

of various sizes, and computing the number of parameters and storage requirements of GPT models.

Chapter 5 implements the pretraining process of LLMs. It covers computing the training and validation set losses to assess the quality of LLM-generated text, implementing a training function and pretraining the LLM, saving and loading model weights to continue training an LLM, and loading pretrained weights from OpenAI.

Chapter 6 introduces different LLM fine-tuning approaches. It covers preparing a dataset for text classification, modifying a pretrained LLM for fine-tuning, fine-tuning an LLM to identify spam messages, and evaluating the accuracy of a fine-tuned LLM classifier.

Chapter 7 explores the instruction fine-tuning process of LLMs. It covers preparing a dataset for supervised instruction fine-tuning, organizing instruction data in training batches, loading a pretrained LLM and fine-tuning it to follow human instructions, extracting LLM-generated instruction responses for evaluation, and evaluating an instruction-fine-tuned LLM.

About the code

To make it as easy as possible to follow along, all code examples in this book are conveniently available on the Manning website at <https://www.manning.com/books/build-a-large-language-model-from-scratch>, as well as in Jupyter notebook format on GitHub at <https://github.com/rasbt/LLMs-from-scratch>. And don't worry about getting stuck—solutions to all the code exercises can be found in appendix C.

This book contains many examples of source code both in numbered listings and in line with normal text. In both cases, source code is formatted in a fixed-width font like this to separate it from ordinary text.

In many cases, the original source code has been reformatted; we've added line breaks and reworked indentation to accommodate the available page space in the book. In rare cases, even this was not enough, and listings include line-continuation markers (➡). Additionally, comments in the source code have often been removed from the listings when the code is described in the text. Code annotations accompany many of the listings, highlighting important concepts.

One of the key goals of this book is accessibility, so the code examples have been carefully designed to run efficiently on a regular laptop, without the need for any special hardware. But if you do have access to a GPU, certain sections provide helpful tips on scaling up the datasets and models to take advantage of that extra power.

Throughout the book, we'll be using PyTorch as our go-to tensor and a deep learning library to implement LLMs from the ground up. If PyTorch is new to you, I recommend you start with appendix A, which provides an in-depth introduction, complete with setup recommendations.

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Other online resources

Interested in the latest AI and LLM research trends?

- Check out my blog at <https://magazine.sebastianraschka.com>, where I regularly discusses the latest AI research with a focus on LLMs.

Need help getting up to speed with deep learning and PyTorch?

- I offer several free courses on my website at <https://sebastianraschka.com/teaching>. These resources can help you quickly get up to speed with the latest techniques.

Looking for bonus materials related to the book?

- Visit the book’s GitHub repository at <https://github.com/rasbt/LLMs-from-scratch> to find additional resources and examples to supplement your learning.

about the author



SEBASTIAN RASCHKA, PhD, has been working in machine learning and AI for more than a decade. In addition to being a researcher, Sebastian has a strong passion for education. He is known for his bestselling books on machine learning with Python and his contributions to open source.

Sebastian is a staff research engineer at Lightning AI, focusing on implementing and training LLMs. Before his industry experience, Sebastian was an assistant professor in the Department of Statistics at the University of Wisconsin-Madison, where he focused on deep learning research. You can learn more about Sebastian at <https://sebastianraschka.com>.