Course Instructor **Mohammad A. Khan (AzK)**

Course Number and Title: **CSE445** (Machine Learning)

Credits: 3 Credits

Type: Optional

Prerequisites:

Contact Hours: Lecture – 3 Hours/Week

**Course Description:**

This course is introduces basic Machine Learning techniques. In this course, we focus on major machine learning algorithms families. The goal is to make the students capable of using appropriate machine learning algorithms for their problems at hand. After finishing this course, students are expected to grow statistical and mathematical insights to pick the most appropriate ML solution to a problem, compare alternative methods, and select the best one based on statistical and probabilistic analysis.

**Course Outcomes (COs):**

Upon successful completion of this course, students will be able to,

CO1: Gain insights into the ML algorithms – (Mid/Final/Quiz)

CO2: Pick the best solution to a problem using statistical analysis - (Quiz/Mid)

CO3: Be able to implement an ML project (Project)

**Tentative week plan (may change later):**

Power point presentation will be distributed for each topic

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| Week | Lecture ID | Topics |
| 1 | Lecture 1 | Machine learning overview |
| 2 | Lecture 2 | Python Programming |
| 3 | Lecture 3 | The Nearest Neighbor algorithm & Intro to Model selection |
| 4 | Lecture 4 | Probability & Generative Models |
| 5 | Lecture 5  Exam | Basic Linear Algebra Review / Quiz 1 |
| 6 | Lecture 6 | Gaussian Generative Models & Bayesian ML |
| 7 | Exam | Project idea |
| 8 | Exam | Project idea |
| 9 | Lecture 7 | Linear Regression |
| 10 | Lecture 8  Exam | Logistic Regression / Quiz 2 |
| 11 | Lecture 9 | Perceptron Algorithm & Duality |
| 12 | Lecture 10 | SVM |
| 13 | Exam | Midterm |
| 14 | Lecture 11 | Model Selection – I |
| 15 | Lecture 12 | Model Selection – II |
| 16 | Exam | Project Mid (presentation) |
| 17 | Lecture 13  Exam | Clustering Algorithms/ Quiz 3 |
| 18 | Lecture 14 | Decision tree classification |
| 19 | Lecture 15 | Decision tree regression |
| 20 | Lecture 16 | Random Forest |
| 21 | Lecture 17 | Boosting Algorithms |
| 22 | Lecture 18 | Dimensionality Reduction, PCA, tSNE |
| 23 | Exam | Project final (presentation) |
| 24 | Exam | Project final (presentation) |

**Book list:**

Fundamentals of Machine Learning for Predictive Data Analytics, second edition: Algorithms, Worked Examples, and Case Studies (2nd Edition) by**John D. Kelleher**

**Optional:**

Machine Learning: A Probabilistic by **Kevin P. Murphy**

Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems (2nd Edition) by **Aurélien Géron**

**Grading point’s distribution:**

1. Attendance - 5%
2. Class test – 15%
   1. Best 2 out of 3
3. Project - 20% (Individual)
   1. Problem formulation - 5%
   2. Presentation & Quality - 15%
4. Midterm - 30%
5. Final - 30%

**Syllabus:**

1. Quiz 1
   1. Nearest Neighbor Algorithm (Lecture 3)
   2. Probability & Generative Models (Lecture 4)
2. Quiz 2
   1. Basic Linear Algebra Review (Lecture 5)
   2. Gaussian Generative Models & Bayesian ML (Lecture 6)
3. Quiz 3
   1. Model Selection (Lecture 11, Lecture 12)
4. MidTerm
   1. Gaussian Generative Models & Bayesian ML (Lecture 6)
   2. Linear Regression (Lecture 7)
   3. Logistic Regression (Lecture 8)
   4. Perceptron Algorithm & Duality (Lecture 9)
   5. SVM (Lecture 10)
5. Final
   1. Clustering Algorithms (Lecture 13)
   2. Decision tree classification (Lecture 14)
   3. Decision tree classification (Lecture 15)
   4. Random Forest (Lecture 16)
   5. Boosting Algorithms (Lecture 17)
   6. Dimensionality Reduction, PCA, tSNE (Lecture 18)

**Project:**

1. One person per group (two at max).
2. Fill up the group and project form
   1. Check google classroom for the link.
3. Report format: <https://drive.google.com/drive/folders/1P0KVQMOrIzhLC7I90n44wH8xC1z_zBT8?usp=sharing>
4. Use of GIT is recommended.

**Grading points to letter grades:**

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| --- | --- | --- |
| **Numerical**  **Scores** | **Letter Grade** | **Grade Points**  **Per Credit** |
| 93+ | A | 4.0 |
| 90 - 92 | A- | 3.7 |
| 87 - 89 | B+ | 3.3 |
| 83-86 | B | 3.0 |
| 80 - 82 | B- | 2.7 |
| 77 - 79 | C+ | 2.3 |
| 73 - 76 | C | 2.0 |
| 70 - 72 | C- | 1.7 |
| 67 - 69 | D+ | 1.3 |
| 60 - 66 | D | 1.0 |
| 0 - 59 | F\* | 0.0 |
|  | I\*\* Incomplete | 0.0 |
|  | W\*\* Withdrawal | 0.0 |
|  | R\*\* Retaken | 0.0 |

**Policy:**

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| **Exams and Quizzes:** Exams and quizzes will be closed book and closed notes. No electronic devices except non-programmable calculators will be allowed during exams. Calculators cannot be shared with friends. **There will be no makeup quizzes or exams.** If you miss a quiz or exam, you will get zero for that. The final exam will be comprehensive. |
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| **Assignments:** There will be two home works/ Assignments throughout the semester. **No late submission will be accepted.** To be successful in the exam, you should solve homework problems independently, although you may discuss with your friends to understand a more comprehensive picture of the problems. |
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| **Class etiquette:** Distracting others in class is violating other's rights to be attentive. **So, laptops, tablets, cell phones or any other devices cannot be turned on during the class time.** You have to share any talk with the whole class. Attendance will be counted at the beginning of the class and if you are late then **no late attendance will be counted.** |
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| **Grade dispute:** If you dispute your grade on any homework, quiz or exam, you have one week time from the date that the graded paper was returned to you to request a change in the grade. After this time, no further change in grade will be considered. |
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| **General course administration:** The class presentations will be interactive lectures. The instructor will provide lecture slides after the lecture sessions. |
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| **Academic Honesty:** Any means of unauthorized assistance in preparing materials which a student submits as original work is deemed to be cheating and constitutes grounds for disciplinary action. Instructors are expected to use reasonably practical means of preventing and detecting cheating. Any student judged to have engaged in cheating might receive a reduced grade for the work in question, a failing grade in the course, or such other lesser penalty, as the instructor deems appropriate. Serious instances may be referred to the Disciplinary Committee in the Office of the Vice-Chancellor. |