SYLLABUS

IE 4683/6683: Machine Learning with Industrial Engineering Applications

INSTRUCTOR:	Haifeng Wang, Ph.D.
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Tel.:	662-325-3923
CLASS TIME:	TR: 08:00am - 09:15am
OFFICE HOURS:	TR: 2pm-3pm; or by appointment
CLASSROOM:	MCCAIN 125
WEBSITE:	canvas.msstate.edu

CATALOG DESCRIPTION

(Prerequisite: IE 4613/6613: Engineering Statistics I or equivalent; an approved computer programing elective course). Three hours lecture. An introduction to machine learning model design and development for use in industrial engineering applications. This course covers minimal theory and focuses mainly on the coding aspects using Python. The topics will include the foundation of Python computational tools, regression, classification, and unsupervised learning.

COURSE OBJECTIVES

- To learn and practice the fundamentals of machine learning for the purpose of industrial engineering applications development.
- To be able to design and program machine learning models in Python to support engineering analyses.
- To be able to solve simple machine learning problems on real problem datasets.
- Learn Python as a computational tool.

COMMUNICATION

Website: canvas.msstate.edu. Course announcements and communication will be sent via CANVAS email. Students are responsible for checking their email frequently.

TEXTBOOKS

1) Müller, Andreas C., and Sarah Guido. *Introduction to machine learning with Python: a guide for data scientists.* O'Reilly Media, Inc., 2016. (required)
2) VanderPlas, Jake. *Python data science handbook: Essential tools for working with data*. O'Reilly Media, Inc., 2016. (optional)
3) Géron, Aurélien. *Hands-on machine learning with Scikit-Learn, Keras, and TensorFlow: Concepts, tools, and techniques to build intelligent systems*. O'Reilly Media, 2019. (optional)

Operating system SOFTWARE

- Window 10/11 Or macOS
- Python 3. All examples provided will be coded in Python.
- Anaconda (https://www.anaconda.com/distribution/, free) or PyCharm (https://www.jetbrains.com/pycharm/, free)

GRADE DETERMINATION

- Assignments 30%
- Midterm Exam 30% (tentatively March 3rd Thursday)
- Final Project 35%
- Participation 5%

Final letter grades will be determined: A = 90% through 100%; B = 80% through 89%; C = 70% through 79%; D = 60% through 69%; F = Less than 60%. Disputations of assignment or exam grades should be discussed with the professor within one week from the date the grade is submitted. As a note: A request for grade review will result in a complete regrade of the assignment or exam, not only those items in the request.

Exam (30%): There will be one take-home exam midterm (30%). No make-up exams will be given without a university documented excuse.

Project (35%): There will be one final project (35%), the final project includes a presentation and a project report. The final project will be on an agreed topic. More details will be provided in the lecture.

Undergraduate: The final project team should include two to three members.
Graduate: The final project will be an individual effort.

Assignments (30%): There will be five assignments. The assignments will contain written questions and questions that require some Python programming. The assignment is due at 12pm of the due date (more details will be noticed in each assignment). A 15% penalty will be assessed for assignments submitted by 5pm on the day the assignment is due. No credit will be given for an assignment that is turned in after 5pm on the day that it is due (unless it is the result of an officially excused absence). Assignments should be submitted online. Emailing assignments is unacceptable unless prior arrangement is made with the instructor.

Participation (5%): Class attendance (on-campus students) and CANVAS discussions (both distance and on-campus students) will be considered for the participation. Please refer to AOP 12.09 regarding attendance expectations and accommodations. For on-campus students, excessive unexcused absences will result in a deduction to their participation grade as follows:

- 0-3 unexcused absences: 0% deduction
- 4-6 unexcused absences: 20% deduction
- 7-9 unexcused absences: 50% deduction
- 10+ unexcused absences: 100% deduction

Excused Absences Policy: There will be an allowance for excused absences in participation, late assignments, and make-up work in accordance with MSU AOP 12.09.

Working Together: It is ok to ***discuss*** assignments with other students. However, when it comes time for you to write up the solutions/codes, I expect you to do this on your own. Working together or using other outside sources on exams is expressly forbidden.

EXPECTED TOPICS COVERED

Topics Covered	Class
Module 1: Introduction to Machine Learning	
➢ Why Machine Learning?	2
➢ Basic Python libraries	2
➢ Python libraries for data analytics	1
➢ Data cleaning and preparation	3
Module 2: Supervised Learning	
➢ Basic regression algorithms	3
➢ Basic classification algorithms	3
➢ Confusion matrices	1
Module 3: Unsupervised Learning	
➢ Unsupervised transformations	2
➢ Clustering algorithms in pattern recognition	2
➢ Feature engineering	2
Module 4: Industrial Engineering Applications	
➢ Model evaluation	1
➢ Hyperparameter tuning	2
➢ Process abnormal detection through residuals	3
➢ **Project presentation**	2
➢ **Exams**	1

INFORMATION FOR DISTANCE STUDENTS

Exam Proctoring:

Proctoring requirements. Distance students are required to take all the exams via a proctor.

