Course Syllabus

Last updated: 02/10/2024

Course Code	Course Title	No. Weeks / Hours	Credits (ECTS)
ECUEF	Deep Learning and AI	14 weeks / 21 hours	

Academic Year	**2024-2025**	**Semester**	**£ Fall**
Pre-requisite	Mathematical Foundations Fondamentals of Artificial Intelligence / Data Mining/ Machine Learning Python proficiency (Numpy, Pandas, and basic programming concepts)		
Program	Master Business Analytics		
Cohort (s)	M2 Business Analytics		
Course Coordinator	Aymen Ben Brik		
Course Instructor	Aymen Ben Brik		
Office Hours & Contact Details	By appointment (email instructor aymen.benbrik@esprit.tn)		

Brief Course Description (As in ESB Catalog):

This course focuses on the foundational and practical aspects of Deep Learning (DL). Students will explore the architecture and implementation of neural networks, including feedforward networks, convolutional neural networks (CNNs), recurrent neural networks (RNNs), and transformers. Emphasis is placed on hands-on coding using Python and deep learning frameworks like TensorFlow and PyTorch. Students will also learn about optimization techniques, model evaluation, and state-of-the-art applications in computer vision and natural language processing (NLP).

This course covers the following BA Program Learning Outcomes:

PLO#	PLO Description
1	Communicate effectively in a variety of contexts using appropriate verbal, written, and nonverbal communication skills.
2	Demonstrate an understanding of fundamental management principles and functional areas within a local and global business environment
3	Demonstrate The ability to identify, analyze and address ethical, social and Legal issues pertaining to management
4	Select and apply relevant technologies to solve business problems and enhance organizational performance.
5	Demonstrate an ability to analyze, interpret and solve complex business problems
6	Utilize advanced analytics to optimize business operations and drive competitive advantage through data-driven decision-making and strategic insights.

This course assesses the following General Skills Areas (GSA):

GSA	GAS Description	Through ..
£	**G1. Develop Critical Thinking and Problem-Solving:** Students will be able to analyse problems, identify solutions, and apply algorithmic strategies to solve them efficiently.	**Problem-based learning**: Students will solve algorithmic challenges during lectures and labs. **Homework assignments**: . **Projects**: Students will work on larger projects that require comprehensive problem-solving and algorithm design.
£	**G2. Demonstrate Logical and Analytical Skills:** Enhance logical reasoning to design algorithms and data structures and evaluate their efficiency.	**Class discussions**: Analyzing various algorithmic approaches and determining the most efficient solutions during class. **Quizzes and exams**: Assessing the student's ability to analyze and apply logical thinking in writing and optimizing algorithms.
£	**G3. Develop** and **Demonstrate Programming Proficiency:** Gain hands-on experience in translating algorithms into executable code, particularly in Python, and debugging programs.	**Hands-on coding sessions**: Labs where students will implement the algorithms they learn in Python, translating theory into practice. **Programming assignments**: Tasks requiring students to write, debug, and optimize Python code. **Project work**: In-depth programming projects that challenge students to apply their skills to real-world problems.
£	**G4. Develop Collaboration and Teamwork** Work effectively in teams to solve problems, share coding tasks, and conduct peer reviews of each other's solutions.	**Group projects**: Students will work in teams to solve more complex problems, encouraging collaboration and peer learning. **Peer code reviews**: Students will review and give feedback on their teammates' code, fostering teamwork and mutual learning.
£	**G5. Develop Effective Communication** Demonstrate the ability to explain technical concepts clearly, both verbally and in writing, particularly when discussing algorithms and code structure.	**Presentations**: Students will present their solutions and algorithms in class or during project reviews, explaining their approach and reasoning. **Code documentation**: Encouraging students to write clear comments and documentation for their code as part of their assignments and projects. **Written reports**: Some projects may require a report detailing the algorithm design, challenges encountered, and how they were addressed.
£	**G6. Develop Adaptability to New Technologies** Stay open to learning new programming tools, languages, or techniques that may enhance problem-solving capabilities in future courses.	**Exploring new programming paradigms**: Encouraging exploration of functional programming approaches or advanced Python techniques beyond the basics. **Optional advanced tasks**: Giving students optional, more advanced exercises that push them to explore new concepts or technologies on their own.

Course Learning Outcomes (CLOs):

Upon completion of this course, the student should be able to:

CLO#	CLO Description	Linked to PLO#
1	Understand and explain deep learning concepts, architectures, and frameworks.	2,4,5
2	Build, train, and fine-tune neural network models using TensorFlow or PyTorch.	5,6
3	Apply CNNs to solve image-related tasks, such as classification and object detection.	5,6
4	Implement RNNs and transformers for sequence modeling tasks, such as NLP applications.	4,5,6
5	Evaluate deep learning models using appropriate metrics and improve them through optimization techniques.	2,6
6	Analyse algorithm efficiency and compare different approaches.	2,4,5,6

CLO Assessment Scheme:

CLO#	Classwork (30%)				Final Exam (70%)
	Assignments (0%)	Case Study (50%)	Project (50%)	Quizzes (%)	
1			X		X
2			X		X
3			X		X
4			X		X
5			X		X
6		X	X		X

Pedagogical Approach and Teaching Methods:

- ✓ Lecture presentations
- ✓ Experiential Learning: Instructor-led tutorial sessions, role playing, simulations, and class presentations
- ✓ Collaborative Learning: Class activities and discussions
- ✓ Problem-Based and Project-Based Learning: Case study analysis and team projects
- ✓ Gamification: Serious games

Course weekly plan:

