INTERNATIONAL QUALIFICATIONS

AND ASSESSMENT CENTRE (IQAC)

«Approved»

2025 y. «16» 01

Programme	**LEVEL 5 EXTENDED DIPLOMA IN ARTIFICIAL INTELLIGENCE**		
Unit Number/ Unit Title	**UNIT 7 ADVANCED MACHINE LEARNING**		
Cohort Code:	L05AML-U7		
Unit Level	5		
Total GLH	Total qualification time 200/ Total Guided learning hours 90/ Self-guided learning hours 110		
Credits	20 CATS/ 10 ECTS		
Lecturer			
Start Date		**End Date**	

Unit Aims	Students will gain hands-on experience with algorithms such as ensemble methods, deep learning, and reinforcement learning. The unit will also emphasize model evaluation, tuning, and ethical considerations in deploying machine learning solutions.
Differentiation Strategies *(e.g. planned activities or support for individual learners according to their needs)*	The total number of students to be in the lesson is approximately 20. This is a multicultural group of students predominantly between the ages of 24 – 45, with numerous ethnic, gender, and creed background. These are UK academic level 5 students; hence it is assumed that they have practical, theoretical, or technological knowledge and understanding of a subject or field of work to find ways forward in broadly defined, complex contexts. These students must be able to generate information, evaluate, synthesise the use information from a variety of sources. Various approaches to addressing the various identified students needs will be adopted throughout the lesson. Such will include:- 1. Progressive tasks 2. Digital resources

	3. Verbal support 4. Variable outcomes 5. Collaborative learning 6. Ongoing assessment Flexible-pace learning
Equality & Diversity	Variety of teaching techniques will be employed to ensure that the needs of each individual learner are met.
Safeguarding & Prevent	Safeguarding policies and the Prevent duty are strictly observed to ensure the safety, well-being, and inclusivity of all students and staff.
Health & Safety	SIRM H&S policies will be maintained.
Learning Resources	**Teaching and Learning Materials**
	• "Deep Learning" by Ian Goodfellow, Yoshua Bengio, and Aaron Courville • "Pattern Recognition and Machine Learning" by Christopher Bishop • "Machine Learning: A Probabilistic Perspective" by Kevin P. Murphy.

Learning Outcome	Assessment Criteria
LO1. **Explore advanced machine learning algorithms.**	1.1 : Understand advanced supervised learning techniques such as ensemble methods. 1.2 : Implement support vector machines and kernel methods.
LO2. **Apply deep learning techniques**.	2.1 : Develop and train deep learning models. 2.2 : Utilize convolutional neural networks (CNNs) for image recognition tasks.
LO3. **Optimize machine learning models.**	3.1 : Apply hyperparameter tuning techniques. 3.2 : Use model evaluation metrics to optimize performance.
LO4. **Develop solutions for complex problems using machine learning.**	4.1 : Apply advanced machine learning techniques to real-world datasets. 4.2 : Evaluate and improve model robustness and generalization.

No	Learning Outcome / Topic	Learning and Teaching Activities	Which assessment criteria does the session relate to?	Day/month/year/ signature
1.	**Ensemble Methods Fundamentals**	**Ensemble Methods Fundamentals** Bagging vs. Boosting, bias-variance tradeoff	LO1: Advanced ML Algorithms	
2.	**Random Forests Deep Dive**	**Random Forests Deep Dive** Feature importance, OOB error, scikit-learn implementation	LO1: Advanced ML Algorithms	
3.	**Gradient Boosting Machines (GBM)**	**Gradient Boosting Machines (GBM)** XGBoost, LightGBM, CatBoost (comparative analysis)	LO1: Advanced ML Algorithms	
4.	**Support Vector Machines (SVMs)**	**Support Vector Machines (SVMs)** Hard/soft margins, kernel trick (RBF, polynomial)	LO1: Advanced ML Algorithms	
5.	**Kernel Methods Workshop**	**Kernel Methods Workshop** Implementing custom kernels for non-linear problems	LO1: Advanced ML Algorithms	
6.	**Neural Networks Review**	**Neural Networks Review** Feedforward networks, backpropagation refresher	LO2: Deep Learning Techniques	
7.	**Deep Learning Frameworks**	**Deep Learning Frameworks** TensorFlow vs. PyTorch comparison, GPU utilization	LO2: Deep Learning Techniques	
8.	Half-Term Exam	- Review of LO1 topics - Practice questions and mock assessment - **Half-term assessment** based on LO1 (theory)	LO1 LO2	
9.	**Training Deep Networks**	**Training Deep Networks** Vanishing gradients, ReLU, batch normalization	LO2: Deep Learning Techniques	
10.	**CNNs for Image Recognition**	**CNNs for Image Recognition** Convolutional layers, pooling, architecture design	LO2: Deep Learning Techniques	
11.	**Transfer Learning Lab**	**Transfer Learning Lab** Fine-tuning pre-trained models (ResNet, VGG)	LO2: Deep Learning Techniques	
12.	**Advanced CNN Architectures**	**Advanced CNN Architectures** Inception modules, residual connections (ResNet)	LO2: Deep Learning Techniques	

13.	**Hyperparameter Tuning**	**Hyperparameter Tuning** Grid search, random search, Bayesian optimization	LO3: Model Optimization	
14.	Final Exam Preparation & Review	- Comprehensive review of all learning outcomes - Practice questions and revision of key topics		
15.	Final Exam	- **Final-term assessment** covering all learning outcomes (theory and practical elements)		
16.	Feedback & Reflection	- Review of final exam - Individual feedback on performance - Reflective discussion on key learning points		
17.	**AutoML Tools**	**AutoML Tools** H2O.ai, AutoKeras (hands-on demo)	LO3: Model Optimization	
18.	**Model Evaluation Metrics**	**Model Evaluation Metrics** Precision-recall tradeoff, AUC-ROC, Fβ scores	LO3: Model Optimization	
19.	**Model Interpretability**	**Model Interpretability** SHAP values, LIME, feature attribution	LO3: Model Optimization	
20.	**Bias Detection & Mitigation**	**Bias Detection & Mitigation** Fairness metrics (demographic parity, equalized odds)	LO3: Model Optimization	
21.	**Time Series Forecasting**	**Time Series Forecasting** LSTMs, Prophet (Facebook's model)	LO4: Complex Problem-Solving	
22.	**Natural Language Processing (NLP)**	**Natural Language Processing (NLP)** Word embeddings (Word2Vec, GloVe), transformer overview	LO4: Complex Problem-Solving	
23.	Half-Term Exam	*Integrated Projects & Assessments* **Kaggle-Style Competition** End-to-end pipeline on a complex dataset (e.g., satellite images)		
24.	**Anomaly Detection**	**Anomaly Detection** Autoencoders, GANs for fraud detection	LO4: Complex Problem-Solving	
25.	**Reinforcement Learning Primer**	**Reinforcement Learning Primer** Q-learning, Deep Q Networks (DQN) concepts	LO4: Complex Problem-Solving	
26.	**Model Deployment Basics**	**Model Deployment Basics** Flask/Docker for ML APIs, ONNX format	LO4: Complex Problem-Solving	

27.	**Model Robustness Challenge**	**Model Robustness Challenge** Adversarial attacks (FGSM), defensive distillation	LO4: Complex Problem-Solving	
28.	**Capstone Project**	**Capstone Project** Solve a real-world problem (healthcare, finance, or IoT)	LO4: Complex Problem-Solving	
29.	Final Exam Preparation & Review	LO1, LO2, LO3, LO4	LO1, LO2, LO3, LO4	
30.	Final Exam		LO1, LO2, LO3, LO4	