

*Event-driven Network Programming  
with Python*

**2nd Edition**

# Twisted

*Network Programming Essentials*



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*Jessica McKellar  
& Abe Fettig*

# Twisted Network Programming Essentials

Get started with Twisted, the event-driven networking framework written in Python. With this introductory guide, you'll learn the key concepts and design patterns to build event-driven client and server applications for many popular networking protocols. You'll also learn the tools to build new protocols using Twisted's primitives.

Start by building basic TCP clients and servers, and then focus on deploying production-grade applications with the Twisted Application infrastructure. Along the way, you can play with and extend examples of common tasks you'll face when building network applications. If you're familiar with Python, you're ready for Twisted.

- Learn the core components of Twisted servers and clients
- Write asynchronous code with the Deferred API
- Construct HTTP servers with Twisted's high-level web APIs
- Use the Agent API to develop flexible web clients
- Configure and deploy Twisted services in a robust and standardized fashion
- Access databases using Twisted's nonblocking interface
- Add common server components: logging, authentication, threads and processes, and testing
- Explore ways to build clients and servers for IRC, popular mail protocols, and SSH

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**Abe Fettig** is a software developer and maintainer of Hep, an open source message server that makes it possible to route information transparently between RSS, email, weblogs, and web services. He speaks frequently at software conferences, including PyCon.

“Twisted Network Programming Essentials provides clear and concise coverage of the major features and provides an excellent introduction to event-driven programming in Python, using working examples of network server code. Jessica's chapters on making your code production-ready are a rare and welcome addition.”

—Adam Fletcher  
Site Reliability Engineer  
at Google

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SECOND EDITION

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# Twisted Network Programming Essentials

*Jessica McKellar and Abe Fettig*

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## **Twisted Network Programming Essentials, Second Edition**

by Jessica McKellar and Abe Fettig

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# Foreword to the First Edition

“My name is Ozymandius, king of kings:  
Look on my words, ye Mighty, and despair!”  
Nothing beside remains. Round the decay  
Of that colossal wreck, boundless and bare  
The lone and level sands stretch far away.

—Percy Bysshe Shelly, “Ozymandius”

As the Twisted project’s originator and nominal leader—and as someone who is not being paid for writing this—I can very honestly say that this is a fine book, and it has made me proud of what I’ve started. You now hold in your hands a wondrous key that contains the knowledge to unlock a very powerful software system—a software system borne of a consistent, methodical vision; a vision half a decade in realization and hundreds of man-years in implementation; a vision for a video game that has yet to be written, called “Divunal.”

I have been lauded many times for my role in Twisted’s creation, and in this foreword I will attempt to disabuse you of the notion that any of it was on purpose. Not only was it an accident, but neither I, nor anyone else, has made one iota of progress towards my original goal of writing a game.

When I was eight years old, I decided I wanted to be a writer. I was going to write video games just like my favorite ones, the text-based games from Infocom. They were like books, but better. I knew how to write already—at a fourth-grade level, or so I’m told—and all I needed to figure out was the part where the computer wrote back. Lucky for you nobody thought to tell me how hard that step between the input and the output was, or Twisted would be a series of detective novels instead of a Python program.

Tolkien said it best: “The tale grew in the telling,” and I’ll say it worse: the code grew in the hacking. Twisted began over a decade after my aforementioned first plunge into the netherworld of software, as a solitary attempt to create a networking subsystem for a small online fantasy world. Since then, it has become an ongoing community quest to

unify all manner of asynchronous communications. This book will take you on an adventure through Twisted for the Web, Twisted for email, Twisted for chat, and of course, Twisted for whatever new kind of networked application you want to dream up—maybe even an online video game.

Much as the tale of Twisted has grown and changed, its origins still have a profound effect on its nature, and on its future. Having origins in an eclectic<sup>1</sup> problem domain has attracted an eclectic<sup>2</sup> audience. The community in the online support forum engages in discussions that are “often funny.” To put it more directly: we’re weird.

“Weird” is a badge I have long worn with pride, dear reader, so please take it as a compliment that I bestow it upon you. You’re not simply non-average, you’re better than average. Almost by definition, Twisted hackers are the ones for whom “good enough” isn’t good enough. You are the web programmers who can’t use their operating system’s stock HTTP daemon because you need more power and more control over how it’s run; the chat developers who aren’t content with chatting on a perfectly working network just because it doesn’t support some cool new features you want; the (dare I say it?) gamers who aren’t content with the market’s offerings of online games. You want to create something newer, different, better. To build higher than those who have come before, because you are building not merely upon the shoulders of giants, but upon the apex of an acrobatic balancing act of giants, or more literally an interlocking network of frameworks and libraries for different tasks, rather than just one at a time.

Twisted will let you do that, by letting you leverage code written by far more and far better programmers than I. Twisted provides a common method for that code to cooperate, which means you can use all of that code without performing a complex integration pass. In this spirit, I’d like to invite you to release your Twisted-based projects, or the infrastructure components of them, as open source software, so that we might together build a Twisted commons upon which many more fantastic applications will be built.

