# Course Specification
## (Bachelor)

| | |
|---|---|
| **Course Title:** | Machine Learning |
| **Course Code:** | 425CCS-3 |
| **Program:** | Bachelor of Science in Computer Science |
| **Department:** | Department of Computer Science |
| **College:** | Computer Science and Information Systems |
| **Institution:** | Najran University |
| **Version:** | 2.0 |
| **Last Revision Date:** | August 2022 |

## Table of Contents

## A. General information about the course:

### 1. Course Identification

**1. Credit hours: ( 3 )**

3 (2, 2, 1) [Theory, Lab, Tutorial]

**2. Course type**

| | | | | | |
|---|---|---|---|---|---|
| A. | ☐University | ☐College | ☒ Department | ☐Track | ☐Others |
| B. | ☒ Required | | ☐Elective | | |

**3. Level/year at which this course is offered: ( Level 8/Year 4)**

**4. Course General Description:**

This course introduces various algorithm design paradigms and the basics of computational complexity analysis using different models of computations with an overview of mathematical essentials, space and time complexities, and asymptotic notations. Design and analysis of algorithms covers linear programming, greedy algorithms, divide-and-conquer, backtracking, branch-and-bound, search methods, graph algorithms and introduction to NP-completeness. Machine Learning is the science of getting machines to learn, more specifically, designing algorithms that allow computers to learn from empirical data. In this course, you will learn about definitions and examples of machine learning, inductive learning, statistical-based learning, reinforcement learning, supervised learning, unsupervised learning, learning decision trees, neural networks, belief networks, nearest neighbour algorithm, clustering, learning theory, the problem of overfitting, and computational learning theory.

**5. Pre-requirements for this course (if any):**

211CCS-4

**6. Co-requisites for this course (if any):**

None

**7. Course Main Objective(s):**

1. After successful completion of this course students should be able to:
2. Comprehend the fundamental concepts of Machine Learning (ML).
3. Developing an appreciation for what is involved in learning from data.

4. Understand outline paradigms for learning, challenges in data, model selection, model complexity and model evaluation.
5. Explain several machine learning algorithms and their weaknesses and strengths.
6. Design a ML solution to real problem using different ML algorithms.

## 2. Teaching mode (mark all that apply)

| No | Mode of Instruction | Contact Hours | Percentage |
|---|---|---|---|
| 1 | Traditional classroom | 75 | 100% |
| 2 | E-learning | | |
| 3 | Hybrid<br>• Traditional classroom<br>• E-learning | | |
| 4 | Distance learning | | |

## 3. Contact Hours (based on the academic semester)

| No | Activity | Contact Hours |
|---|---|---|
| 1. | **Lectures** | 30 |
| 2. | **Laboratory/Studio** | 30 |
| 3. | **Field** | |
| 4. | **Tutorial** | 15 |
| 5. | **Others (specify)** | |
| **Total** | | 75 |

## B. Course Learning Outcomes (CLOs), Teaching Strategies and Assessment Methods

| Code | Course Learning Outcomes | Code of PLOs aligned with the program | Teaching Strategies | Assessment Methods |
|---|---|---|---|---|
| **1.0** | **Knowledge and understanding** | | | |
| 1.1 | Comprehend the fundamental concepts of Machine Learning (ML). | K1 | 1. Review of the previous topics before the new lecture that relates and has an impact on new lecture topics.<br>2. Explain questions during the lectures. | Projects<br>Midterm exam<br>Final Exam |

| Code | Course Learning Outcomes | Code of PLOs aligned with the program | Teaching Strategies | Assessment Methods |
|---|---|---|---|---|
| | | | 3. Encourage students to bring up new ideas related to the topics/lectures.<br>4. Assignments<br>5. Tutorials | |
| 1.2 | Understand outline paradigms for learning, challenges in data, model selection, model complexity and model evaluation. | K1 | 1. Compose more real-life examples in the lecture relating to the surroundings of the students to draw attention that certainly helps them to concentrate more on the specific topic.<br>2. In some cases, pick one student who understood best a specific topic and let him describe in front of the class in his own manner.<br>3. Represent more easily understandable graphs/pictures in the class to describe certain topic and in that process use interesting words or interactive sounds to help students to improve their receptive memory.<br>4. Dictate students on certain topics during the lectures.<br>5. Recall the topics of last lecture and the critical issues based on different topics, which certainly helps students to recall memory frequently and store that topic in their memory for long term.<br>6. Before start a new topic or at the end of each topic, students are given couple of minutes to imagine the real life scenarios relating to that topic including implementation, advantages, deficiencies etc. to improve their logical thinking. | Projects<br>Midterm exam<br>Final Exam |
| 1.3 | Explain several machine learning algorithms and their weaknesses and strengths. | K1 | | Projects<br>Midterm exam<br>Final exam |
| **2.0** | **Skills** | | | |

