# American University of Ras Al Khaimah

## AURAK Syllabus

### Course & Instructor Information

**Course Title:** Machine Learning

**Course Code:** CSAI 450

**Credit Hours:** 3.0

**Methods of Instruction** *(See Syllabus Guide for additional information that should be added here):*

NA

**Prerequisite course(s) and/or co-requisite courses, if applicable:**

Course Prerequisite: (Course : CSAI 350 AND Course : ENGR 200)
Course Corequisite: (Course : CSAI 451)

**Faculty Name:** Lobna Nassar AB Nassar

**Contact Information and Office Hours:**

Office Hours: Wed 4:20 PM -5:20 PM- Email: Lobna.nassar@aurak.ac.ae

**Course Description:**

This course introduces fundamental concepts of machine learning, and provides students with knowledge and understanding of the methods, mathematics, and algorithms used in machine learning. Topics include statistical learning concepts, linear & quadratic discriminant analysis, resampling methods, model selection and regularization, regression & smoothing splines, generalized additive models, regression trees, bagging and boosting, support vector machines, principal components analysis, k-means clustering, hierarchical clustering, and neural networks.

**Additional Information about the course:**

This course is NOT an online course. This course covers machine learning concepts.

**Course Textbooks and Materials:**

James, G., Witten, D., Hastie, T., Tibshirani, R., “An Introduction to Statistical Learning: With applications in R,” (Corrected printing 2017), New York: Springer. ISBN: 1461471370.

Raschka, Sebastian, and Vahid Mirjalili, “Python Machine Learning: Machine Learning and Deep Learning with Python, scikit-learn, and TensorFlow 2,” 3rd Ed, Packt Publishing, 2019. ISBN-10: 1789955750.

**Other Resources:**

Bishop, Christopher M., “Pattern Recognition and Machine Learning,” New York: Springer, 2006, ISBN: 0387310738.

**Web Resources:**

Additional material is uploaded to BlackBoard.

## Course Learning Outcomes (CLOs)

| **Course Learning Outcomes**<br>**At the end of this course, students should be able to:** | |
|---|---|
| CLO 1 | Apply mathematical concepts and algorithms used in machine learning. |
| CLO 2 | Analyze and apply resampling, model selection and regularization, and dimensionality reduction methods to solve problems. |
| CLO 3 | Use a wide variety of learning algorithms to develop AI based applications. |
| CLO 4 | Design, implement, and evaluate machine learning algorithms for real-world applications. |

## Program Learning Outcomes (PLOs) and Mapping Course to Program Outcomes

Please see the APPENDIX for the Course to Program Learning Outcomes Mapping.

## Assessment Activities

The dates for quizzes, exams, and submission of assignments are specified in the schedule. You will be graded in this class based on the number of points you earn for quizzes, exams written assignments, or other activities, including your class participation. Keep track of your scores in Blackboard.

| Assessment Activities and Grading Weight | Course Activities / Assignments 10% | Quizzes 15% | Mid-term Exam 25% | Project 25% | Final Exam 25% |
|---|---|---|---|---|---|
| **CLO 1** | X | X | X | | X |
| **CLO 2** | X | X | X | | X |
| **CLO 3** | X | X | X | X | X |
| **CLO 4** | X | | | X | |

## Grading Scale

The grading system and scale for AURAK, as established by the Board of Trustees, is as follows:

| AURAK Grading System and Scale | | |
|---|---|---|
| **Grade** | **Percentage Scores** | **Grade Points** |
| A | 95-100 | 4.00 |
| A- | 90-94 | 3.70 |
| B+ | 86-89 | 3.30 |
| B | 83-85 | 3.00 |
| B- | 80-82 | 2.70 |
| C+ | 76-79 | 2.30 |
| C | 73-75 | 2.00 |

| | | |
|---|---|---|
| C- | 70-72 | 1.70 |
| D+ | 66-69 | 1.30 |
| D | 60-65 | 1.00 |
| F | 0-59 | 0.00 |

**An “S” grade reflects satisfactory, or passing, work in a course (i.e., equivalent to grade of C or higher for graduate students. A “U” grade reflects unsatisfactory, or failing, work in a course. S/U will have no effect on the GPA.**

