

Machine Learning for Education

Revolutionizing the way we learn and teach

**Dr. Amit Dua
Sankha Das
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Dedicated to

*Tony Robbins and Dr. Anamika Chawhan —
inspirational mentors igniting my passion
for lifelong learning.*

— Dr. Amit Dua

*“Dedicated to my best friends:
Baba and Phiphi.”*

— Sankha Das

*“This book is dedicated to my parents,
my sisters, and Iris.”*

— Pulkit Sinha

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— *Dr. Amit Dua*

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— *Sankha Das*

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— *Pulkit Sinha*

Preface

This book is a comprehensive guide to understanding and utilizing machine learning techniques in the field of education. The book covers a wide range of topics, including supervised and unsupervised learning, deep learning, transfer learning, etc. It also includes practical examples and case studies of the successful implementation of machine learning in educational settings. Whether you are an educator, administrator, or researcher, this book provides valuable insights and strategies for leveraging the power of machine learning to improve student outcomes and enhance the educational experience.

The book is divided into five chapters, with the first chapter aimed to be an introduction to machine learning. The remaining chapters examine the educational scenario from different perspectives of students, parents, and educators and how machine learning can be used as an exemplary tool in the same.

Chapter 1: Basics of Machine Learning- will cover the basic concepts related to machine learning and its applications. The chapter introduces the idea of machine learning from the viewpoint of a human learner and slowly builds up toward the idea of an intelligent machine. The chapter also touches on the need for machine learning in the contemporary world and the various domains in which machine learning has found applications. A number of myths and misconceptions related to hot buzzwords, such as machine learning, artificial intelligence, data science, etc., have been addressed in this chapter to build a strong foundation for the reader for the forthcoming chapters. The chapter also introduces the different sub-domains under machine learning, such as supervised and unsupervised learning, deep learning, reinforcement learning, etc., which are topics of much research and interest in today's industry and academia.

Chapter 2: Machine Learning for Students- talks of how machine learning can be useful to students for the betterment of their educational journey. The chapter identifies scopes of improvement

in the current education system and tries to propose elegant enhancements to the same using machine learning concepts learned in the previous chapter. The chapter also contains a section on education for specially-abled children which is a topic of much social concern these days.

Chapter 3: Machine Learning for Parents- builds on the previous chapter and talks about the concerns and queries faced by parents regarding their children's education. The chapter proposes ideas for a better home environment and parent-child relationship when it comes to education and how machine learning can come in handy in such cases.

Chapter 4: Machine Learning for Teachers- shifts the lens from the home to educational institutions such as schools and universities. This chapter chiefly talks about the tasks and responsibilities entrusted to teachers and the various difficulties that they often face in the pursuit. Machine learning can prove to be an apt aid in improving the way instruction takes place in classrooms and easing teachers' work in evaluating assessments and grading students. The same aspects have been covered in this chapter in the form of thought-provoking examples and encouraging project ideas.

Chapter 5: Machine Learning for Educational Administrators- is the final chapter of the book, which addresses the concerns of educational administrators such as principals and deans who manage and run educational institutions often housing thousands of students and hundreds of teachers. The chapter gives insights into how challenging tasks such as managing student admissions, recruiting instructors and staff, and overseeing institution infrastructure can be eased by the advent of machine learning. Furthermore, the role of educational institutions in promoting education on a national and international scale has also been identified, and suggestions for the betterment of the current educational scenario have been provided by means of this chapter.

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CHAPTER 1

Basics of Machine Learning

Introduction

One of the most interesting things to observe in nature is how organisms evolve. How do different living things adapt to their environment, how do they get to know their surroundings, and how do they respond to stimuli? All these questions are raised by the organism itself at some point or the other. Even a human baby asks itself whether putting a piece of chocolate in its mouth will make it feel better or will make it feel uncomfortable. All such questions have their answers too: answers one is told about or answers one learns through personal experience. These answers are often memorized, consciously or subconsciously, by the organism so as to use them when a similar situation arises again in the future.

