**Week 1 Report Summer Internship**

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7. **Abstract**

In this report I’ll be researching and familiarizing myself with this week’s topics, the main purpose behind these topics is to understand AI and the many components under its umbrella including ML and DL. I’ll focus on machine learning and its many algorithms and will implement 2 of these algorithms. Then do further research on Deep learning and how it is a subset of Machine learning.

1. **Introduction**

Artificial Intelligence may seem incomprehensible to the average onlooker. How could a fully binary machine mimic the human brain? Unlike other topics that only seem complex on the surface, AI tends to complete its end of the bargain because the complexity is genuine. AI must first be unfolded into its components for a full understanding, the biggest umbrella is AI, then under it fall its many subsets, in order of increasing specialization there exists machine learning, deep learning, neural networks, LLMs and transformers. In this report I will focus on machine and deep learning as they are foundational concepts to AI.

Understanding each of these components will prove necessary as today’s AI cannot be fully understood without at least a base understanding of each component, as today AI’s development speed is unlike anything we’ve seen for quite a while, and it continues to transform industries from healthcare to finance.

1. **Artificial Intelligence Fundamentals**

Put concisely, AI refers to the simulation of human intelligence performed by computer systems, it is continuously becoming a larger part of our everyday lives, thus the understanding of its concepts is increasingly useful. AI needs 3 things to work efficiently and differentiate itself from “basic code”, lots of data, algorithms, and computing power. This allows AI to find patterns in data using algorithms and come to conclusions that weren’t explicitly hard coded.

1. **Machine Learning and Key algorithms**

Machine Learning refers to a branch of AI focused on simulating human behavior through pattern recognition, machines/computers use algorithms along with a lot of fed data, to help them predict outcomes and make decisions.

According to UC Berkeley there are 3 main parts to ML algorithms. A decision process decides based on some input data using patterns from past data. An error function looks at the decision and evaluates it based on given examples to assess the accuracy of the model. Finally, the model optimization process checks if a certain accuracy threshold has been met and continuously adjusts the weights until the disparity between the model’s estimate and the example meets said threshold. This process repeats in a cycle, predict -> check error -> adjust.

Now onto the 3 broad categories of ML algorithms, supervised learning, unsupervised learning and reinforcement learning. Supervised learning is whereby an algorithm learns by using labeled data (input output relationship is known), this category includes algorithms such as linear regression, logistic regression and decision trees. The second category of ML algorithms is unsupervised learning, where algorithms work with unlabeled data to uncover hidden data patterns and groups. Unsupervised learning algorithms are once again split into 3 main categories, clustering algorithms which group data based on their similarities or differences, dimensionality reduction which is used to simplify data sets by conserving the most important information and association rules which are used to find patterns amid items in large datasets. The final category of ML algorithms is reinforcement learning algorithms, these algorithms reward training agents for good actions and penalize them for poor actions.

I conducted 2 types of supervised machine learning algorithms using Python along with scikit-learn libraries, the algorithms coded were linear and logistic regression. Using the sklearn.linear model library I imported the logistic regression formula and along with other relevant libraries such as sklearn.model\_selection for the train\_test\_split function, I tried different train test splits to study the correlation between accuracy and training time.

For logistic regression I used a Titanic dataset from Kaggle and achieved 100% accuracy for 0.2 test data. For linear regression I used a housing dataset and managed 75.9% accuracy with an average error of $631K.

1. **Deep Learning**

Another subset of AI is deep learning; it is also a subset of machine learning that uses multi-layered neural networks (DNN). Deep learning is currently used for modern AI from ChatGPT to Claude. It is different from traditional machine learning through its underlying neural network architecture. Deep learning can make pattern recognitions, derive groups and characteristics from unstructured data as well as produce outputs from that data which continuously improves in accuracy. Deep learning is powerful due to its ability to extract these features and patterns without the need for manual feature engineering; this allows it to deal with intricate issues such as natural language processing and computer vision.

1. **References**

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