## Weekly Course Information

| Schedule of Course Topics, Required Reading, and Assignments and Assessments | | | | |
|---|---|---|---|---|
| **Week** | **Topic** | **Required Readings** | **Assignment, Assessment (with grade weighting) & Due Date** | **Mapping of CLOs to Assessments** |
| 1 | Introduction | Chapter 1 | | |
| 2 | Statistical Learning | Chapter 2 | | |
| 3 | Linear Discriminant Analysis | Chapter 4 | | |
| 4 | Quadratic Discriminant Analysis | Chapter 4 | Quiz #1<br>**10%** | CLO 1, 2 |
| 5 | Resampling Methods: Cross-validation and<br>Bootstrap | Chapter 5 | | |
| 6 | Model Selection and Regularization: Subset Selection and Shrinkage Methods | Chapter 6 | Assignment<br>**10%**<br>**Due W 9** | CLO 1, 2 3,4 |
| 7 | Model Selection and Regularization:<br>Dimension Reduction Methods | Chapter 6 | | |
| 8 | Regression & Smoothing Splines, and Generalized Additive Models | Chapter 7 | Midterm Exam<br>**25%** | CLO 1, 2, 3 |

| | | | | |
|---|---|---|---|---|
| 9 | Regression Trees | Chapter 8 | | |
| 10 | Bagging and Boosting | Chapter 8 | Project<br>**25%**<br>Due W14 | CLO 3, 4 |
| 11 | Support Vector Machines | Chapter 9 | | |
| 12 | Principal Components Analysis | Chapter 10 | Quiz #2<br>**5%** | CLO 1, 2, 3 |
| 13 | k-means Clustering<br>Hierarchical Clustering | Chapter 10 | | |
| 14 | Neural Networks | | | |
| 15 | Revision and Presentations | | | |
| 16 | Final Exam | - | Final Exam<br>**25%** | CLO 1, 2, 3 |

## Attendance Policy

**Regular student attendance and class participation are essential for students to meet course expectations and to succeed in their studies. The following are benefits associated with attending classes:**

- Opportunity to participate in active learning
- Opportunity to demonstrate preparation for class

- Opportunity to engage with the faculty member teaching the course, classmates, and the course material.

**The following are requirements of the university's attendance policy:**

- Students must provide a satisfactory reason for being absent from class, to the course instructor and the Student Life Departent, in advance of missing a class.

- Students must observe protocols for online course attendance (e.g., having camera turned on).
- Students must arrive on time for class and must not depart early from the class. Persistent late arrival at, or early departure from, class meetings may result in being counted as absent from class.

**If students fail to attend 20% of the scheduled classes for the semester *without a valid excuse*, they will be withdrawn from the course with a grade of either W or F depending on when the 20% unexcused absence level is reached.**

**The total number of *unexcused and excused absences* cannot exceed 30% of the class meetings for the course, with unexcused absences not exceeding 20%. Students who miss more than 30% of the scheduled classes will be withdrawn from the course with a grade of either W or F depending on when the 30% absence level is reached.**

**Please refer to the Student Handbook for details.**

## Accommodations for Students of Determination

Students of determination may find they require additional support, services, or considerations. AURAK will endeavor to support students of determination of those with special needs where resources are available. Accommodations will be provided, for students with verified needs, allowing equal access to educational facilities, programs, services, and activities at AURAK. Accommodations are never applied retroactively – only students who have previously requested and have been approved for supporting accommodations can have them apply to a given academic semester/course. Students needing support must make the request from the Office of Support Services located in Building D.

## Other Relevant Policies

**A. Academic Integrity**

The Honor Code

The American University of Ras Al Khaimah strongly supports the concept of academic integrity and expects students and all other members of the AURAK community to be honest in all academic endeavors. The AURAK Honor Code can be found in the AURAK Student Handbook.

The role of the Honor Code and associated Academic Integrity Policy is to protect the academic integrity of the university, encourage consistent ethical behavior among students, and foster a climate of honorable academic achievement. The Honor Code is an integral part of university life and students are responsible, therefore, for understanding and abiding by the code's provisions. While a student's commitment to honesty and personal integrity is assumed and expected, this Code and associated policy and procedures provides clarity of expectations.