Don’t mistake this friendly vision for altruism, however. I didn’t have anything to do with the start of the Free Software or Open Source movements, respectively, but they came along at a convenient time for me. This feeling of share-and-share-alike has been a feature of the Twisted community since day one, but not because I care about sharing.<sup>3</sup> It is because—I may have mentioned this—I want to write a video game one day. A game that effortlessly connects to the Web and to your email, that politely requests that you play when you have time, and that reminds you to get back to work when you do not.

1. And difficult! Making an online game work properly is *hard*.
2. And intelligent! People who solve unusual problems are always learning.
3. Caution for the humorless: this is a joke. I am not actually an enemy of freedom. Still, there is some truth to this.

You see, the majority of Twisted’s core developers, including myself, suffer from Attention Deficit Disorder. This malady is the grease that makes the magic wheels of integration turn. While most developers—sane developers—would be content to write a perfectly good web server that could work only as a web server and leave it at that, we are always afraid we’ll suddenly lose interest and need a chat application instead—or maybe it should be a mail server? Hey, there’s a squirrel! I don’t like this song.

What was I saying? Oh yes. The essence of Twisted is apparently paradoxical. Created on a whim by crazed eccentrics, designed to be a toy, and yet powerful enough to drive massive email systems, high-traffic web sites, transaction-processing systems, and inventory management applications.

However, the paradox is an illusion. People produce the best work when they are working and having fun at the same time. It takes a sense of humor to call yourself a crazed eccentric (whether it’s true or not). You have to have a sense of fun to try and build a toy. In enjoying ourselves, we have brought to life a system that many of us have tried and been unable to create in more serious surroundings.

So, when I look out upon the “lone and level sands” of Divunal, a game whose incarnation today is little more than its name, I am not concerned. I am having a good time with Twisted. With this book in hand, I have no doubt that you will, too.

—Matthew “the Glyph” Lefkowitz  
*CTO at Divmod, Inc.*  
*(not a game company)*  
*(yet)*  
*August 2005*



---

# Preface

This book is about Twisted, an open source, event-driven networking engine written in Python.

Twisted supports many common transport and application layer protocols, including TCP, UDP, SSL/TLS, HTTP, IMAP, SSH, IRC, and FTP. Like the language in which it is written, it is “batteries-included”; Twisted comes with client and server implementations for all of its protocols, as well as utilities that make it easy to configure and deploy production-grade Twisted applications from the command line.

Twisted includes both high- and low-level tools for building performant, cross-platform applications. You can deploy a web or mail server with just a few lines of code, or you can write your own protocol from scratch. At every level, Twisted provides a tested, RFC-conforming, extensible API that makes it possible to rapidly develop powerful network software.

In keeping with the spirit of the O’Reilly Essentials series, this book is not about torturing you with the nitty-gritty details of specific networking protocols, or with exhaustively documenting Twisted’s APIs. For a comprehensive treatment of how to use Twisted to build applications for a particular protocol, please get your footing with this book and then consult the official documentation.

Instead, the goal of this book is to give you fluency in the primitives Twisted provides and the idioms that it uses to build network clients and servers. It starts with an introduction to the underlying event-driven model and a big-picture view of Twisted as a framework, focusing on simple, self-contained examples that you can play with and extend as you explore Twisted’s APIs. Where possible, the client and server examples are written so they can be run together.

After reading this book, you will have the tools and conceptual background to build any event-driven client or server application you need, not just for the protocols that are a part of Twisted and covered in this book, but also for new protocols that you build using Twisted’s primitives.

# Why Use Twisted?

Why should you use Twisted instead of some other networking library or framework? Here are a few compelling reasons. Twisted is:

## *Python-powered*

Twisted is written in Python, a powerful, object-oriented, interpreted language. Python is a language that inspires great enthusiasm among its fans, and for good reason. It's a joy to program in Python, which is easy to write, easy to read, and easy to run. And because Python is cross-platform, you can run the same Twisted application on Linux, Windows, Unix, and Mac OS X.

## *Asynchronous and event-based*

Synchronous network libraries leave developers with a painful choice: either allow the application to become unresponsive during network operations, or introduce the additional complexity of threading. Twisted's event-based, asynchronous framework makes it possible to write applications that stay responsive while processing events from multiple network connections, without using threads.

## *Full-featured*

Twisted includes an amazing amount of functionality. Mail, web, news, chat, DNS, SSH, Telnet, RPC, database access, and more—it's all there, ready for you to use.

## *Flexible and extensible*

Twisted provides high-level classes to let you get started quickly. But you'll never find yourself limited by the way things work out of the box. If you need advanced functionality, or if you need to customize the way a protocol works, you can. You can also write your own protocol implementation, to control every byte sent over the wire.

