جامعة الزيتونة الأردنية

Al-Zaytoonah University of Jordan

Course Syllabus

According to JORDAN National Qualification Framework (JNQF)

Course Name: Artificial Intelligence in Mathematics

Course Number: 0101474

General Course Information:

Course Title	Artificial Intelligence in Mathematics
Course Number	……
Credit Hours	3 credit hours
Education Type	Traditional learning
Prerequisites/Co-requisites	-
Academic Program	Bachelor
Program Code	…
Faculty	Faculty of Science and Information Technology
Department	Mathematics
Level of Course	3
Academic Year /Semester	---
Awarded Qualification	BSc
Other Department(s) Involved in Teaching the Course	-
Language of Instruction	English
Date of Production	2024-2025
Date of Revision	November 2024

Course Coordinator:

Coordinator's Name	
Office No.	
Office Phone Extension Number	
Office Hours	
E-mail	

Other Instructors:

Instructor Name	
Office No.	
Office Phone Extension Number	
Office Hours	
Email	

Course Description *(English/Arabic)*:

English	This course introduces students to the essential mathematical concepts underpinning artificial intelligence (AI) and machine learning. This course is designed to build a solid foundation in mathematics while demonstrating how these concepts are applied in AI to analyze data, optimize solutions, and design predictive models. Covering topics such as linear algebra, probability, calculus, and optimization, students will explore the mathematical tools used in algorithms, machine learning, and neural networks. Through hands-on exercises and examples, they will develop skills in matrix operations, eigenvalues, probability distributions, gradients, and more, with a focus on applying these principles to AI-related tasks like dimensionality reduction, regression, and data transformation.
Arabic	تقدم هذه الدورة للطلاب المفاهيم الرياضية الأساسية التي تدعم الذكاء الاصطناعي والتعلم الآلي. تم تصميم هذه الدورة لبناء أساس متين في الرياضيات مع توضيح كيفية تطبيق هذه المفاهيم في الذكاء الاصطناعي لتحليل البيانات وتحسين الحلول وتصميم النماذج التنبؤية. من خلال تغطية موضوعات مثل الجبر الخطي والاحتمالات وحساب التفاضل والتكامل والتحسين، سيستكشف الطلاب الأدوات الرياضية المستخدمة في الخوارزميات والتعلم الآلي والشبكات العصبية. من خلال التمارين والأمثلة العملية، سيطورون مهارات في عمليات

	المصفوفة والقيم الذاتية وتوزيعات الاحتمالات والتدرجات والمزيد، مع التركيز على تطبيق هذه المبادئ على المهام المتعلقة بالذكاء الاصطناعي مثل تقليل الأبعاد والانحدار وتحويل البيانات.

Textbook: ***Author(s), Title, Publisher, Edition, Year, Book website.***

Marc Peter Deisenroth, A. Aldo Faisal, and Cheng Soon Ong, Mathematics for Machine Learning, Cambridge University Press, 2020.

References: *Author(s), Title, Publisher, Edition, Year, Book website.*

Eric Lehman, F. Thomson Leighton, and Albert R. Meyer, Mathematics for Computer Science, Samurai Media Limited, England, 2017.

Course Educational Objectives (CEOs):

CEO1	Build a Mathematical Foundation for AI
CEO2	Demonstrate Application of Mathematics in AI Models
CEO3	Enhance Problem-Solving Skills
CEO4	Prepare for Advanced AI and Machine Learning Studies

Intended Learning Outcomes (ILO's):

Intended learning outcomes (ILOs)		**Relationship to CEOs**	**Contribution to PLOs**	**Bloom Taxonomy Levels***	**JNQF Descriptors****
K	Knowledge and understanding				
1. ILO1-k	Students will gain a foundational understanding of core mathematical concepts such as linear algebra, probability, calculus, and their relevance to AI models and algorithms.	CEO1	PLO1-k	Remembering	K
2. ILO2-k	Students will comprehend how mathematical principles are applied in AI, including how they underpin tasks like data processing, optimization, and predictive modeling within machine learning and neural networks.	CEO2	PLO2-k	Understanding	K
S	Intellectual skills				
3. ILO3-s	Students will develop the intellectual skill to apply mathematical tools such as matrix operations, probability distributions, and derivatives to analyze and solve problems within AI and machine learning.	CEO3	PLO5-s	Analysing	S
4. ILO4-s	Students will gain the ability to interpret complex data sets and utilize mathematical models for tasks such as prediction, classification, and pattern recognition in AI applications.	CEO3	PLO6-s	Applying	S

5. ILO5-s	Students will be able to critically assess different mathematical methods, such as linear regression and gradient-based optimization, to determine their effectiveness in specific AI algorithms and scenarios.	CEO3	PLO7-s	Creating	S
C	Subject specific skills				
6. ILO6-c	Students will acquire the skill to implement fundamental mathematical techniques, such as matrix manipulations and probability calculations, in simple AI models, enabling them to apply these methods directly to computational tasks in artificial intelligence.	CEO1-CEO4	PLO9-c	Applying	C

***Bloom Taxonomy Levels:**						
Level #	1	2	3	4	5	6
Level Name	Remembering	Understanding	Applying	Analysing	Evaluating	Creating

