

## **CIS335      MACHINE LEARNING AND ARTIFICIAL INTELLIGENCE**

Credits: 3

Instructor: Zheng Qu

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Office hours: Thursday 2pm-3pm

Location: FTCM D405

**Class Meet: 10:00-11:15am Tue./Thu. @ D421**

### **Catalog Description**

This is a required course for the Data Science majors. It introduces the theoretical basis as well as applications of the state-of-the-art machine learning algorithms. Students will get familiar with Python machine learning tools and use them for projects. **Prerequisite:** CIS102&STA221

### **Course Description**

Application of machine learning has helped numerous companies to maximize efficiencies, profits, and to create new products.

This course provides introduction to concepts and theoretical basis of key machine learning algorithms, as well as hands-on experience on machine learning pipelines and working with real-world problems. Some of the machine learning algorithms covered in the course include k-means, support vector machines, naïve Bayes, decision trees, random forests, gradient boosting, ensemble methods, hierarchical clustering, and latent Dirichlet allocation, etc. An introduction to the deep learning algorithms with appropriate use case scenarios will also be covered in the second half of the course. In addition, the course also covers topics on practical machine learning techniques such as model validation and performance evaluation, data augmentation, hyper-parameter tuning, and feature engineering, etc.

Students will get familiar with Python machine learning tools and use them for projects.

### **Course Learning Objectives (CLOs)**

This course will enable students to:

1. Have an understanding of how machine learning algorithms work (supporting PLO1);
2. Demonstrate capability to apply and debug machine learning algorithm with application to real-world data (supporting PLO2);
3. Get familiar with Python machine learning tools, such as scikit-learn, PyTorch, Orange (supporting PLO2).

### **Prerequisites & Co-requisites**

CIS105 Data Structures and Algorithms

STA211 Statistical Theory and Methods

## **Method & Format**

Lecturing through PowerPoint presentation as well as Python Jupyter notebooks will be used for most of the classes. Videos, guest speakers, group and individual projects will also be offered.

## **Course Resources**

- Required Textbook: *An Introduction to Machine Learning* 2nd ed. by Miroslav Kubat, Springer 2017.
- Required Textbook: *Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow* by Aurélien Géron, O'Reilly Media, 2019
- Additional Reading: *Data Science from Scratch: First Principles with Python 2nd Edition*, by Joel Grus, O'Reilly Media, 2019
- Access to Canvas: You must have access to Canvas, where all class material and weekly announcements will be posted.

## **Evaluation and Grading**

Component	Percentage
Quiz	15%
Assignments	30%
Midterm (paper test + project)	25%
Final (paper test + project)	30%

### Grading Scale:

A	A-	B+	B	B-	C+	C	C-	D+	D	D-	F
93-100	90-92	87-89	83-86	80-82	77-79	73-76	70-72	67-69	63-66	60-62	0-59

## **Course Policies**

### Attendance

Regular attendance is essential to the successful completion of this course. If you have to be late, leave early, or miss a class for legitimate reasons, you are expected to inform the instructor beforehand. It is also your responsibility to proactively communicate with the instructor for any make up work.

You will be excused for an absence if you provide official documentation no later than three days upon returning to class. One undocumented absence is permitted to cover various personal needs. Every absence beyond one undocumented instance will lower your participation grade by a full letter grade (e.g. from A to B). It is your responsibility to catch up with the materials covered in the class that you've missed.

### Participation

You are expected to come to each class prepared and focused both mentally and physically. Please read the assigned readings before coming to class. Active participation in class is required, and is beneficial for your individual learning, as well as those of your peers.

### Tardiness

You are expected to be ready to start class on time and remain for the entire class. Every 3 times of being tardy for under 10 minutes will be counted as 1 undocumented absence. Three tardiness of more than 10 minutes will result in your course final grade drop by one letter grade.

### Respectful Behavior

Please be respectful and courteous to your instructor and fellow classmates during all your interactions, whether in person, or via written or electronic communication. Be accepting of different backgrounds, opinions and viewpoints, and participate in discussions and scholarly debate in a tolerant and understanding manner. Disruptive behavior in class will result in a student being asked to leave the classroom. If disruptive behavior continues, violation of Student Code of Conduct of Fei Tian College will be reported.

