

[Neural Networks: An Introduction](#)

[Deep Learning: Foundations and Concepts](#)

[Neural Networks and Deep Learning](#)

[Dive into Deep Learning](#)

[Deep Learning Tuning Playbook](#)

[Algebra, Topology, Differential Calculus, and Optimization Theory For Computer Science and Machine Learning](#)

[Neural Networks: Zero to Hero](#)

[Practical Deep Learning](#)

[Designing Machine Learning Systems](#)

## Neural Networks: An Introduction

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Neural networks have been studied for many decades, but it's especially since 2012 that they have come to dominate the state of the art in many machine learning fields, such as computer vision, NLP, reinforcement learning, generative AI, and so forth. They are the foundational building blocks of LLMs. The following list of resources focuses upon gaining a foundational mastery. The resources cover everything from math, coding, to engineering, all with a practical orientation.

All LLMs are built on a foundation of deep neural networks (deep learning). The following materials provide a solid foundation on which to build your learning of LLMs.

All sources are excellent in quality. We added a score (up to 5 stars) for difficulty, 5 stars means very difficult.

### [Deep Learning: Foundations and Concepts](#)

Difficulty: 

Christopher Bishop (Cambridge and Microsoft) is one of the world's best known specialists on machine learning and deep learning. This recent book is a tour de force through all the main deep learning ideas and techniques, including transformers. It is recommended to anyone who wants to understand the statistical and mathematical foundations of deep learning and LLMs.

Use for: Referring to the book when you need a strong mathematical and statistical explanation.


## [Neural Networks and Deep Learning](#)

Difficulty: 

This is one of the clearest explanations (with python code) of the basic ideas of deep learning. It goes through the relevant math clearly and slowly. It's a bit long if you know the basics.

Use for: Learning to build deep learning models without the use of external frameworks (such as PyTorch), just using Python.

## [Dive into Deep Learning](#)

Difficulty: 

A very useful resource with a choice of code from the major platforms. The exercises are planned well, and the forum is helpful to learners. It's useful as a foundation for LLMs.

Use for: Pre-made notebooks for PyTorch and MXNet, available on Google's Colab and on Amazon's SageMaker Studio Lab.

## [Deep Learning Tuning Playbook](#)

Difficulty: 

An excellent resource from Google employees. It covers many important steps in the process of tuning deep learning models. It distills the knowledge gained from tuning many models, the kind of practical knowledge you gain from reading multiple papers.

Use for: Reference if you need to tune models (instead of for example, training them from scratch). It's a fantastic resource that shares a lot of hard-earned "secrets" that are difficult to find anywhere else.

## [Algebra, Topology, Differential Calculus, and Optimization Theory For Computer Science and Machine Learning](#)

Difficulty: 

A tour de force through the math relevant for machine learning, deep learning, and more. It's (at the time of typing this) over 2100 pages long. Useful as a resource to consult when you need it more than a book you read cover to cover.

Use for: The most comprehensive reference source on various mathematical topics relevant to ML and deep learning.

## [Neural Networks: Zero to Hero](#)

Difficulty: 

Andrej Karpathy is one of the most accomplished deep learning specialists in the world, with important roles at OpenAI and Tesla. His teaching style is very popular and he has been sharing his practical knowledge for over a decade. He's active on several media platforms.

Use for: You want to learn deep learning from scratch, with just some knowledge of Python and math, and learn best by watching videos and coding along.

## [Practical Deep Learning](#)

Difficulty: 

Fast AI is one of the most influential resources on deep learning and neural networks, including LLMs. You can learn pretty much all the basics and intermediates from this resource, setting you firmly on a solid trajectory.

Use for: Comprehensive and well-designed, it's particularly useful as they use HuggingFace for NLP and elsewhere, one of the most important parts of the deep learning and LLMs ecosystem

## [Designing Machine Learning Systems](#)

Difficulty: 

Even though it's fundamentally important, there are few resources that cover the life-cycle of machine learning-based products. The author is well-known in Silicon Valley for her contributions to many startups and companies.

Use for: Learning practically how to design and implement ML systems, including deep learning systems. This resource is much more focused on the engineering side of things compared to the previous ones.