

CHAPTER 2 PRACTICAL APPLICATIONS OF MACHINE LEARNING

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2.1 INTRODUCTION

Machine learning (ML) is present in many areas of our daily lives and is transforming entire industries, not just those in schools or research labs. For instance, it is used when your phone unlocks by scanning your face, and it also enhances the quality of care in hospitals. Overall, ML significantly impacts how we live and how we perform tasks at work. In healthcare, ML helps doctors identify diseases earlier and more accurately by analysing medical data, leading to personalised treatment plans. Farmers utilise ML to predict crop yields and monitor soil health, improving productivity and sustainability.

In finance, ML enables quicker fraud detection, automated credit scoring, and algorithmic trading, ensuring fairer and more secure decisions. Overall, ML has moved from research labs to become an essential part of our everyday experiences, making life more efficient. In the world of manufacturing and logistics, ML is transforming the landscape. By utilising the power of predictive maintenance, companies can avoid expensive machine breakdowns before they happen. This proactive approach not only saves money but also ensures operations run smoothly. On the supply chain side, demand forecasting using ML

allows businesses to swiftly adapt to market changes, ensuring customers' needs are fulfilled.

The impact of ML isn't limited to industry alone; its ripple effect extends to the education sector. Adaptive learning platforms use advanced technology to personalise educational content for every student. This customised approach creates a more engaging and relatable learning experience. By allowing students to learn at their own pace and tackle their unique challenges, it significantly enriches their educational journey.

The recent surge of innovation led by powerful foundation models like GPT-5, Gemini 2.0, and Claude 3 has made these technologies more accessible and impactful than ever. These advanced ML systems are not just about calculating numbers or processing text, they have learned to combine various types of data, text, images, and sensor inputs to navigate complex environments in real time. This capability can be seen in everything from steering autonomous vehicles safely down city streets to optimising energy consumption in smart grids.

Machine learning (ML) transforms raw information into actionable insights. It changes processes across countless fields, allowing people to tackle problems more efficiently, make informed decisions, and reveal insights that were previously uncovered. In this chapter, we will discover how the theories discussed transform into real-world solutions that not only boost industries but also bring communities closer together and make our day-to-day experiences more meaningful.

2.2 CURRENT LANDSCAPE OF MACHINE LEARNING APPLICATIONS

The world of ML is incredibly diverse and always changing. With the arrival of attention mechanisms (Vaswani et al., 2017) and transformer models (Devlin et al., 2019), we have seen a remarkable boost in how efficient and effective these algorithms can be. These innovations are really pushing the limits of what's possible in this field. Whether it's supervised, unsupervised, or reinforcement learning, these techniques

are being applied to a wide range of problems, demonstrating just how adaptable and powerful they are in tackling complex challenges.

2.2.1 Application of Supervised Learning

Supervised learning is a widely used method in ML that is very effective for solving complex problems in various fields. In this approach, models are trained using labelled data, with each input paired with its corresponding correct output. This gives the algorithm the chance to understand how input features relate to the target labels. After training, these models can use what they have learned to make predictions on new, unseen data. Supervised learning finds its uses in various areas like healthcare, finance, self-driving cars, and even natural language processing (NLP), helping us make better decisions and automate processes.

(1) Healthcare: Medical diagnosis and prognosis

One of the most impactful applications of supervised learning is in the healthcare industry, particularly in medical diagnosis and prognosis. By analysing patient data, such as medical history, imaging, and lab results, supervised learning algorithms can assist in diagnosing diseases and predicting patient outcomes. For instance, supervised models like logistic regression, support vector machines (SVMs), and random forests (RF) are commonly used to predict the likelihood of diseases such as cancer, diabetes, and cardiovascular conditions. Advancements in technology have really transformed how we approach medical diagnostics. One significant development involves using models that can sift through vast amounts of historical patient records. These models spot patterns that might be overlooked by even the most experienced doctors.

In the field of medical imaging, techniques like supervised learning, particularly convolutional neural networks (CNNs), have made a huge impact on how accurately we can diagnose conditions in radiology. These neural networks are adept at analysing medical images, such as X-rays, magnetic resonance imaging (MRIs), and computed tomography (CT) scans, to identify issues, for instance, tumours or