Chapter 41. All Good Things

Welcome to the end of the book! Now that you've made it this far, this chapter says a few words in closing about Python's evolution before turning you loose on the software field and then wraps up with a bit of fun.

You've now had a chance to see the entire Python language yourself—including some advanced features that may seem at odds with a scripting language meant to be accessible to nonprofessionals. Though many users will understandably accept this as status quo, in an open source project, it's crucial that some ask the "why" questions too. Ultimately, the trajectory of the Python story—and its true conclusion—is at least in part up to you.

Toward that end, this chapter begins by calling out what may be one of Python's biggest downsides: its rate of change. This topic is unavoidably subjective, and you should weigh its coverage here on whatever scale you bring to the table.

The Python Tsunami

Twelve years ago, this book warned that Python was growing too convoluted and bloated—and then Python grew a lot more convoluted and bloated. Clearly, this message has not reached those behind the convoluting and bloating.

Even so, this stuff still matters. To parrot the Preface, the last dozen years have hosted the rise of f-string literals, named-assignment expressions, `match` statements, type hinting, async coroutines, dictionary union, star-unpacking proliferation, underscore digit separators, module attribute hooks, exception groups, dictionary-key insertion order, positional-only function arguments, hash-based bytecode files, the `sys.executable` snub, and other superfluous additions, opinionated deprecations, and tangled mutations we've met along the way.

Moreover, this *tsunami* of mods simply added to the flood of complexity and redundancy that came before it—including the oddly artificial MRO, the stunningly implicit `super`, and the horrifically convoluted inheritance algorithm of the preceding chapter, which elevates metaclasses and descriptors to prerequisites. The sum of these is an esoteric morass, which obfuscates the fundamental meaning of names in Python.

Most of what should be said about these changes already has been said in this book, but their combined weight qualifies as problematic for a tool that promotes itself as simpler than others. To illustrate, Table 41-1 updates the prior edition's accounting of Python's largely unchecked growth so far—a partial but representative tally.

Table 41-1. A sampling of redundancy and tool explosion in Python

Category	**Members**
3 major paradigms	Procedural, functional, object-oriented
4 string-formatting tools	`%` expression, `str.format`, `string.Template`, f-strings
4 attribute-accessor tools	properties, descriptors, `__getattr__`, `__getattribute__`
2 finalization statements	`try`/`finally`, `with` plus context managers
4 varieties of comprehension	List, set, dictionary, generator
3 class-augmentation options	Manual rebinding, `@` decorators, metaclasses
4 kinds of methods	Instance, static, class, metaclass
2 attribute-storage systems	`__dict__`, `__slots__`
4 flavors of imports	Module, package, package relative, namespace package
2 superclass-reference tools	Explicit class names, `super` plus MRO
6 assignment forms	Basic, sequence, multitarget, `+=` augmented, `*` unpacking, `:=` named
3 types of functions	Basic, `yield` generator, `async` coroutine
6 function-argument forms	Basic, *`name=X`*, *`*X`*, *`**X`*, keyword-only, positional-only
2 class-behavior sources	Superclasses, metaclasses
3 multiple-choice tools	`if`/`elif`, dictionary indexing, `match`
4 state-retention options	Classes, closures, function attributes, mutables
2 bytecode storage schemes	timestamp, hashkey
3 name-string importers	`exec`, `__import__`, `importlib`

Category	Members
2 kinds of decorators	Function, class
4 dictionary-merge options	`for` loops, `update` method, `*D` unpacking, `|` union operator
2 exception-handler models	`except` singles, `except*` groups
4 statement-aping expressions	`if` / `else` , comprehensions, `lambda` functions, `:=` assignment
8 starred collectors/unpackers	Assignment; function header, call; list, tuple, dict, set literal; `match`

If you care about Python, you should take a moment to browse this table. It reflects a virtual *explosion* of bifurcation, redundancy, and toolbox size—and *81* concepts that can all be required reading for both newcomers learning the language and experts reusing code written by others. Most of its categories began with just one original member in Python; many were added in part to imitate other languages; and none can be simplified today by pretending that the latest Python is the only Python that matters. Python 3.X now owns the flux in full.

F-strings are a prime example in this category. This book's prior edition lamented the three redundant string-formatting tools of its time, but this set was subsequently expanded to a colossal four. While f-strings may be deemed a refinement by some, in truth they are a minor variation on a theme that adds yet another topic to the heap. More fundamentally, millions of programmers have written millions of programs using longer-lived options; while new code has the luxury of using new tools, pretending that the past didn't happen constitutes a break with reality.