Instructions for registering your proctor. At least one week in advance of each exam, the student must have up-to-date proctor information. Students can submit information about their proctor by accessing the proctor form (http://distance.msstate.edu/proctoring) and following the directions therein. If only one proctor is used for the entire semester, then only one proctor form must be submitted. However, a new proctor form must be submitted for each change in proctor at least one week in advance of the exam. In choosing your proctor, you should find someone who is not related to you and is trustworthy. Examples include your supervisor or someone in Human Resources. If you have a question about whether someone would be an acceptable proctor, please email the instructor.

Procedure for using a proctor. Prior to the exam, the instructor will email a copy of the exam to your proctor. You will then take the exam under their supervision. After you complete the exam, your proctor will scan your work and email it to me. Please be responsible for ensuring that your proctor submits your work to me on time.

When to take exams. Distance students are typically expected to take exams before the end of three days after the exam has given in class. For example, if an exam is given on a Thursday, I would give distance students until Sunday at 11:59 pm to take the exam. If for some reason, the student cannot take the exam on time, the student need to email the instructor before the in-class exam with an eligible excuse.

Office Hours:

The instructor will hold weekly office hours through Webex during the weekend. A doodle link will be sent out during the first week of class to get a time frame that works for most of the distance students. In addition, the students can also email the instructors to schedule a conference call if needed.

Learning Progress:

Distance students are expected to keep up-to-date with watching video lectures. A link to the video lectures will be provided on the course website.

ADDITIONAL INFORMATION

Attendance policy for face-to-face instruction: This section is a face-to-face instructional class. Please refer to Academic Operating Policy 12.09, regarding attendance expectations and accommodations.

Continuity of Instruction: In the event that face-to-face classes are suspended due to extenuating circumstances, such as weather, the instructor will continue instruction in a manner that best supports the course content and student engagement. In this event, all instructors will notify students of the change via their university email address (the official vehicle for communication with students). At that time, they will provide details about how instruction and communication will continue, how academic integrity will be ensured, and what students may expect during the time that face-to-face classes are suspended. If a student becomes unable to continue class participation due to extenuating circumstances, (e.g., health and safety, loss of power, etc.) the student should contact their instructor and advisor for guidance. For additional guidance, please refer to Academic Operating Policy 12.09.

Disability Resource Center: Mississippi State University is committed to providing equitable access to learning opportunities for all students. The Disability Resource Center (01 Montgomery Hall) collaborates with students who have disabilities to arrange reasonable accommodations. If you have, or think you may have, a disability, please contact drc@saffairs.msstate.edu or 662-325-3335 to arrange a confidential discussion regarding equitable access and reasonable accommodations. Disabilities may include, but are not limited to, conditions related to mental health, chronic health, attention, learning, autism, brain injury, vision, hearing, mobility, speech, or intellectual disabilities. In the case of short-term disabilities (e.g., broken arm), students and instructors can often work to minimize barriers. If additional assistance is needed, please contact the Disability Resource Center.

Student Honor Code: Mississippi State has an approved Honor Code that applies to all students. The code is as follows: "As a Mississippi State University student, I will conduct myself with honor and integrity at all times. I will not lie, cheat, or steal, nor will I accept the actions of those who do." Upon accepting admission to Mississippi State University, a student immediately assumes a commitment to uphold the Honor Code, to accept responsibility for learning, and to follow the philosophy and rules of the Honor Code. Student will be required to state their commitment on examinations, research papers, and other academic work. Ignorance of the rules does not exclude any member of the MSU community from the requirements or the processes of the Honor Code. For additional information, please visit the Honor Code Policy.

Title IX: MSU is committed to complying with Title IX, a federal law that prohibits discrimination, including violence and harassment, based on sex. This means that MSU's educational programs and activities must be free from sex discrimination, sexual harassment, and other forms of sexual misconduct. If you or someone you know has experienced sex discrimination, sexual violence and/or

harassment by any member of the University community, you are encouraged to report the conduct to MSU's Director of Title IX/EEO Programs at 325-8124 or by e-mail to titleix@msstate.edu. Additional resources are available at Dean of Students Sexual Misconduct and Sexual Assault.

University Safety Statement: Mississippi State University values the safety of all campus community members. Students are encouraged to register for Maroon Alert texts and to download the Everbridge App. Visit the Personal Information section in Banner on your MyState portal to register. To report suspicious activity or to request a courtesy escort via Safe Walk, call University Police at 662-325-2121, or in case emergency, call 911. For more information regarding safety and to view available training including helpful videos, visit ready.msstate.edu