## *Open source*

Twisted is free, both as in beer and as in freedom. It includes full source code and is released under a liberal license. Want to distribute all or part of Twisted with your application? You're welcome to do so, with no obligations to release your own code or pay any licensing fees. Want to get a better understanding of how an object in Twisted works? Take a look at the source. And when you get to the point where you're developing your own improvements and extensions to Twisted, you can contribute them to the community for the benefit of others.

## *Community-backed*

Twisted has an active community of developers and users. If you run into a problem, you'll find many fellow developers ready to help on one of the Twisted mailing lists (see [“Finding Answers to Your Questions” on page 8](#), in [Chapter 1](#)). Or you can drop into the `#twisted` IRC channel, where the chances are good you'll be able to start a live conversation with the very person who wrote the code you're having trouble with.

### *An integration-friendly platform*

A Twisted application can share data between several different services within the same process. This makes integration tasks a snap. You can write an SMTP-to-XMLRPC proxy, an SSH server that lets you update a website, or a web discussion board that includes an NNTP interface. If you need to transfer data between systems that don't speak the same protocol, Twisted will make your job a whole lot easier.

## What This Book Covers

This book does not attempt to exhaustively document every module and class available for the Twisted framework. Instead, it focuses on presenting practical examples of the most common tasks that developers building network applications face. This book will also help you to understand the key concepts and design patterns used in Twisted applications.

This book has three parts:

### *Learning Twisted basics through building basic clients and servers*

This part covers installing Twisted, an architectural overview of the framework, and building basic TCP clients and servers. We then apply the primitives and idioms from the chapters on basic applications to a variety of client and server examples for a particular protocol, HTTP.

### *Building production-grade servers*

At this point, well-practiced with basic clients and servers, we focus on deploying these applications in a robust and standardized fashion using the Twisted application infrastructure. This part also adds to our repertoire common components of production-grade servers: logging, database access, authentication, using threads and processes in a Twisted-safe way, and testing.

### *More practice through examples from other protocols*

For more practice, to give a sense of Twisted's breadth, and to cover many popular uses of Twisted, the final part of the book explores clients and servers for IRC, various mail protocols, and SSH.

## Conventions Used in This Book

This book uses standard typographical conventions to highlight different types of text. You'll see the following font styles used:

### *Italic*

Used for emphasis, to highlight technical terms the first time they appear, and for commands, packages, filenames, directories, and URLs

### Constant width

Used for code samples, and for the names of variables, classes, objects, and functions when they are used within the main text of the book

### Constant width bold

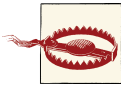
Shows user input at the command line and interactive prompts

### Constant width bold italic

Shows placeholder user input that you should replace with something that makes sense for you



This icon signifies a tip, suggestion, or general note.



This icon indicates a warning or caution.

## What You'll Need

This book assumes a familiarity with programming in Python. If you're looking for a good introduction to Python, check out *Learning Python*, by Mark Lutz (O'Reilly), or *Dive Into Python*, by Mark Pilgrim (Apress). You should have a Linux, Mac OS X, or Windows computer with Python version 2.6 or 2.7 installed. Python 2.6 is included in Mac OS X 10.6 ("Snow Leopard") and higher and in many Linux distributions. If you don't already have Python installed, you can download it for free from the [Python home page](#).

## Changes Since the Previous Edition

The first edition of *Twisted Networking Essentials* was released in 2005. Since then, networking protocols have come in and out of fashion, and Twisted's APIs have evolved and matured. This second edition builds upon the excellent foundation first edition author Abe Fettig crafted by trimming off aged protocols and Twisted APIs and covering more Twisted subprojects and features.

In particular, this edition removes the chapter on NNTP and adds chapters on building IRC clients and servers and testing your Twisted applications using the Trial framework. The sections on deploying production-grade services using the Twisted application infrastructure have been significantly expanded. In addition to a discussion and examples of Twisted applications and Twisted plugins, logging, working with databases, and using threads and processes all now get more coverage in their own chapters.

The focus of this book has also been sharpened to give you fluency in Twisted’s primitives and idioms with minimal distraction from the nitty-gritty details of specific protocols. Almost all of the examples have been streamlined, and where reasonable, reworked so that you have client and server pairs that can be run together to maximize experimentation value. Also, as part of building a solid conceptual foundation, the section on Deferreds, a frequent source of confusion and frustration for developers new to event-driven programming, has been expanded into its own chapter with many more examples.

Since the structure and many of the examples have changed, it is hard to give a short and complete enumeration of the differences between this edition and the last. I hope this has given you some idea, though, and I welcome your thoughts and feedback.

Portions of Chapters 2, 3, and 6 were adapted from the author’s chapter on *Twisted for The Architecture of Open Source Applications, Volume II* under a Creative Commons Attribution 3.0 Unported license. You can find out more about this book at [The Architecture of Open Source Applications home page](#) and about this license at the [Creative Commons website](#).

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Twisted was my first-ever experience with open source contribution. I am so grateful that as a naive and clueless intern way back when, Glyph, JP, Itamar, and others patiently guided me through the contribution process and invested their time in making me a core developer for the project. What I've learned from this wonderful community