Even extensions perhaps more unique often come loaded with surplus complexity. The `match` statement, for example, couldn't simply provide a potentially useful multiple-choice option. It had to bolt on the conceptually tortuous and syntactically ad hoc structural pattern matching, which seems an answer to a question that nobody asked.

Nor are additions the only user-unfriendly theme in Python. Its subjective *changes* and *deprecations* are now so common that they must be expected as an implicit cost of using the language. To be clear, your Python code will almost certainly break eventually when you upgrade to a new Python release—and only because a Python core developer's whim was made mandatory for everyone else.

The Python Sandbox

All of this stems from the fact that Python is, and probably always has been, a constantly morphing *sandbox* of ideas, which prioritizes its developers' egos over its users' needs. Playing in a sandbox can be fun, of course, but it's lousy for the millions of people downstream from its churn. These people are simply trying to write software that's reliable and durable. Like all engineering endeavors, that works best with a *stable base*, not constantly shifting sand.

As a pathological example, Python's sandbox model seems to have hit its zenith in *type hinting*—the optional, unused, out-of-place, and embarrassingly academic subdomain we glanced in Chapter 6 but largely omitted here by design. This is unchecked convolution on parade, and leaves Python users to puzzle over the paradox of pointless type declarations in a dynamically typed language. Sadly, it's also likely to appeal to control freaks.

As we've also seen regularly in this book, because the sandbox is oriented toward experts, it inevitably produces tools that assume that you have to already be an expert to use them. Classes and OOP, for example, are required skills for even simple exception handling. Python is not just for its developers, but the *forward knowledge* assumptions of many of its additions embed this message and raise the bar for newcomers unnecessarily and unkindly.

To be fair, it's not just Python: the entire software field is permeated by a *culture of change* in which churn is an expected constant, and prowess often consists of flaunting the latest and greatest tools even when they are unwarranted. This doesn't prove intelligence (and often demos its absence), but annual and mandatory mods are now a norm. Whether one breaks your PC, smartphone, or Python code, it's difficult not to see this as divisive and rude.

The Python Upside

All that being said, it’s also difficult to deny that Python, despite its warts, is still more productive and pleasant to use than other programming languages. If you’ve coded other languages, you know that many come laden with extraneous syntax and rules, which seem to reflect an assumption that programmers cannot be trusted to do their jobs. By sharp contrast, Python’s dynamic typing and innate flexibility make it more ally than obstacle.

Python’s rise in *popularity* seems to attest to this value proposition, though it’s impetus may be more practical than academic. Today’s larger Python world may naturally be less concerned with the language’s original and perhaps idealistic goals than with solving concrete problems. In the real world that hosts Python popularity, arcane language topics usually take a back seat to libraries, platforms, and schedules—calls that Python has always answered in full.

Moreover, some change and complexity is *warranted* in software. Programming is a substantially challenging task (despite what you may have heard), and computer science is a field still young enough to be excused for some youthful thrashing. For Python specifically, though, complexity and thrashing should be modulated by broad appeal.

In the end, the Python language remains a remarkably expressive tool that still fits both programming tasks and your brain as well as it ever did. Especially if you stick to its tried-and-true parts that propelled Python to the top of the language charts, you’ll likely find it an enabling technology that makes coding as much fun as chore.

Prudent engineers, though, would do well to exercise caution when upgrading to the leading edge, and give a pass to the sandbox’s annual outflow except when clearly beneficial. Given that this is now an industry-wide requirement, it’s hardly cause to dismiss an otherwise useful tool. Bad practice, however, does not justify bad practice.

Closing Thoughts

So there you have it: some observations from the trenches, born of three decades using, teaching, and advocating Python, and grounded in a desire to improve the Python story.

None of these concerns are entirely new. Indeed, the growth of this very book over the years seems a testament to that of Python itself—if not an ironic eulogy to a mission statement that once stressed simplification of programming, and accessibility to both experts and nonprofessionals alike. Judging by language heft alone, that dream seems to have been either neglected over time or abandoned entirely.

But we can do better. A well-established tool like Python can afford to focus more on its users' needs than its changers' hubris. Per the old adage, we simply have to stop fixing what isn't broken. If we can, it will go far toward addressing the concerns of those vetting the language for projects that cannot afford to budget for shifting sands.

More importantly, in an open source project like Python the answers to such questions must be formed anew by each wave of newcomers. Hopefully, the wave you ride in will have as much common sense as fun while plotting Python's future.

