Introduction

This is the second edition of my book “Applied Deep Learning” that has been updated for TensorFlow 2.X. The goal of this book is to teach you the necessary fundamentals of how neural networks works, how to train them and how to implement them with Keras. We will start from what is a neuron, what you can achieve with just one, then move to multiple layers in feed forward neural networks. You will learn what is regularization and how to use it, how advanced optimizers (as Adam) works and how to do hyperparameter tuning. At the end we will look at some advanced topics, as autoencoders, metric analysis and generative adversarial networks (GANs). If you are new to the subject, I suggest you read the chapters in order, but if you have already some experience, and you want to look at a specific topic, you can directly jump to the relevant part. The chapters are self-contained, but each refers to concepts explained in previous ones so in case you don’t know what a specific symbol or concept means, you can refer to the previous chapters. I tried really hard to keep the mathematical notation and programming style as consistent as possible to make following the book easier. In the book I only discuss very short code snippets (the one I consider relevant) so you will not find complete code to copy and use, but don’t worry. This book has an online version where you will find lots of Jupyter notebooks that you can use and that will be updated regularly with new examples and topics. You can find it at

<https://adl.toelt.ai>

So anytime you would like to see complete code in action, go there and you will find complete examples that you can download or open in Google Colab to try the examples yourself. TensorFlow gets updated very often, and giving in the book lots of code examples would make the book outdated very quickly!

# Whom this book is for

To profit from this book you should have an intermediate python programming experience. It is good if you understand how the NumPy library works, since it is used extensively with TensorFlow and therefore learning it pays off. You should also have a basic understanding of algebra and calculus. You should understand *at least* the following concepts:

* What is a matrix
* How to do basic operations on matrices, like multiplication, inverting them, etc.
* What a derivative is (and what a partial derivative is)
* How to calculate easy derivatives
* Know what a function is and what it means to minimize it

If you understand those concepts, you should be fine in following the explanations in the book. I marked the sections that are more mathematical heavy, and if you want you can skip them without too many consequences. I also always give some practical tips at the end, that should give you some practical tips for you to follow.

# Do I need to know TensorFlow/Keras?

This is a tricky question. The more you know the more you will be able to profit from the book. But the main goal of this book is not to teach you Keras, but to teach you how neural networks work and give you implementation examples in Keras. Let me stress it again: the focus is on “understanding how neural networks work”, now on how Keras work. This is **not** a book on Keras. The best way of learning all the particularities of Keras is to look at the official documentation (https://www.tensorflow.org/learn) that is always up to date and contain many examples. This book will cover the necessary skills you will need to understand basic examples but if you want to really understand all subtleties, you should go to the official documentation and study it.

You will probably be able to understand most of the concepts even without knowing how Keras work, but the more experience you have, the easier it will be for you to follow the explanations.

# How to setup your environment

There are several ways of setting up a development environment to try the code we will discuss in this book. I have worked very hard to make sure that you can run all the examples in the book in Google Colab (<https://colab.research.google.com/>), so that you don’t have to install anything on your personal laptop or PC.

# Final Words

I hope that this book will give students a clear curriculum to follow to study neural networks in the most structured and easy way. The topics are not easy and require effort and time. Thus, the students should not be discouraged. Unfortunately to do real machine learning projects is very different than simply copying-pasting from some blog in internet. Programming is only a part of it, and without knowing how the algorithms work, writing code will be useless, and in the worst case will give wrong results.

Dübendorf, 29th October 2021