation will be made unless it is determined that doing so would cause undue hardship for the University. Students requesting accommodation based on a disability must register with the UTEP Center for Accommodations and Support Services (CASS). Contact the Center for Accommodations and Support Services at 915-747-5148, or email them at [cass@utep.edu](mailto:cass@utep.edu), or apply for accommodations online via the CASS portal.

## **16 Scholastic Integrity**

Academic dishonesty is prohibited and is considered a violation of the UTEP Handbook of Operating Procedures. It includes, but is not limited to, cheating, plagiarism, and collusion. Cheating may involve copying from or providing information to another student, possessing unauthorized materials during a test, or falsifying research data on laboratory reports. Plagiarism occurs when someone intentionally or knowingly represents the words or ideas of another as one's own. Collusion involves collaborating with another person to commit any academically dishonest act. Any act of academic dishonesty attempted by a UTEP student is unacceptable and will not be tolerated. All suspected violations of academic integrity at The University of Texas at El Paso must be reported to the Office of Student Conduct and Conflict Resolution (OSCCR) for possible disciplinary action. To learn more, please visit HOOP: Student Conduct and Discipline.

## **17 Plagiarism Detecting Software**

Some of your coursework and assessments may be submitted to SafeAssign, a plagiarism-detecting software. SafeAssign is used to review assignment submissions for originality and will help you learn how to properly attribute sources rather than paraphrase.

## **18 Copyright Statement for Course Materials**

All materials used in this course are protected by copyright law. The course materials are only for the use of students currently enrolled in this course and only for the purpose of this course. They may not be further disseminated.

## **19 Class Recordings**

The use of recordings will give you access to class lectures and group discussions in the event you miss a synchronous or in-person meeting due to illness or other extenuating circumstances. Our use of such technology is governed by the Federal Educational Rights and Privacy Act (FERPA) and UTEP's acceptable-use policy. A recording of class sessions will be kept and stored by UTEP in accordance with FERPA and UTEP policies. I will not share the recordings of our class activities outside of course participants. You may not share recordings outside of this course. Doing so may result in disciplinary action.

**Tentative Course Schedule (It may change based on feedback or progress) \***

Module	Week	Date	Topics	Tasks/Activities	Submission Due date**	Submission items
1	1	01/17	Course syllabus and Introduction to Data Analytics	<ul style="list-style-type: none"> <li>▪ Review the PPT slides</li> <li>▪ Review the recorded video</li> <li>▪ Complete Test-01</li> </ul>		
2	2	01/23	Getting to know your data	<ul style="list-style-type: none"> <li>▪ Review the PPT slides</li> <li>▪ Review the recorded video</li> <li>▪ Complete Test-02</li> <li>▪ Form project group (<i>Undergraduate student only</i>)</li> </ul>	01/22	Test-01
3	3	01/30	Similarity and dissimilarity measures	<ul style="list-style-type: none"> <li>▪ Review the PPT slides</li> <li>▪ Review the recorded video</li> <li>▪ Complete Test-03</li> <li>▪ Assignment-01 will be posted</li> </ul>	01/29	Test-02 Submit project group ( <i>Undergraduate students only</i> )
4	4	02/06	Data preprocessing	<ul style="list-style-type: none"> <li>▪ Review the PPT slides</li> <li>▪ Review the recorded video</li> <li>▪ Complete Test-04</li> <li>▪ Assignment-02 will be posted</li> </ul>	02/05	Test-03
5	5	02/13	Anaconda (Python) installation and basic Python programming	<ul style="list-style-type: none"> <li>▪ Install anaconda (Python)</li> <li>▪ Complete the basic python course (link will be given) and upload the certificate of completion</li> <li>▪ Prepare an introductory presentation video on the project paper.</li> </ul>	02/12	Test-04 and Assignment-01
6	6	02/20	Data preprocessing using the Pandas library	<ul style="list-style-type: none"> <li>▪ Run the program file and understand the code</li> <li>▪ Review the recorded video</li> <li>▪ Complete Test-05</li> </ul>	02/19	Completion certificate Upload project paper presentation video
7	7	02/27	Linear regression	<ul style="list-style-type: none"> <li>▪ Review the PPT slides</li> <li>▪ Review the recorded video</li> <li>▪ Complete Test-06</li> </ul>	02/26	Test-05



8	8	03/06	Logistic regression	<ul style="list-style-type: none"> <li>▪ Review the PPT slides</li> <li>▪ Review the recorded video</li> <li>▪ Complete Test-07</li> <li>▪ Assignment-03 will be posted</li> </ul>	03/05	Test-06 and Assignment-02
	9	03/13	Spring break (No class)		03/12	Test-07
	10	03/20	Mid-Term Exam. Exam will be through Blackboard from 7.00 PM to 10.00 PM (MST).			
9	11	03/27	Linear and Logistic regression using Python	<ul style="list-style-type: none"> <li>▪ Run the program files and understand the code</li> <li>▪ Review the recorded video</li> <li>▪ Prepare the project progress video</li> </ul>	03/26	
10	12	04/03	Decision Tree	<ul style="list-style-type: none"> <li>▪ Review the PPT slides</li> <li>▪ Review the recorded video</li> <li>▪ Complete Test-08</li> </ul>	04/02	Reporting of project progress (video)
11	13	04/10	Project advising and coding help	<ul style="list-style-type: none"> <li>▪ Join the online synchronous session to discuss project questions/concerns and to get coding help</li> </ul>	04/09	Test-08
12	14	04/17	Clustering techniques - I	<ul style="list-style-type: none"> <li>▪ Review the PPT slides</li> <li>▪ Review the recorded video</li> <li>▪ Complete Test-09</li> <li>▪ Assignment-04 will be posted</li> </ul>	04/16	Assignment-03
	15	04/24	Clustering techniques - II	<ul style="list-style-type: none"> <li>▪ Review the PPT slides</li> <li>▪ Review the recorded video</li> <li>▪ Complete Test-10</li> </ul>	04/23	Test-09
	16	05/01	Project advising and coding help	<ul style="list-style-type: none"> <li>▪ Exam review.</li> <li>▪ Join the online synchronous session to discuss project questions/concerns and to get coding help</li> </ul>	04/30	Test-10 and Assignment-04
	17	05/08	Final Exam. Exam will be through Blackboard from 7.00 PM to 10.00 PM (MST).			
	18	05/12	Students will be required to submit the final project report along with the source code.			

\* The instructor reserves the right to change/modify the course schedule based on the needs.

\*\* All submissions (except the mid-term and final exams) will be due by the end of the day, i.e., 11.59 PM (MST).