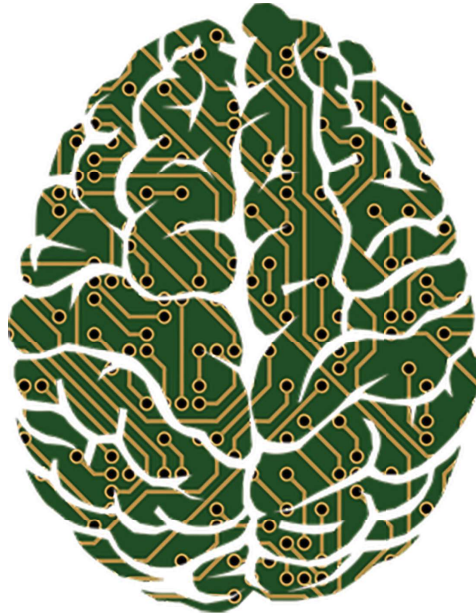


Figure 1.1: Can machines possess intelligence?

For a living organism, this process of “learning” continues throughout its lifetime, and the techniques associated with the same often become more and more specialized over time. But can even non-living things think and learn? Can a machine such as a mobile phone, laptop, or television have “intelligence” as humans or other species do? Let us try to answer these questions one by one.

Structure

In this chapter, we will cover the following topics:

- What is machine learning
- The rise of machine learning
- Applications of machine learning
- The need for machine learning
- Different dimensions of machine learning

Objectives

This introductory chapter aims to familiarize the reader with the idea of machine learning and help them to appreciate the same in our day-to-day lives. Here, we smoothly transition from a crude understanding of learning in general to the idea of how machines undergo the same process, trying to find similarities and differences between them and humans. We also try to bust some common misconceptions about machine learning and distinguish between machine learning and artificial intelligence, two closely related yet distinct buzzwords. The reader will then be in a good position to understand how machine learning has made itself a place in the modern world and transformed it in myriad ways at a steady pace. The chapter concludes with a section on the different dimensions of machine learning, providing details on the various forms of machine learning prevalent in the industry and academia these days.

What is machine learning?

Put in very simple words, machine learning as a collective term refers to how a machine thinks and learns about certain events, objects, or actions to be performed. The process of learning is very complex and long-drawn, with many interesting observations that can be made throughout it. To understand machine learning in detail, one may start by understanding how human intelligence works and how it differs from machine intelligence.

Human intelligence versus machine intelligence

To distinguish between human intelligence and machine intelligence, perhaps we first need to ponder over what exactly intelligence is. Let us start with the dictionary definition. The Merriam- Webster dictionary defines intelligence as the ability to think about, learn, understand, and often manipulate the environment and situations that an individual is faced with. Relating this to our own life, we try to use intelligence right from waking up in the morning to going to bed at night. We think about the steps that we should complete

before having breakfast (brushing our teeth, taking a bath, and going for a jog), the route that we should take to reach our workplace or university, the food that we should have for lunch, which movie to watch for the evening, and so on.

For all these events, we often rely on our past experiences and the knowledge we gain about each one of them to make an informed decision. For example, we decide upon which movie to watch based on many factors such as the star cast, the genre of the movie, the reviews we have received about the movie from the news or friends, how much money we must pay for the ticket, whether we will have enough time to reach the theater and other details. Based on our own experience after watching the movie, we might change our own thoughts about the movies generally featuring the specific star cast, the general plot of movies from the specific genre, the average cost of tickets for such movies, and so on. These activities are very much related to the process of learning: learning about our surroundings, learning about events taking place around us, learning from information agents around us, and learning from our own experiences.

When we say that the topper of the class is very intelligent, what we mean to say is that she uses her knowledge and experiences in a very efficient and logical manner to arrive at correct answers to the problems at hand. This example gives us a sufficiently good and practical understanding of intelligence and learning.

Let us return to our previous question: do machines also think and learn, and if yes, how do they do so? Our young friend Jane is just as confused about the same question! Professor M. says that if we suppose that machines think as humans do, then it would be cruel to do so. A machine should be at liberty to think in its own way. However, it is interesting to know that how machines have evolved to think over the decades is similar to how a human learns from its surroundings and experiences. A machine like a laptop or mobile phone may be perceived in its simplest form as an organized collection of wires, microprocessors, and physical parts such as screens and buttons. The machine is “programmed” or instructed to do a certain task when subjected to a sequence of actions performed on it (for example, pressing a certain button, typing in a piece of text, pressing