Python for Scientific Computing and Artificial Intelligence

Stephen Lynch

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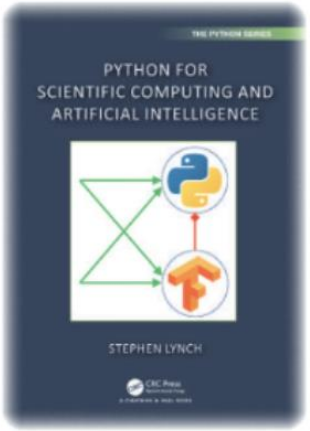
This textbook follows on the heels of the author's very successful *Dynamical Systems with Applications* series and, at 334 pages, is considerably shorter. It is written in such a way as to engage a wide audience, from high school students through to late-stage undergraduates and even postgraduate researchers. Capturing the interest of such a broad readership is no mean feat but Stephen Lynch FIMA has somehow managed to make it look easy.



Part 1 contains five chapters that give the reader a self-contained introduction to Python. The opening chapter provides a tutorial-style guide to the IDLE/Python Shells and Editor windows, introducing some basic commands and control structures before setting simple programming tasks. Chapter 2 moves on to the Anaconda user interface and Spyder environment, along with the NumPy, Matplotlib and SymPy libraries. The increasingly popular Jupyter Notebooks and Google Colab are covered in Chapter 3, and time is also spent explaining how to create animations and interactive plots.

Of particular note are Chapters 4 *Python for AS-level mathematics* and 5 *Python for A-level mathematics*. They present a compelling case for embedding Python in particular, and programming in general, within A-level syllabi. There is no shortage of applications drawn from core topics in pure mathematics, mechanics and statistics. The example codes are simple and concise, and they illustrate the force multiplier that comes from weaving together mathematical ability with computational know-how.

Part 2 is on scientific computing and addresses a staggering array of subject areas. The ten constituent chapters are *Biology*, *Chemistry*, *Data science*, *Economics*, *Engineering*, *Fractals and multifractals*, *Image processing*, *Numerical methods for ordinary and partial differential equations*, *Physics* and *Statistics*. Each offers a diverse selection of topics – for instance, the *Physics* chapter attacks fast Fourier transforms, nonlinear optical resonators, Josephson junctions and the classic three-body problem. In each case, the governing equations are stated along with background qualitative information for some context. An example problem is then posed and a worked solution given by way of a code. Helpfully, the desired output is shown so the reader knows what each program ought to do.

It is evident that Stephen has aimed his book squarely at the practical aspects of scientific computing; he focuses much more on aspects of programming and producing effective visualisations early-on rather than dwelling on extensive technical details. This is a sensible choice and, in my view, his formula works exceedingly well. Each chapter contains set exercises comprising four questions with various complexity; brief solutions are provided at the back of the book. As an added bonus, full 'answer' codes are readily available on the author's personal GitHub pages – this is an enormously useful supplementary resource to assist students with their debugging. Each chapter also closes with a fairly extensive reference list for those readers wanting to discover more about the mathematics underpinning specific systems. To that end, Stephen Lynch's *Dynamical Systems with Applications using Python* (Birkhäuser, 2018) is probably the most logical companion piece.

Part 3, slightly smaller in scope, introduces the reader to the concept of *Artificial intelligence* (AI). Its five chapters are *Brain inspired computing*, *Neutral networks and neurodynamics*, *TensorFlow and Keras*, *Recurrent neural networks*, and *Convolutional neural networks, TensorBoard and further reading*. Taken together, these are key elements needed to grasp the fundamentals of an emerging field that seems destined to play such a major role in our society.

This book has been a pleasure to read. Writing it has clearly been a labour of love, and the author's more than two decades of experience in delivering Python and related content to national and international audiences is evident from the off. The text has been painstakingly considered and, as a result, is always very readable and instructive. More than that, the 155 colour figures are carefully prepared and beautifully presented, which shows a respect not just for the material he is putting across but also for his readers and their learning.

For students, the book is crammed absolutely full of real-world examples to help learn Python quickly and efficiently from scratch. The content spans so many topics across so many subject areas that surely all interests are accommodated somewhere within. For instructors, it provides a gold mine of ideas for preparing our own courses and is likely one for the reading list. The inclusion of AI, very much a hot topic for today and for the foreseeable future, also gives this book a cutting-edge feel. I fully expect Stephen's book to become another hit with students and lecturers alike.

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