Where to Go from Here

And that's a wrap, folks. You've officially reached the end of this book. Now that you know Python inside and out, your next step, should you choose to take it, is to explore the libraries, techniques, and tools available in the application domains in which you will work.

Because Python is so widely used, you'll find ample resources for using it in almost any domain you can think of—from GUIs, the web, and apps, to numeric programming, databases, and system administration. See Chapter 1 and your favorite web browser for pointers to popular tools and topics.

This is where Python starts to become truly fun, but this is also where this book's story ends, and those of other resources begin. Good luck with your journey. And as always: code well!

Encore: Print Your Own Completion Certificate!

And one last thing: in lieu of exercises for this part of the book, Example 41-1 lists a bonus script for you to study and run on your own. A book can't directly provide completion certificates for its readers (and the certificates would be worthless if it could), but it can include an arguably cheesy Python script that does. This one creates a simple book completion certificate in both plain-text and HTML files, and auto-opens them in a web browser or other viewer where supported.

Example 41-1. You-made-it.py

```
"""
Generate a simple class completion certificate: printec
the console, and saved in auto-opened text and HTML fil
Run from a console, and print saved output files if des
Works on all PCs, but may require manual opens on smart
"""
import time, sys, html, os

maxline = 60                                    # Text separ
browser = True                                  # Display ir
saveto  = 'Certificate'                         # Output fil

# Template values
SEPT = '*' * maxline
DATE = time.strftime('%A, %b %d, %Y, %I:%M %p')
NAME = input('Please enter your name: ').strip() or 'Ar
BOOK = 'Learning Python, 6th Edition'
SITE = 'https://learning-python.com'            # For icon,

# F-string templates work for preset in-code references
texttext = f"""
{SEPT}

⭐
 Official Certificate
⭐
```

```
Date: {DATE}

This certifies that:

\t{NAME}

Has survived the massive tome:

\t{BOOK}

And is now entitled to all privileges thereof, includir
the right to proceed on to learning how to develop webs
desktop GUIs, scientific models, smartphone apps, and
anything else that the future of computing may hold.

--Your humble
🐍
 instructor

(Note: void where obtained by skipping ahead.)

{SEPT}
"""

# Interact, setup
for c in 'Congratulations!'.upper() + '
👏
' * 3:
    print(c, end=' ')
    sys.stdout.flush()    # Else some shells wait for \
    time.sleep(0.25)      # Reveal message slowly for f
print(); time.sleep(3)

# Make text-file version
textto = saveto + '.txt'
fileto = open(textto, 'w', encoding='utf8')
print(texttext, file=fileto)
fileto.close()

# Start HTML: replace text markers with tags
htmltext = texttext.replace(SEPT,   '<div class=cert>',
htmltext = htmltext.replace(SEPT,   '</div>')
htmltext = htmltext.replace('
⭐
 ', '<h1 align=center>
```

```
⭐
&nbsp;', 1)
htmltext = htmltext.replace('
⭐
', '&nbsp;
⭐
</h1>')

# Line-by-line mods
linemods = []
for line in htmltext.split('\n'):
    if line == '':
        line = '<p>'
    elif line[:1] == '\t':
        line = f"<i>{'&nbsp;' * 4}{html.escape(line[1:]
    linemods.append(line)
htmltext = '\n'.join(linemods)

# Ignorable HTML bits (mind the {{ and }} escapes)
preamble = f'''<!doctype html>
<html>
<head>
<meta http-equiv="Content-Type" content="text/html; cha
<meta name="viewport" content="width=device-width, init
<link rel="icon" type="image/x-icon" href="{SITE}/favic
<style>
body  {{font-family: Arial, Helvetica, sans-serif;}}
.cert {{background-color: cornsilk; padding: 16px; borc
</style>
<title>LP6E Completion Certificate</title>
</head>
'''

image, page = 'lp6e-large.jpg', 'about-lp.html'
footer = f'''
<table><tr>
<td><a href="{SITE}/{page}"><img src="{SITE}/{image}" h
<td><a href="{SITE}/{page}" align=center><i>Book suppor
</tr></table>
'''

# Put it all together
htmltext = f'{preamble}<body bgcolor="#eee">{htmltext}{

# Make HTML-file version
htmlto = saveto + '.html'
fileto = open(htmlto, 'w', encoding='utf8')
```