| Code | Course Learning Outcomes | Code of PLOs aligned with the program | Teaching Strategies | Assessment Methods |
|---|---|---|---|---|
| 2.1 | Developing an appreciation for what is involved in learning from data. | S4, S5 | 1. Assignment or research on selected topic: Divide students in to small groups and randomly select the team leader of the group (one member at a time) who will distribute workloads among group members and responsible to collect, merge, modify the content if needed, represent in front of the class.<br>2. Quiz tournament among groups: After every two weeks all groups must participates a quiz competition where one group will produce questions from the last four lectures topics and the others will answer.<br>3. Delivering speech on a topic: Students will be chosen randomly to deliver speech in front of the class on the topics covered in the class in their own fashion. | • Lectures<br>• Projects |
| 2.2 | Design an ML solution to the real problem using different ML algorithms. | S1, S2 | | |
| 2.3 | | | | |
| 2.4 | | | | |
| **3.0** | **Values, autonomy, and responsibility** | | | |
| 3.1 | | | | |
| 3.2 | | | | |

## C. Course Content

| No | List of Topics | Contact Hours |
|---|---|---|
| 1. | Introduction | 5 |
| 2. | Linear Regression with One Variable | 5 |
| 3. | Linear Regression with Multiple Variables | 5 |
| 4. | Logistic Regression | 10 |
| 5. | Regularization | 10 |

| | | |
|---|---|---|
| 6. | ML Project Design | 10 |
| 7. | Neural Networks: Representation | 10 |
| 8. | Neural Networks: Learning | 5 |
| 9. | Bayesian Decision Theory | 5 |
| 10. | Decision Trees / Clustering | 5 |
| **Total** | | **75** |

## D. Students Assessment Activities

| No | Assessment Activities * | Assessment timing (in week no) | Percentage of Total Assessment Score |
|---|---|---|---|
| **1.** | Midterm | 9th week | 20 |
| **2.** | Project-1 | 5th week | 10 |
| **3.** | Project-2 | 10th week | 10 |
| **4.** | Final lab | 11th week | 10 |
| **5.** | Final Theory Exam | 16th or 17th | 50 |

*Assessment Activities (i.e., Written test, oral test, oral presentation, group project, essay, etc.).

## E. Learning Resources and Facilities

### 1. References and Learning Resources

| | |
|---|---|
| **Essential References** | 1. Ethem Alpaydin, Introduction to Machine Learning, Third Edition, The MIT Press (ISBN: 9780262028189).<br>2. Tom Mitchell, Machine Learning, McGraw-Hill, (ISBN: 0070428077) |
| **Supportive References** | |
| **Electronic Materials** | |
| **Other Learning Materials** | |

### 2. Required Facilities and equipment

| Items | Resources |
|---|---|
| **facilities**<br>(Classrooms, laboratories, exhibition rooms, simulation rooms, etc.) | Well-equipped lecture room containing board and data show device.<br>Well-equipped laboratory for practical work. |

| Items | Resources |
|---|---|
| **Technology equipment**<br>(projector, smart board, software) | Lecture room should contain a PC attached to the data show device with MS Office and Adobe Acrobat Reader packages being installed |
| **Other equipment**<br>(depending on the nature of the specialty) | |

## F. Assessment of Course Quality

| Assessment Areas/Issues | Assessor | Assessment Methods |
|---|---|---|
| Collecting students' suggestions to facilitate more during the class. | Students | Verbal discussion |
| Student's questionnaire once during the semester about course learning outcomes. | Students | Indirect Survey |
| Achievement percentage of course learning outcomes, direct evaluation using CLO assessment sheet | Course Instructor | Direct evaluation using CLO achievement calculation |
| Teaching strategies | Quality unit | Indirect |
| Assessment methods | Quality unit | Indirect |
| Instructor performance | Quality unit | Indirect |
| Course content | Quality unit | Indirect |

**Assessors** (Students, Faculty, Program Leaders, Peer Reviewers, Others (specify)

**Assessment Methods** (Direct, Indirect)

## G. Specification Approval

| | |
|---|---|
| **COUNCIL /COMMITTEE** | Computer Science Departmental Council |
| **REFERENCE NO.** | 14440203-0185-00002 |
| **DATE** | 1st Sep, 2022 |