Week #	Topic	Class objectives	Related to CLO#	Class Activities / Assessment	Assignment/Readings

1	Introduction to ML/DL	Understand ML concepts and course structure	1	Discuss examples of ML applications; Introductory coding	Read Chapter 1 of 'Deep Learning' by Goodfellow
2	Supervised Learning	1. Regression Algorithms 2. Classification algorithms	1,2	Lab 1 correction	Complete lab1 and coding exercises from Chapter 1 and 2
3	Supervised Learning algorithms : Logistic regression as an example	1. Learn how to fix hyperparameters of algorithms like Decision Tree and KNN 2. Learn how a logistic regression works.	2,3	Hands-on exercises on k-NN and decision trees. Hands-on exercises on Logistic Regression.	Prepare and submit Lab 2
4	Neural Networks	Introduction to perceptrons and activation function	2,3	Code a single-layer neural network	Submit some calculus exercice of how many parameters used by neurons
5	Neural Networks (contd.)	Implement forward and backward propagation	2,3	Group coding session	Prepare Lab3
6	Neural Networks (contd.)	Understand how to evaluate a neuron networks Fix underfitting and Overfitting problems	2.3,4,6	Group coding session	Submit Lab 3
7	Convolutional Neural Networks (CNNs)	Apply CNNs to image classification	2,3,4	Lab: Build a simple CNN using TensorFlow	Submit Lab3
8	Advanced CNNs	Implement advanced CNNs (e.g., ResNet)	1,2,3	Group coding session	Prepare and submit Lab4
9	Recurrent Neural Networks (RNNs)	Understand RNNs and sequence modeling	4	Group coding session Lab on simple RNN	Prepare and submit Lab5
10	Long Short-Term Memory (LSTMs)	Work with advanced RNNs	4,5	Group coding session Lab on LSTM Technics	Prepare and submit Lab 6
11	Natural Language Processing	Use DL for text tasks (e.g., sentiment analysis)	4,5	Group coding session Lab of sentiment analysis with NLP Technics	Prepare and submit Lab 7
12	Applications in Computer Vision	Object detection and segmentation	4,5,6	Group coding session Detection Task with Computer	Prepare and submit Lab 8

				Vision	
13	Final Project Presentation		1,2,3,4,5, 6	Peer review and feedback	
14	**Course Feedback and Wrap-Up**	1. Gather feedback on the course. 2. Discuss next steps in learning.	1, 2, 3, 4, 5, 6	Answering to all questions and homework. Course evaluation and discussion on future topics.	Reflective assignment on learning experiences.

Educational Resources:

Reference Books	***Deep Learning* by Ian Goodfellow et al.**
Recommended Readings	***Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow* by Aurélien Géron** **https://www.tensorflow.org/** **https://pytorch.org/**
Course LMS Repository	

Classroom Policy:

1. **Attendance and Punctuality:**

Tardiness: Students are expected to arrive on time for all classes. Students arriving more than 10 minutes late will not be admitted into the classroom and will be considered absent.

2. **Assignment Submission:**

Deadlines: All assignments must be submitted by the specified deadlines. Late submissions will incur a penalty of 20% per day, up to a maximum of three days. Assignments submitted more than three days late will not be accepted.

Extensions: Extensions might be granted in cases of documented emergencies or prior arrangement with the instructor.

3. **Group Work**

Participation: Each group member is expected to contribute equally to group projects. Peer evaluations will be conducted at the end of each project to ensure fair assessment of individual contributions.

Communication and Teamwork: Effective communication within teams is essential. team members should address any issues internally first, and if unresolved, bring them to the instructor's attention promptly.

4. **Classroom Behavior:**

Respect: Students should always show respect to peers and the instructor. Disruptive behavior will not be tolerated and may result in the student's dismissal from the class. Students caught violating the code of conduct will be summoned to appear before the disciplinary council.

Technology Use: Laptops and tablets may be used for notetaking and class activities only. Mobile phones should be silenced and not used during class time.

5. **Communication with Instructor:**

Office Hours: Students are encouraged to contact the instructor via email to book an Appointment if they need assistance outside the class.

Email: Email is the preferred method of communication outside of class. Students should expect a response within 24 hours during weekdays.

6. Academic Integrity:

Honesty: Students are expected to adhere to the highest standards of academic integrity. Plagiarism, cheating, and other forms of academic dishonesty will result in severe penalties, including zero mark in the course.

Academic dishonesty encompasses more than just cheating on exams or assignments. It also includes the following actions:

- ✓ Facilitating academic dishonesty for others
- ✓ Submitting someone else's work or work previously used in other courses without informing the instructor
- ✓ Receiving outside assistance without the instructor's permission
- ✓ Incorporating ideas from external sources (such as websites or library materials) without proper citation
- ✓ Assisting other students during exams

7. Course Policy on the Usage of Large Language Models (LLMs):

The use of Large Language Models & Generative Artificial Intelligence (GAI) tools (ChatGPT, DALL-E, Midjourney, etc.) is permitted. However, its use must be governed by ethical and responsible principles. Students are required to disclose any use of generative AI in their academic work, providing specific details about the nature and extent of the assistance received from the AI tool. This disclosure should be included in the appendices or at the end of the submitted work.

Furthermore, as the course instructor, I reserve the right to prohibit the use of GAI for certain assessments or assignments. In such cases, the prohibition will be clearly specified in the assessment guidelines.

Any undeclared or fraudulent use of generative AI will be considered a violation of academic integrity and may result in sanctions in accordance with the ESB ethical and academic integrity policies and guidelines.