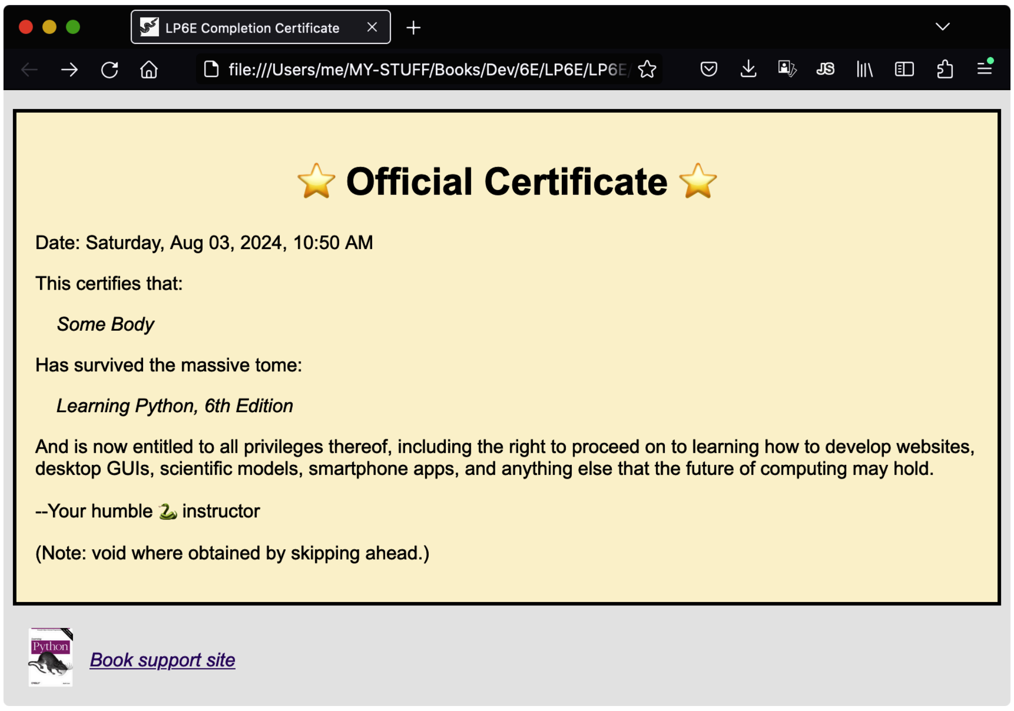
```
print(htmltext, file=fileto)
fileto.close()

# Display text results in console
print(f'[File: {textto}]', end='')
print('\n' * 2, open(textto, encoding='utf8').read())

# Open docs (may also fail silently)
if browser:
    try:
        import webbrowser
        for doc in (textto, htmlto):
            webbrowser.open('file://' + os.path.abspath
    except Exception:
        print('Unable to auto-open docs: open manually.

input('[Press Enter to close]')    # Keep window open i
```

Run this script in a console or other interface on your own, and study its code for a review of some of the ideas we've covered in this book. Copy/paste from emedia or fetch it from this book's examples package as described in the Preface, but ignore its undocumented and out-of-scope HTML bits if you're not a web developer. You won't find any descriptors, decorators, metaclasses, or `super` calls in this code, but it's typical Python nonetheless:

```
$ python3 You-made-it.py
Please enter your name: Some Body
C O N G R A T U L A T I O N S !
👏

👏

👏

…etc…
```

This script works in full on PCs (where code might also open files with `os.startfile`, or "open" or "xdg-open" commands in `os.system`), but on smartphones you'll probably need to open the output files manually in file-explorer apps. When run, it generates the web page captured in the fully gratuitous Figure 41-1. This could be much more grandiose, of course; see the web for pointers to Python support for PDFs and other document tools such as

Sphinx surveyed in Chapter 15. But hey—if you've made it to the end of this book, you deserve another joke or two.


LP6E Completion Certificate
file:///Users/me/MY-STUFF/Books/Dev/6E/LP6E/LP6E/

⭐ **Official Certificate** ⭐

Date: Saturday, Aug 03, 2024, 10:50 AM

This certifies that:

Some Body

Has survived the massive tome:

Learning Python, 6th Edition

And is now entitled to all privileges thereof, including the right to proceed on to learning how to develop websites, desktop GUIs, scientific models, smartphone apps, and anything else that the future of computing may hold.

--Your humble 🐍 instructor

(Note: void where obtained by skipping ahead.)

Book support site

Figure 41-1. HTML doc created and opened by You-made-it.py