# AIG110 Artificial Intelligence

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## Introduction

Machine learning refers to a branch of artificial intelligence that develops an algorithm so computers can learn through data to make predictions without being explicitly programmed. Rather than being explicitly told to do the activity, besides being programmed explicitly, ML models focus on the patterns in data. Therefore, better accuracy is established after a certain period when more and more information gets processed. This enables various applications, from image recognition to natural language processing, making ML a mighty weapon in many fields. This importance is reflected in increasing personalization in our lives, enhanced efficiency across industries, and better decision-making based on big data analysis. The role it has played so far in shaping daily experiences and improving various sectors will continue to grow. (OpenText, 2025)

## Application 1: Medical Imaging Analysis

### Description:

Medical imaging analysis involves training, including X-rays, MRI, and CT scans. It is the algorithms that eventually learn from and identify patterns linked to specific diseases or conditions. After being trained, they are used to analyze new images regarding abnormal detection, condition classification, and even feature quantification in the severity of a disease. It aids radiologists and medical practitioners in making quick and correct diagnoses for better patient care. (R. P., 2024)

### Types of ML:

Medical imaging analysis usually employs the use of machine learning, such as supervised learning, where models are trained using labeled data, followed by CNNS, which are very good in image analysis. It also involves unsupervised learning, where it detects a pattern without a label and moves the learning, which fixes pre-educated models for special tasks. (R. P., 2024)

### Benefits:

It enhances the accuracy, speed of interpretation, consistency of results, early detection of disease, quantification of features, and optimization of resources. These are the advantages that have improved patient outcomes with better healthcare delivery. (Zheldak, P.,2025)

### Drawbacks:

The challenges of machine learning in medical imaging analysis include data quality issues, difficulties in generalization to new data, lack of interpretability of model decisions, high computational resource requirements, regulatory and ethical concerns, and challenges in integrating ML tools into clinical workflows. (Zheldak, P.,2025)

### Real-world Example:

Google's DeepMind has developed AI that can detect eye diseases by analyzing retinal scans. (Google)

### Ethical Considerations:

**Bias and Fairness** – ML Models Training on a Particular Demography or Sample set of People cannot be used to Diagnose Patients from Different or Unrelated Demography.

**Privacy** – Using or Providing ML Models Patient Data is a Cause for Concern & measures for Data Protection Must be put in Place.

**Accountability** – If ML Models is utilized to make a Diagnosis, its Algorithm must be put to Tests/Scrutiny cause diagnosing a Patient is dealing with Human Life and must be Carefully Done. (NLM-PMC, 2024)

## Application 2: Customer Service Chatbot

### Description:

The chatbots in customer service use machine learning, mainly through understanding user queries with natural language processing, recognizing users' intent for what they want, and learning from past interactions to improve responses. They make interactions personalized based on user data and perform sentiment analysis to adjust responses according to the emotional tone of the user. (Lime Chat, 2024)

### Types of ML:

Customer service chatbots need variants of machine learning, which means training systems using supervised and unsupervised learning to create patterns from data and even reinforcement learning trial-and-error methods to optimize their performance following received feedback. They embed many techniques ranging from natural language understanding to language generation. (Lime Chat, 2024)

### Benefit:

It follows 24x7 availability, immediate answers, cost efficiency, scalability, consistent answers, and rich data gathering on customer preference, which are all benefits that come with customer service chatbots. Perhaps such benefits might create higher quality for general customer service and support. (Lime Chat, 2024)

### Drawback:

Challenges of customer service chatbots include a limited understanding of complex queries, a lack of human touch, potential technical issues, reliance on the quality of training data, and integration difficulties with existing systems. (Lime Chat, 2024)

### Real-world Example:

Sephora uses chatbots to assist customers by answering questions about products, providing personalized recommendations based on preference and helping with order tracking. (Lime Chat, 2024)

### Ethical Considerations:

**Bias and Fairness** – Chatbots are trained on Stereotype & Standard Data of Existing Interactions, so all Training Data must be Fair & Bias to Avoid Miscommunications with different User Groups.

**Privacy** - The collection and processing of customer data pose significant risks, especially if personal or sensitive information is not handled while keeping in mind Data Privacy Guidelines

**Job Displacement** – Automation using Chatbots will reduce the Need for Human Interactions & Could shut down all the Call Centers in this world which Provides a Huge Sector of the Society with Jobs.

**Accountability** – If chatbots Provide Misleading/Outdated Information, it can be Critical to the Business’s Operations. (Code Academy, 2025)

## Application 3: Autonomous Vehicles

### Description:

Autonomous cars process huge amounts of information coming from sensors, cameras, and radar with a view of the world outdoors by using machine learning. Specifically, ML algorithms assist such vehicles in identifying objects, recognizing road signs, and predicting pedestrian behavior, coupled with that of other cars on the road. A system will drive more in real-world scenarios to be better equipped with self-improving decisions to handle tricky situations on roads graciously and efficiently. As time goes on and they experience more situations, their performance further improves to make them even more road reliable. (Marshall, A. D. A.,2021)

### Type of ML:

In general, autonomous vehicles depend on how the processes of supervised and unsupervised learning intertwine with reinforcement learning. Supervised learning is mainly about training several models with images and videos to identify objects and their decisions to drive. As opposed to this, unsupervised learning can also be seen by clustering or detecting anomalies to learn a pattern or an anomaly in data. Fine-tuning them with reinforcement learning, therefore, enables them to learn by trial and error- just drive, improve performance, and learn in the process. (Hong, Z.,2024)

### Benefits and drawbacks:

Some advantages of these vehicles are road safety, reduction in accidents, mobility for persons with disability challenges, and intelligent transportation systems. However, some challenges entail some technical hurdles, regulatory obstacles, ethical problems, and issues related to a human driver’s job loss. An autonomous driving car, by nature, all electronic, gives rise to questions of liability when an accident occurs, ethics and morals when emergencies arise, and changes that might be forced upon public transportation. (Marr, B., 2021)

### Real-world Example:

Waymo has developed a fleet of fully autonomous vehicles that use ML to navigate complex urban environments. (OpenText, 2025)

### Ethical Considerations:

**Bias and Fairness** – The Problem with Autonomous Vehicles is that they would be trained in Ideal Conditions. The Model must be able to Adapt to any new Situation Including Difficult Traffic &or Harsh Weather Conditions.

**Privacy** – The Data Collected from the Car’s Components like Sensor, Camera Feed, and Travel logs must remain Private, & Measures to make sure no Data Leakage happens are Important.

**Accountability** – In the event of accidents/speeding dilemmas arise on who is to blame (eg, manufacturers, software developers, and human operators). (Lampinen, M.,2023)

## Conclusion

Machine Learning is Providing Significant Advances to Healthcare, Customer Support, Transportation, etc. Each Application Brings Unique Opportunities & new Challenges to the Society. While ML Provides Benefits like Efficiency, Accuracy, Personalised Experience, Higher Safety, Reduction of Human Error it has many Ethical Downsides which must be Addressed & Regulations should be put in Place. We believe that with proper Regulations, Policy’s & Guidelines the potential benefits of ML can be realized while mitigating its challenges. The Future of ML is Very Promising but it’s long-term Success depends on Balance between Innovation & it’s corresponding Ethical Responsibilities this must be done to ensure fair, secure, and sustainable societal progress. (365 Data Science, 2024)

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