Task 3

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# Machine learning

Random Forest (n\_estimators=200)

Four multi-class supervised learning classifiers were investigated to find which algorithm better suited the CIFAR-10 dataset. These classifiers were Random Forest, Decision Trees, Naive Bayes and K-Nearest Neighbor. From initial findings, the Random Forest classifier produced better accuracy results (figure 1.1). With Random Forest as the selected model, the hyperparameter that helped improve performance was selected and fine tuned with GridSearchCV.

Random Forest (n\_estimators=200) model has an accuracy of 47% (46.82) (figure 1.2).

From the prediction results and confusion matrix, this model had better accuracy predicting aeroplanes, automobiles, frogs, ships and trucks, with an above 50% probability of producing a correct prediction (figure 1.0).

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| *Figure 1.0 - Confusion Matrix of the Random Forest Model* |

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| *Figure 1.1 - Accuracy Scores of the Four Machine Learning Models* |

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| *Figure 1.2 - Accuracy Score and Classification Report of Random Forest Model* |

# Deep learning

* In the deep learning task, the CIFAR-10 dataset was trained through a fine-tuned model derived from a pre-trained CNN model - ResNet50. With fine-tuning, the model gets better performance and accuracy, without spending too much time and data resources.
* Data normalization and feature extraction is facilitated by ResNet50 configuration.
* We chose CNN model over Vision Transformer, as Vision Transformer is not easy to apply to large datasets.
* Learn high-level features from data through many hidden layers of neurons

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| *Figure 2.0 - Accuracy and errors of train and validation performance during training* |

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| *Figure 2.1 - Deep learning Sample of prediction of test dataset with true results* |

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| *Figure 2.2 - Deep learning accuracy on test dataset* |

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| *Figure 2.3 - Deep learning confusion matrix (test dataset)* |

# Comparison of Deep Learning and Machine learning

In comparison to machine learning, deep learning achieves higher accuracy on unseen data (95% accuracy to 47% accuracy). Deep learning is suitable for dealing with larger and complex data. It can be seen that the deep learning model has better performance on image processing and classification over the machine learning model.

*Table 1.0 - Model Comparison*

|  | **Pro** | **Cons** |
| --- | --- | --- |
| **Machine Learning (Random Forest)** | Hyperparameter tuning does not require as many parameters to adjust.  High accuracy score can be reached if hyperparameter tuning is optimised.  Better performing machine learning algorithm for image classification.  The methodologies adopted are much easier to explain and understand. | Accuracy: 47% (46.82)  Not accurate enough for practical image classification of larger datasets.  High resource consumptions and runtime for tuning model based on the complex data set.  Limited scalability and less efficiency. |
| **Deep Learning (CNN model - ResNet50)** | High efficiency for image classification due to the concept of dimensionality reduction.  Accuracy: 95% | Requires much more time and GPU to train in comparison to the machine learning model. |