Expectations

Cheating, plagiarism, and all other forms of academic fraud are unacceptable; they are serious violations of university policy. AURAK expects all students to be familiar with university policies on academic integrity. The university will not accept a claim of ignorance – either of the policy itself or of what constitutes academic fraud – as a valid defense against such a charge.

Violations of Academic Integrity

Violations of academic integrity constitute academic fraud. Academic fraud consists of any actions that serves to undermine the integrity of the academic process or that gives the student an unfair advantage, including:

- Inspecting, duplicating or distributing test materials without authorization.
- Cheating, attempting to cheat, or assisting others to cheat – relevant here is the prohibition on being in possession of a mobile telephone or similar electronic device during a test or examination. In case such devices are found with a student, the student will be deemed to have attempted to cheat and will be subject to disciplinary action under the Student Academic Integrity Policy.
- Altering work after it has been submitted for a grade.
- Plagiarizing.

- Using or attempting to use anything that constitutes unauthorized assistance. ***PLEASE NOTE***: Faculty members may prohibit the use of generative AI, including though not limited to, generative AI such as Open AI ChatGPT and Canva, in completing assignments. When such prohibitions have been communicated by the faculty member, incorporating information from such sources into your assignment submission will be treated as a serious violation of academic integrity expectations.

- Fabricating, falsifying, distorting, or inventing any information, documentation, or citation.

Plagiarism

One of the most common violations of academic integrity is plagiarism. Plagiarism can be intentional or unintentional. However, since each student is responsible for knowing what constitutes plagiarism, unintentional plagiarism is as unacceptable as intentional plagiarism and thus will bring the same penalties.

Plagiarism – submitting the work of others as one's own - is a serious offense. This includes submitting work obtained from AI writers such as Open AI Chat GPT, as well as other forms of generative AI. In the academic world, plagiarism is theft. Information from sources – whether quoted, paraphrased, or summarized – must be given credit through specific citations. When a student paraphrases a work, it is still necessary to cite the original source, even when the information has been provided by generative AI writers and/or sources. Merely rearranging a sentence or changing a few words is not sufficient. The citation style should be appropriate for the discipline and should clearly indicate the beginning and ending of the referenced material. All sources used in the preparation of an academic paper must also be listed with full bibliographic details at the end of the paper, as appropriate in the discipline. ***PLEASE NOTE:*** Faculty members may prohibit the use of generative AI in completing assignments. When such prohibitions have been communicated by the faculty member, incorporating information from such sources into your assignment submission will be treated as a serious violation of academic integrity expectations.

While plagiarism detection software can assist identifying plagiarism, there is no "percentage of matching content" threshold for determining that content in a written assignment has been plagiarized. Indeed, the presentation of a single striking phrase originally written by another without attribution to the original source can constitute plagiarism, even though the percentage of matching content found by plagiarism-checking software might be very small.

Faculty and Student Expectations

- Every student, faculty member, and administrator is responsible for upholding the highest standards of academic integrity. Every member of the AURAK community shall honor the spirit of this policy by refusing to tolerate academic fraud.

- It is the responsibility of the instructor to provide students with additional guidelines for what constitutes “authorized” and “unauthorized” assistance.

- It is the responsibility of every student to see clarification if in doubt about what constitutes ‘authorized” and “unauthorized” assistance. In cases involving collaborative work, all students within the collaborative group may be help responsible for violating the code if any member of the group receives, accepts, or utilizes "unauthorized" assistance.

- Students are required to obtain permission prior to submitting work, any part of which was previously or will be submitted in another course. The instructor has the option of accepting, rejecting, or requiring modification of the content of previously or simultaneously submitted work.

A student who suspects that a violation of academic integrity has occurred should report the violation to the dean or to the Office of the Provost. In this report, the student should describe any action taken, such as talking with the person involved or with a faculty or staff member. Every effort will be made to preserve the anonymity of the student reporting the incident;

Possible penalties for academic fraud include: Formal warning, Reduction in grade for the assignment, Reduction in the grade for the course, A failing grade for the assignment, A failing grade (F) in the course, and/or Dismissal or Expulsion from the University.