### Technology / Electronic Devices

Mobile device ringers (e.g., smart phones, smart watch) must be turned off or placed on vibrate prior to class.

Laptops and tablets can only be used in the classroom to take notes, make calculations, and download/read course materials.

### Makeup Exams

In general, there will be no makeup examination; missing an exam will result in a mark of zero for that exam. Missing the final exam will result in a grade F for the course.

In rare circumstances, where the reason for missing an exam is outside of the student's control, a makeup exam may be granted. These situations include medical and family emergencies, mandatory participation in institutional events, jury duty, military service, religious observances, and events of similar nature. You are responsible for proactively communicating clearly with your instructor as early as possible if you foresee that you must miss an exam, and to make arrangements for a makeup exam.

### Academic Policies

*FTCM's Academic Policies and Standard* specifies additional policies that apply to this course (unless overridden explicitly above). These include:

- Academic Dishonesty
- Academic Load
- Maintain good academic standing
- Policy on incomplete grade
- Administrative withdraw

### Academic Dishonesty

This class adopts a zero-tolerance policy towards cheating and plagiarism. Definition of these behaviors and the consequences can be found in the *FTCM's Academic Policies and Standard* and *Student Code of Conduct of Fei Tian College*. It is your responsibility to be familiar with and understand these policies and how they apply to your studies in this course. For more information, please contact the Office of Academic Affairs, [OAA@mt.feitian.edu](mailto:OAA@mt.feitian.edu).

### Disability Support Services

Please contact the Office of Student Affairs, [OSA@mt.feitian.edu](mailto:OSA@mt.feitian.edu), for accommodation of qualified disabilities. Instructors must be informed of a student's eligible for disability accommodation.

***Student Learning Support Services***

Please contact the Office of Student Affairs, [OSA@mt.feitian.edu](mailto:OSA@mt.feitian.edu), for tutoring, counseling, career advising, and writing center support as needed.

**Course Outline\***

Unit	Content Overview
1	<ul style="list-style-type: none"> <li>• What is machine learning?</li> <li>• Types of Learning</li> <li>• Testing and Validation;</li> <li>• Main challenges in machine learning</li> </ul>
2	<ul style="list-style-type: none"> <li>• Classification and Model Performance Measures</li> <li>• Binary classification</li> <li>• Multilabel classification</li> </ul>
3	<ul style="list-style-type: none"> <li>• Training Models</li> <li>• Gradient Descent</li> <li>• Overfitting</li> <li>• Learning Curves</li> </ul>
4	<ul style="list-style-type: none"> <li>• Linear Regression and Regularized Linear Models               <ul style="list-style-type: none"> <li>• Project 1 introduced</li> </ul> </li> </ul>
5	<ul style="list-style-type: none"> <li>• Logistic Regression</li> </ul>
6	<ul style="list-style-type: none"> <li>• Decision Trees</li> </ul>
7	<ul style="list-style-type: none"> <li>• Ensemble Learning; Random Forest, Gradient Boosting</li> </ul>
8	<ul style="list-style-type: none"> <li>• Naïve Bayes               <ul style="list-style-type: none"> <li>• Midterm and Project 1 Review</li> <li>• Project 2 starts</li> </ul> </li> </ul>
9	<ul style="list-style-type: none"> <li>• SVM</li> <li>• Review: K-nearest Neighbors and K-means; Hierarchical Clustering</li> </ul>
10	<ul style="list-style-type: none"> <li>• Introduction to Neural Networks</li> </ul>
11	<ul style="list-style-type: none"> <li>- Deep Neural Networks: CNNs</li> <li>- Project 2 due; Final project starts</li> </ul>
12	<ul style="list-style-type: none"> <li>• Deep Neural Networks: RNNs</li> </ul>
13	<ul style="list-style-type: none"> <li>• Autoencoders</li> </ul>
14	<ul style="list-style-type: none"> <li>• Network Analysis</li> </ul>

Unit	Content Overview
15	<ul style="list-style-type: none"><li>• Gaussian Mixture Models and Latent Dirichlet Allocation</li></ul>
16	<ul style="list-style-type: none"><li>• Class Review and Final Exam</li><li>- Final project due</li></ul>

\* Instructor reserves the right to amend it within reason and will make every effort to inform the students of the changes in a timely manner.