University of Essex
MSc Artificial Intelligence
Module: ML_PCOM7E July 2025 B

<u>**Collected Unit Notes**</u>

For convenience, unit notes from this module are collected here.

Please note that my personal reflections on the learning process for the module subject matter, for the sake of brevity, are collected and presented in the Unit 12 reflective essay.

Unit 1: Introduction to Machine Learning

The objectives of this unit were to review the history and current state of the art of machine learning as a field, as well as to examine the interaction between machine learning and related fields such as big data analytics in the context of Industry 4.0 / 5.0.

My takeaway was a better understanding of the role of machine learning in modern industry, a sense of the skills needed to develop proficiency in creating machine learning applications, and a sense of the pitfalls of using machine learning-based software solutions.

I also contributed my thoughts to a collaborative discussion about an example of unexpected outcomes of human-computer interaction, with a focus on the "resilience" aspect of designing modern business process software.

Unit 2: Exploratory Data Analysis

The objective of this unit was to gain an introductory grasp of Exploratory Data Analysis (EDA), with a focus on identifying unusual, abnormal, or outlier points in a set of data points for the purpose of normalizing training data for machine learning applications.

My takeaway was a grasp of how to perform baseline EDA on real world data to prepare it for machine learning analysis.

Unit 3: Correlation and Regression

The objectives of this unit were to review the core elements of statistical correlation and regression, including computational methods and their application to real world data.

My takeaway was an understanding of the basics of how to perform correlation and regression analysis on real world data.

Aside from seminar preparatory exercises, I also summarized peer responses from Unit 1's collaborative discussion about an example of unexpected outcomes of human-computer interaction in the context of Industry 4.0 / 5.0.

Unit 4: Linear Regression With Scikit-Learn

The objectives of this unit were to develop familiarity using Scikit-Learn to model single variable and multivariate linear relationships, as well as the with the standards for evaluating model effectiveness.

My takeaway was a grasp of how to use Scikit-Learn to perform regression analysis on complex data.

Unit 5: Clustering

The objectives of this unit were to review the statistical concept of clustering, with a focus on K-means and agglomerative clustering, as well as evaluative standards for the same.

My takeaway was a better understanding of the logic that drives clustering analysis, as well as the pitfalls of industry-standard clustering techniques.

Unit 6: Clustering with Python

The objectives of this unit were to develop familiarity using Python to implement K-means clustering algorithms on large data sets.

My takeaway was a better grasp of how to perform and evaluate clustering analysis on large sets of data, as well as the standards for selecting appropriate Python libraries to do so programmatically.

I also completed the first major module project: a group project to develop and evaluate a predictive model for Airbnb rental prices in the greater New York City area.

My project role was to write the final report. I wrote all of the project report; code and visualizations were provided by other group members.

Unit 7: Introduction to Artificial Neural Networks

The objective of this unit was to gain a baseline understanding of perceptrons and

artificial neural networks (ANNs), including the algorithmic structure ANNs are derived from and the different types of functions used to compose ANNs and their implementation code.

My takeaway was an understanding of how to design, code, and evaluate the output of a basic ANN in Python.

Unit 8: Introduction to Artificial Neural Networks

The objectives of this unit were to review the concepts of error-handling and backpropagation in artificial neural networks (ANNs), as well as to review the application of ANNs to real world scenarios.

My takeaway was a better understanding of how to manage errors and the best practices for developing error handling code in Python-based ANNs.

I also started a collaborative discussion in the student forum on the subject of written material produced by ANNs, and the legal risks associated with developing generative writing ANNs from copyrighted training material.

Unit 9: Introduction to Convolutional Neural Networks

The objective of this unit was to review more advanced neural network models, such as convolutional neural networks (CNNs), dueling neural networks, and transformer models such as BERT and GPT.

My takeaway was a grasp of the basics of computer vision principles, along with an understanding of how to develop simple computer vision-related models and the Python code for them.

Unit 10: Natural Language Processing

The objective of this unit was to continue developing familiarity with transformer-based architectures such as BERT and GPT, as well as to review advances in natural language processing ("NLP") techniques and architectures.

I also summarized a collaborative discussion on the subject of written material produced by ANNs, and the legal risks associated with developing generative writing ANNs from copyrighted training material.

My takeaway was an understanding of the components and standard architectural patterns used to develop NLP models and systems, as well as the standards for evaluating the accuracy and utility of their outputs.

Unit 11: Model Selection and Evaluation

The objective of this unit was to deep dive into the workflow for machine learning models, evaluation, and production deployment standards. Machine learning operations (MLOps) was also introduced as a concept for further exploration.

My takeaway was a grasp of the standards for model selection, evaluation, and optimization, as well as industry-standard techniques for model hyperparameter tuning for more efficient model performance.

I also completed the second major project of this module, an individual presentation on coding and evaluating the accuracy of a convolutional neural network designed to categorize images from a set of stock thumbnails by image subject type ("car," "truck," etc.).

Unit 12: Industry 4.0 and Machine Learning

The objective of this unit was to focus on the emergence of Industry 5.0 as a paradigm, with an introduction to future areas of research in machine learning, such as self-supervised learning and neural architecture searches.

My takeaway was a broader understanding of the core principles of Industry 4.0 as compared to the emergence of Industry 5.0, and the associated challenges and opportunities to practicing machine learning professionals.

I also prepared an individual reflective essay on my module learning experiences, as viewed through the lens of the Gibbs' Reflective Cycle.