Please refer to the relevant section in the *Student Handbook* and ensure a clear understanding of the provisions of the University Honor Code and the Student Academic Integrity Policy.

**B. Concerns about grades or other course matters.**

Students are responsible for their learning experiences. If you are concerned about a class matter, first discuss it with the instructor. If the matter is not resolved, the next step is to meet with the Chair of the department in which the course is taught. If you still have a concern, meet with the Dean of the school in which the course is taught. The matter is likely to be resolved before it reaches that point, but if it is not, then visit the Associate Provost for Academic Affairs. Students who decide to “jump to the top” will be referred “back” to the appropriate next step.

**C. Assignments**

University policy is that assignments are due on the date indicated when the assignment is made. Instructors may refuse to accept late assignments or lower the grade that would be otherwise given.

**D. Mobile Phones**

All mobile phones and other communication devices should be turned off before entering the classroom. Students may NOT have mobile telephone or other electronic devices in their possession while completing examinations. Any violation will be deemed as having attempted to cheat.

**E. Diversity and the Use of English**

English is the common language of the AURAK campus for everyone. It is the only language to be used in the classroom. AURAK brings together students and faculty from diverse cultural and linguistic backgrounds, which is one of the strengths of the university. This diversity provides an opportunity to share our different experiences and enlarge our understanding of the world.

# APPENDIX

## Program Learning Outcomes (PLOs) : BS IN ARTIFICIAL INTELLIGENCE

| **Program Learning Outcomes**<br>**At the completion of the program, students should be able to:** | |
|---|---|
| PLO 1 | PLO 1. Analyze a complex computing problem and to apply principles of computing, artificial intelligence, statistics, and other relevant disciplines to identify solutions. |
| PLO 2 | PLO 2. Design, implement, and evaluate computer science or artificial intelligence solutions to meet a given set of computing requirements in the context of the program's discipline. |
| PLO 3 | PLO 3. Communicate effectively in a variety of professional contexts. |
| PLO 4 | PLO 4. Recognize professional responsibilities and make informed judgments in computing practice based on legal and ethical principles. |
| PLO 5 | PLO 5. Function effectively as a member or leader of a team engaged in activities appropriate to the program's discipline. |
| PLO 6 | PLO 6. Apply computer science, artificial intelligence, or data science theory and software development fundamentals to produce computing-based solutions. |
| PLO 7 | PLO 7. Build, apply, and evaluate data science models to solve problems in real world context. |

## Mapping Course to Program Learning Outcomes : BS IN ARTIFICIAL INTELLIGENCE

| **The learning outcomes of this course contribute to meeting one or more of the program learning outcomes as shown below, with the contribution designated as "high", "medium", or "low":** | | | | | | | |
|---|---|---|---|---|---|---|---|
| | **PLO 1** | **PLO 2** | **PLO 3** | **PLO 4** | **PLO 5** | **PLO 6** | **PLO 7** |
| **CLO 1** | *low* | | | | | | |
| **CLO 2** | *high* | *low* | | | | | |
| **CLO 3** | | | | | | *high* | |
| **CLO 4** | | *high* | | | | | |

## Mapping ABET Standards and Course Learning Outcomes to Program Learning Outcomes

| *PLOs* | *Program Learning Outcomes (Based on ABET's CAC)* | *Program Learning Outcomes Addressed in* |
|---|---|---|

| *(1-7)* | | *Course* |
|---|---|---|
| 1 | Analyze a complex computing problem and to apply principles of computing, artificial intelligence, statistics, and other relevant disciplines to identify solutions. | X |
| 2 | Design, implement, and evaluate computer science or artificial intelligence solutions to meet a given set of computing requirements in the context of the program's discipline. | X |
| 3 | Communicate effectively in a variety of professional contexts. | |
| 4 | Recognize professional responsibilities and make informed judgments in computing practice based on legal and ethical principles. | |
| 5 | Function effectively as a member or leader of a team engaged in activities appropriate to the program's discipline. | |
| 6 | Apply computer science and artificial intelligence theory and software development fundamentals to produce computing-based solutions. | X |
| 7 | Build, apply, and evaluate data science models to solve problems using theoretical fundamentals. | |