**** Descriptor (National Qualification Framework Descriptors): K: Knowledge, S: Skill, C: Competency.**

Program Learning Outcome (PLOs):

	(PLOs)	JNQF Descriptors**		
		K	S	C
1	Comprehend Mathematical Foundations of AI.	√		
2	Understand the Role of Optimization in AI.	√		
3	Recognize Mathematical Modeling in AI Applications.	√		
4	Master Key Theoretical Concepts in Machine Learning.	√		
5	Analyze and Solve AI Problems Using Mathematical Methods.		√	
6	Critically Evaluate Mathematical Models for AI.		√	
7	Apply Mathematical Reasoning to AI Data Interpretation.		√	
8	Implement Core Mathematical Techniques in AI Models.			√
9	Develop Basic AI Models Using Mathematical Frameworks.			√

**** Descriptors according to the national qualifications framework (K: knowledge, S: skill, C: Competency)**

Weekly Schedule *(please choose the type of teaching)*

- ☒ **Face to Face** (F2F)
- ☐ Hybrid *(One – To - One)*
- ☐ Online

Schedule of Simultaneous and their Topics:

Week	First Lecture (F2F)	IL	PLOs	JNQF

		Os		Descriptors*
1	Introduction to AI and Mathematical Foundations including an overview of AI and the role of mathematical concepts.	ILO1-k	PLO1-k	Understanding
2	Basics of vectors and matrices, focusing on matrix operations and their applications in data representation and transformations in AI.	ILO2-k	PLO2-k	Understanding
3	Matrix Transformations and Properties, including rotations and projections, with simple examples showing their use in data manipulation.	ILO2-k	PLO2-k	Understanding
4	Eigenvalues, Eigenvectors, and their significance in dimensionality reduction, a common AI preprocessing step.	ILO3-k	PLO3-k	Understanding
5	Probability Theory Basics, covering foundational ideas like random variables, events, and conditional probability.	ILO4-s	PLO5-s	Remembering
6	Probability Distributions in AI and their use in modeling and making predictions in AI.	ILO5-s	PLO6-s	Remembering
7	Basic calculus concepts with a focus on understanding the optimization.	ILO5-s	PLO7-s	Applying
Midterm Exam				
9	Multivariable Calculus including the partial derivatives and gradients, essential for understanding gradient-based optimization in AI.	ILO5-s	PLO7-s	Remembering
10	Optimization in A, with an emphasis on gradient descent and its role in training AI models.	ILO5-s	PLO7-s	Remembering
11	Linear Regression and Applications, focusing on the mathematical foundation behind fitting data to models.	ILO6-c	PLO7-s	Remembering
12	Matrix Decompositions in Machine Learning that includes an overview of matrix factorization techniques and their role in data compression and feature extraction.	ILO6-c	PLO8-c	Understanding
13	Introduction to Gradient Descent, focusing on how gradients are calculated and used to minimize errors in model predictions.	ILO6-c	PLO9-c	Applying
14	Optimization with Constraints with constraints (e.g., Lagrange multipliers) and their applications in constrained AI models.	ILO6-c	PLO9-c	Analyzing
15	Markov Chains, focusing on how they are used in AI models for decision processes, especially in reinforcement learning.			
16	**Final Exam**			

* **K: Knowledge, S: Skills, C: Competency**

Teaching Methods and Assignments:

Development of ILOs is promoted through the following teaching and learning methods:

- Lecture.
- Zoom and Videos

- learning through projects.
- learning through problem solving.
- participatory learning

Course Policies:

A- Attendance policies:
The maximum allowed absences is 15% of the lectures.
B- Absences from exams and handing in assignments on time:
Midterm exam can be retaken based on approval of excuse by the instructor's discretion.
Not handing assignment on time will incur penalties.
C- Academic Health and safety procedures
D- Honesty policy regarding cheating, plagiarism, and misbehaviour:
Cheating, plagiarism, misbehaviour will result in zero grade and further disciplinary actions may be taken.
E- Grading policy:

- All homework is to be posted online through the e-learning system.
- Exams will be marked within 72 hours and the marked exam papers will be handed to the students.
- Online Activities (Course Videos, Practice labs, Discussion Forums, Quizzes) 3**0%**
- Midterm 30**%**
- Final Exam 40 **%**

F- Available university services that support achievement in the course: **E-Learning Platform, Labs, Library.**

Required Equipment:

- PC / Laptop with webcam and mic
- Internet Connection
- Access to the ZUJ E-Learning Platform at https://exams.zuj.edu.jo/
- E-learning plan
- Satisfaction questionnaires for online and face-to-face learning
- Training

Assessment Tools Implemented in the Course:

- Final Exam
- Midterm Exam
- Quizzes
- Homework
- Discussion Forums
- Periodic reports for learning assessment
- Improvement plans for online or face-to-face teaching.

Responsible Persons and their Signatures:

Course Coordinator	Dr. Iqbal M. Batiha	**Completed Date**	**11/07/2024**
		Signature	
Received by (Department Head)		**Received Date**	/ /
		Signature	