



# Course Specification

— (Bachelor)

<b>Course Title:</b> Machine Learning
<b>Course Code:</b> CSC1403
<b>Program:</b> Bachelor in Computer Science
<b>Department:</b> Computer Science
<b>College:</b> Computers and Information Technology
<b>Institution:</b> University of Tabuk
<b>Version:</b> 1.0
<b>Last Revision Date:</b> 27 July 2022



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## A. General information about the course:

### 1. Course Identification

1. Credit hours: ( 2 )

#### 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 provides fundamental concepts and an understanding of machine learning, covering theoretical foundations and essential algorithms for both supervised and unsupervised learning. The practical component focuses on applying machine learning to real-world examples. The main topics covered include linear and non-linear regression, logistic regression, k-NN, dimensionality reduction, PCA, support vector machines, decision trees, clustering, and neural networks.

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

Math1205: Linear Algebra  
CSC1401: Artificial Intelligence.

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

None

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

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

- Define the fundamental problems of machine learning.
- Provide an understanding of techniques, mathematical concepts, and algorithms used in machine learning to facilitate further study in this area.
- Provide an understanding of the limitations of various machine learning algorithms and the way to evaluate performance of machine learning algorithms.
- Read the state-of-art literature in this domain, and build a project based on the state-of-art literature.
- Apply machine learning algorithm to real-world problem, optimize the models and report the expected accuracy of different models using state-of-art tools such as sikit-learn, PyTorch and etc.

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



No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	30	100%
2	E-learning		
3	Hybrid <ul style="list-style-type: none"> <li>● Traditional classroom</li> <li>● E-learning</li> </ul>		
4	Distance learning		

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

No	Activity	Contact Hours
1.	Lectures	30
2.	Laboratory/Studio	
3.	Field	
4.	Tutorial	
5.	Others (specify)	
<b>Total</b>		<b>30</b>

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

Code	Course Learning Outcomes	Code of PLOs aligned with program	Teaching Strategies	Assessment Methods
<b>1.0</b>	<b>Knowledge and understanding</b>			
1.1	Define terminologies, concepts, techniques, functions, and algorithms used in machine learning.	K1, and K4	Lectures	Midterm exams Final exam Assignments
1.2	Recognize the principles, advantages, limitations, and possible applications of machine learning Algorithms.	K2	Lectures	Midterm exams Final exam Assignments Projects



Code	Course Learning Outcomes	Code of PLOs aligned with program	Teaching Strategies	Assessment Methods
1.3	Demonstrate familiarity with a set of well-known supervised, unsupervised and semi-supervised learning algorithms.	K3	Lectures	Midterm exams Final exam Assignments
<b>2.0</b>	<b>Skills</b>			
2.1	Apply machine learning concepts in real-life problems.	S1	Lectures Case study	Assignments Project
2.2	Build ML algorithms for solving real problems, code them with popular programming languages, and test them with benchmark datasets.	S3 and S4	Lectures Case study	Assignments Project
2.3	Analyze and evaluate a learned model in practice.	S4	Lectures Case study	Assignments Project
<b>3.0</b>	<b>Values, autonomy, and responsibility</b>			
3.1	Demonstrate to communicate and work (effectively and professionally) individually and in groups/teamwork to accomplish the assigned tasks.	V2	Lectures Group Discussion Case study	Project

### C. Course Content

No	List of Topics	Contact Hours
1.	<b>Introduction to Machine Learning:</b> Overview of machine learning: Definition, key concepts, and applications. Types of machine learning problems: Classification, regression, and clustering.	2
2.	<b>Introduction to Python:</b> Syntax, data types, control flow, and functions. Working with libraries for machine learning: NumPy, Pandas, and Matplotlib.	2
3.	<b>Learning Concepts:</b> Training, Validation, Test Sets, Overfitting, Underfitting,	2
4.	<b>Linear Regression:</b> Basics of linear regression-Hypothesis function Cost function- Gradient descent.	2



5.	<b>Logistic Regression:</b> Logistic regression for binary classification. Logistic function- Maximum likelihood estimation- Handling categorical variables- model evaluation techniques.	2
6.	Midterm 1. Introduction to Bayesian Classifiers & Naïve Bayes: Assumptions and applications.	2
7.	<b>Naïve Bayes:</b> Probability concepts, Bayes theorem, priors, posteriors, Naive Bayes classifier, Applications in text classification	2
8.	<b>Support Vector Machines</b> Maximal margin classifier intuition, Mathematical optimization with SVMs, Kernels - polynomial, RBF, SVM implementation in Python	2
9.	<b>Perceptron and Neural Networks:</b> perceptron model, Neural networks components, backpropagation, Activation functions, and loss metrics.	2
10.	<b>Decision Trees:</b> Decision tree intuition, Entropy, information gain, pruning, Random forests, bagging, boosting, Implementation in sklearn	2
11.	<b>Ensemble Methods:</b> Ensemble learning approaches, boosting algorithms like AdaBoost, Model stacking, and Voting classifiers	2
12.	Clustering: K-means clustering, Agglomerative hierarchical clustering DBSCAN.	2
13.	<b>Midterm 2.</b> Introduction to Dimensionality Reduction: Benefits of dimensionality reduction, feature selection, and feature extraction	2
14.	<b>Principle component analysis (PCA):</b> Applications of PCA, PCA for dimensionality reduction, Mathematics of PCA, Implementing PCA in Python with scikit-learn.	2
15.	<b>Introduction to deep learning:</b> Understanding the fundamental concepts and principles behind deep learning algorithms, and convolutional neural networks	2
<b>Total</b>		<b>30</b>

## D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	Assignments	3, 7, 12	15%
2.	Individual/ group Project	8	15%
3.	Midterm exam 1	6	15%
4.	Midterm exam 2	12	15%
5.	Final exam	16	40%

\*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- C. M. Bishop, Pattern Recognition and Machine Learning, Springer, 2006, ISBN:978-0387310732





	2- Tom Mitchell, Machine Learning, McGraw-Hill Science/Engineering/Math, 1st Ed, 1997, ISBN:978-0070428072
<b>Supportive References</b>	Sebastian Raschka, Machine Learning with PyTorch and Scikit-Learn : Develop machine learning and deep learning models with Python, 2022
<b>Electronic Materials</b>	
<b>Other Learning Materials</b>	

## 2. Required Facilities and equipment

Items	Resources
<b>facilities</b> (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	Classroom
<b>Technology equipment</b> (projector, smart board, software)	Whiteboard, data show projector, computer, and internet connection.
<b>Other equipment</b> (depending on the nature of the specialty)	

## F. Assessment of Course Quality

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of Teaching	Faculty, Program Leaders, and Advisory Board	Both Direct and Indirect
	Students	Indirect
Effectiveness of Students Assessment	Faculty, Program Leaders, Advisory Board, and Independent Opinion	Both Direct and Indirect
Quality of Learning Resources	Faculty, Students, and Advisory Board	Indirect
The Extent to which CLOs have been Achieved	Faculty, Program Leaders, Advisory Board, and Independent Opinion	Direct (as in section B) and Indirect/Surveys
	Students	Indirect
Other	-	-

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

**Assessment Methods** (Direct, Indirect)

## G. Specification Approval

<b>COUNCIL /COMMITTEE</b>	
<b>REFERENCE NO.</b>	
<b>DATE</b>	26/10/2023



